Air Vice-Marshal H. N. Wrigley,
CBE, DFC, AFC, RAAF

RAAF Air Power Studies Centre

THE DECISIVE FACTOR

Air Power Doctrine by Air Vice-Marshal H. N. Wrigley

Edited by
Alan Stephens and
Brendan O'Loghlin

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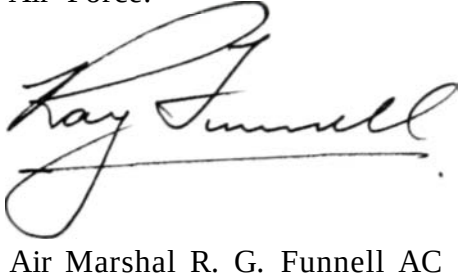
FOREWORD

I first learned of Air Vice-Marshal Henry Neilson Wrigley CBE DFC AFC when I was a young man and a cadet at RAAF College at Point Cook. To me he was mainly a name and a reputation; he was one of those almost unreal, ethereal figures of RAAF history who appeared each year for the ceremony at the Australian Flying Corps Memorial at Point Cook. It was only late in his life that I met him personally; and it was only very late in his life that I got to know him although, unfortunately, it was only briefly. Almost to the end of his long life—and he lived to be 95—he was full of vim and nervous energy. He was an impressive man not least because of his grasp of current issues and because his vast storehouse of knowledge gave him a very solid base on which to offer his opinions of current issues. Mentally he was very fit.

I had heard of his diaries and notebooks but I did not get to see them until after his death. I was astounded and delighted. To me they provided what I believe we have lacked in the Royal Australian Air Force, namely, solid documentation of our intellectual history from the formation of the Central Flying School as part of the Australian Army in 1913 until the outbreak of World War II in 1939.

Our histories have mainly been records of equipment, events and people. They have been dominated by personalities and by accounts of organisational and political disputation. Matters of strategy, doctrine and the development of operational concepts have been given little attention. It was as if they were not matters of concern or discussion to the officers of the pre-war RAAF. Henry Wrigley's diaries and notebooks prove otherwise.

From Henry Wrigley's notes, Brendan O'Loghlin and Alan Stephens have selected essays, notes and other writings and inter-leaved them with editorial comment that establishes both their chronological and their conceptual contexts. The outcome is not just a collection of Henry Wrigley's notes but, more importantly and more valuably, a history of the development of air power concepts in air power's formative years. We can all share the insights revealed in these notebooks and be forever grateful that 'Wrig' was such a meticulous chronicler. *The Decisive Factor* is a most important book for the Royal Australian Air Force.



Air Marshal R. G. Funnell AC
Chief of the Air Staff
Royal Australian Air Force
October 1990

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Note: AWM: Australian War Memorial; RM: RAAF Museum.

ACKNOWLEDGMENTS

A book like this cannot be produced without a great deal of assistance. We are grateful for the help given by a number of individuals and organisations.

Mrs Zenda Wrigley's generosity in donating her late husband's notebooks to the RAAF Museum at Point Cook has made available a most valuable source of air force and Australian history. We also appreciated the time Mrs Wrigley and Air Commodore C. R. Taylor gave to discuss aspects of Air Vice-Marshal Wrigley's career with us.

We are indebted to the Ministry of Defence, Publications Clearance Branch (RAF), for permission to reproduce source material from the Royal Air Force.

From the RAAF Museum, Squadron Leader Jeremy Clark, Warrant Officer David Gardner and Mr John McKenzie assisted by providing access to the documents, reference books and photographs. The RAAF Museum also supported the project financially. Flight Lieutenant Rosemary Fisher completed the onerous task of keying in the initial draft of the documents. Thoughtful and constructive comments on the draft of the book were provided by Group Captain Alan Titheridge and Wing Commander Gary Waters.

Finally, we should like to thank the Chief of the Air Staff, Air Marshal R. G. Funnell, whose encouragement and support were essential to the success of the project.

EDITORS' INTRODUCTION

For the first 70 years of its existence as an independent service the Royal Australian Air Force did not have an officially endorsed, indigenous volume of air power doctrine. Explanations can be found for that circumstance. In the period between the wars the RAAF was explicitly subordinated to the Navy and the Army, with its main roles being those of supporting sea and land forces. That was not a situation which encouraged progressive thinking on the development of air power. Australia's strong commitment to the Imperial defence arrangements and the RAAF's dependence on the Royal Air Force further increased the tendency simply to adopt existing doctrine. Thus, the RAAF's sole definitive publication on air power between 1921 and 1990 was the British manual titled *Operations,* which was used from 1957 to 1984.

It should not be surprising, then, that in the late 1980s the RAAF's Chief of the Air Staff, Air Marshal R. G. Funnell, observed that the use of air power in military operations 'has been and continues to be the major intellectual problem confronting military thinkers', as a consequence of which air power as an element of national military power 'has been consistently undervalued in Australian defence thinking'. Air Marshal Funnell identified as a major cause of that unsatisfactory state the failure of airmen to present a 'comprehensive, coherent, well-articulated and broadly supported theory of air warfare'.

An Australian Viewpoint

It is in that context that the air power notebooks of Air Vice-Marshal H. N. Wrigley, CBE, DFC, AFC, RAAF, represent a significant addition to Australian military historiography. In the absence of formal, officially endorsed texts on air power doctrine, Wrigley's remarkably detailed and thoughtful essays and notes demonstrate that the central concepts and operational practices of air warfare as they existed in the early 1920s were clearly understood by the RAAF. Thus, the documents merit attention not simply for their intrinsic historical value—which itself is considerable—but also as a *de facto* expression of early Australian air power doctrine. They provide an exposition of the RAAF's understanding of air power that previously had not been identified.

But there is a broader dimension tc the notebooks than that. Wrigley's experiences were catholic. He was an Australian flying in an Australian squadron, but as part of a British force which worked closely with the French. His essays and notes describe the elements of air power theory and employment—that is, doctrine—as they were understood and practised by the world's major air forces from World War I to the late 1920s. Airmen from the United Kingdom, France, the United States, Canada and, indeed, Germany, would have recognised the experiences and ideas recorded by their Australian colleague. Air Vice-Marshal Wrigley's notebooks thus amount to a documentary history of the first 15 years of the systematic application of air power.

Henry Neilson Wrigley has perhaps not received the recognition his splendid career deserves. Born in Melbourne in 1892, he was a school teacher with the Victorian Department of Education before enlisting in the Australian Flying Corps in 1916. He served with distinction as a pilot with No. 3 Squadron in France, eventually becoming the unit's commanding officer and winning the DFC. His book on No. 3 Squadron's operations in France, *The Battle Below,* published in 1935, was a valuable contribution to Australian military history.

Wrigley stayed in uniform after the war, and in November 1919 made the first flight from Melbourne to Port Darwin to survey the route which was to be used by aircraft entered in the historic England to Australia air race. His pioneering flight across the continent remains one of Australian aviation's most notable achievements. His original report of that flight was presented in the same fastidious style as his air power notebooks.

Following the disbandment of the AFC, Wrigley was commissioned into the Air Force as a Flight Lieutenant on the day it was formed. There were at that time only 21 officers in the force. During those early years Wrigley filled a number of influential positions in RAAF Headquarters. He served on the staff of the Chief of the Air Staff (Wing Commander R. Williams, later Air Marshal Sir Richard Williams), who was responsible for Operations and Intelligence, and from March 1923 to April 1925 was the RAAF Headquarters Training Officer. He was one of the first Australian officers to complete the RAF Staff College course, graduating in 1928, only four year after Williams. Promotion was regular. He became a Squadron Leader in October 1924, at which time the CAS was only one rank above him; and he reached the rank of Air Commodore shortly after the start of World War II. As an Air Vice-Marshal he became AOC RAAF Overseas Headquarters in London in 1942.

Given that background, it is reasonable to accept that Wrigley's extraordinarily fastidious notes would have been representative of the RAAF's central beliefs and an accurate reflection of its teachings. He wrote the important essay on 'Air Strategy' (Document 6), for example, in July 1923 when he was the RAAF's senior training officer.

Wrigley has been described by colleagues as an 'inveterate notetaker'. That description is supported by the material his widow bequeathed to the RAAF Museum at Point Cook in 1988. The collection consists of over 20 separate volumes of notes, essays, personal diaries, maps and photographs, covering both world wars and part of the period between.

The documents reproduced here all come from the first three volumes, which the RAAF Museum registered as Access Nos 7089, 7090 and 7091. The items in those volumes are dated from 1915 to 1928 and appear to have been collected and written from the time of Wrigley's arrival in England with No. 3 Squadron in December 1916 through to his attendance at the RAF Staff College in 1927-28. There is no particular structural order in the documents as presented in the three notebooks. This book contains about one-fifth of the material from the three volumes concerned. Items which were excluded generally either repeated information contained in the selected documents or were not concerned with air power.

Two categories of document have been reprinted. First, there are essays and lecture notes prepared by Wrigley. The sources for those were the author's wartime experiences, official papers, existing public material on air power (see the bibliographies included for Documents 6 and 10), and the RAF Staff Course. Where known, documentary sources are identified. The second category consists of transcripts of official orders, instructions and reports which were issued by the Royal Flying Corps and Royal Air Force during the Great War. Those transcripts are all identified by source and date.

Documents have been placed into four parts. Part One addresses the nature of air warfare, and focuses on the psychology of war, national will, morale and leadership. From the outset the critical connection is established between air power—in the form of 'terror' bombing—and the development of total war. In many respects Part Two could be compared to a modern manual of air power doctrine. It contains most of Wrigley's original material, and combines the theory and practice of air warfare in an immensely informative and stimulating series of essays. The independence of air forces has been a persistent and contentious issue from the beginning of military aviation. Part Three discusses the origins of the Independent Force in France, highlighting again the significance of strategic bombing in the development of concepts of air power. The official orders transcribed in Part Four were intended to provide guidance at the tactical level, that is, to the men in the field fighting the war. Clearly, however, they also provided a basis for future policies.

A number of facsimiles of maps, diagrams and tables have been reproduced to give an indication of the nature and style of the original volumes. They were drawn by Wrigley, and demonstrate his fastidious attention to detail, as well as the fluid calligraphy which was characteristic of the era.

Readers may notice some inconsistencies in the spelling of place names in Wrigley's text. We have chosen to leave those names as presented by the author.

Defining Air Power

As we mentioned above, the use of air power remains a major intellectual problem for military strategists. Accordingly, some comment on the nature of the subject is necessary to establish a framework within which Wrigley's work can be considered.

Air power is a form of combat power, which in turn can be defined as a measure of the military force or potential that can be brought to bear at the desired point in time and space. Combat power can be exercised in or through the three mediums of sea, land and air. Thus, a nation which possesses air power has the ability to apply combat power from or through a platform in the third dimension above the surface of the earth.

It is commonplace to speak of three levels of warfare at which combat power can be applied. Those levels are the strategic, operational and tactical. At the first level, 'grand strategy' is the broad general approach or method used to achieve the national interest; 'military strategy' is the part the armed forces play in pursuing that interest. At the other end of the scale, 'tactics' are the plans and actions of those who apply combat power, that is, soldiers, sailors

and airmen. In between is the 'operational' level of war, which is generally taken to be the level at which campaigns are planned and the groups of different force elements arranged and directed. In smaller nations or in some limited warfare situations, it may be hard to distinguish between the operational and strategic levels.

What, then, makes up an *air* strategy? This is a most important question, for without a sound strategy operations and tactics are unlikely to succeed. Wrigley examines the question carefully, while we also have made some comments at appropriate points along the way. Current RAAF thinking has identified the essence of air strategy as the ability to conduct three distinct campaigns in the air (a campaign being a collection or series of broad operations under one aim). These campaigns may be conducted alone, consecutively or concurrently, but each is important in its own right.

First and foremost of the three campaigns is the control of the air. Without air superiority, all other combat activities are liable to be constrained or, worse, untenable. The second air campaign is independent strike. As Wrigley emphatically points out, 'independence' in the context of air strike operations does not mean insulation from the objectives of the other components of combat power. On the contrary, for air strike to be effective it must be carefully attuned to the national strategy. 'Independence' simply means that *an* air strike campaign can be conducted against an enemy quite separately from other campaigns being waged on the surface. The third (but historically earliest) campaign is air support for land and sea operations (and indeed for other air operations). As is the case with the other two campaigns, air support is examined in detail by Wrigley.

The singular characteristics ot the air weapon are reflected in its ability to prosecute those three distinct campaigns either individually or concurrently. Indeed, it was those characteristics of pervasiveness, the ability to concentrate force, and rapidity and flexibility ot response, which in combination prompted such distinguished soldiers as Viscount Montgomery and Lord Trenchard to identify air power as a necessary component for victory in any substantial war. Like other great commanders since, they both appreciated that success in holding land and controlling the seas has become almost impossible without control of the air.

It is in that sense that for the past 70 years, air power has been the decisive factor in warfare.

Wrigley's Achievement

In Wrigley's day, the very thing that made flying so fascinating—breaking free from 'the surly bonds of Earth' (John Gillespie Magee *Dancing the Skies)*—also made it an eccentric and slightly crazy pursuit. The ability to cast aside the limits of land and sea, to be able to manoeuvre freely in three dimensions with great rapidity, called for a profound adjustment in thinking. Those relatively few specialists who ventured into the air usually did so with great practical enthusiasm but little pause to debate theory.

It is noteworthy that Wrigley collected, assessed and recorded his material in parallel with some of the great air power theorists. That is not to suggest

that his work should be elevated to the status of that of, say, a Douhet or a Mitchell. Clearly, it should not. Some of his essays draw on Lanchester and Trenchard (which he acknowledges); and others incorporate the ideas and experiences of notable RAF figures. In general it is our judgment that Wrigley was more of an observer and astute commentator than a significant original thinker. At the same time, the importance of his work should not be underestimated. Even while a number of the 'classical' theorists were still establishing themselves, Wrigley had identified, summarised and recorded opinions on the theory *and* practice of air power in a cogent and readable form. His achievement reflects his background as both a serious student of the topic and an operational pilot.

In addition to establishing a basis for Australian concepts of air power, this edited collection of Air Vice-Marshal Wrigley's notebooks provides a documentary history of the first 15 years of the systematic application of the air weapon, as seen by a significant and important airman. Interestingly, most of the lessons which emerge remain relevant today.

A.W.S.
B.D.O'L.

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Canberra
October 1990

PART ONE

The Nature of Air Warfare

DOCUMENT 1.

The Nature of War

This essay represents a commendable attempt to place the (then) new force of air power into concepts of the nature of war. The two writers on that subject who have perhaps been most studied in the RAAF are Clausewitz and Sun Tzu; as it happens, both are mentioned here.

Wrigley's notes establish the critical connection between air power and the development of total war. As paragraph 11 points out, the air weapon gave states for the first time a substantial capability to bypass an enemy's army and navy and take the war to his homeland. Indeed, victory seemed possible by destroying the morale or willpower of the civilian population through the material and 'terror' effects of aerial bombardment. That notion ran counter to the Clausewitzian principle that war can be won only by defeating an opponent's military power.

The idea of terror bombing also underpinned the air power theories of men like Douhet, Mitchell and Trenchard, and haunted statesmen in the period between the wars. Mr Balfour's image from 1921, reproduced here in paragraph 12, of the Naval and General Staffs carrying on with their duties at the bottom of a coal-pit, while above them marauding bomber fleets destroyed their country, exemplifies the feeling of helplessness created by the spectre of air power. While the (assumed) devotion to duty of the admirals and generals was admirable, it would have been futile. The image must have appealed to airmen.

The unrealistic expectations raised by the early air power theorists are illustrated by the way in which the quote from Sun Tzu is used in paragraph 14. The suggestion that the air weapon might shorten wars by breaking an opponent's willpower, and thus reduce the material damage in the defeated country, could scarcely have been wider of the mark in the cases of the RAF and USAAF campaign against Germany in World War II, and the United States' attacks against North Vietnam. Opinions on the employment of the atomic bombs against Japan vary, and the results are used to support both points of view.

Wrigley's sources for this paper included a presentation on 3 October 1927 by the Commandant of the RAF Staff College, Air Commodore R. Ludlow-Hewitt, CMG, DSO, MC.

1. This lecture refers throughout to big national wars and not to tribal operations or punitive expeditions.

War is an act of violence whereby one nation seeks to impose its will on another.

A nation tries first to get what it wants by persuasion, in other words by diplomacy; when this fails resort is had to force. As Clausewitz expressed it, war is a continuation of policy by other means. The amount of force which a nation has to use and the degree of pressure it has to bring, in order to impose its will on its opponent, depends mainly upon three factors:

(a) National character.

(b) Social conditions.

(c) What each nation wants; how important this want is to itself and to the other side; in other words, upon the cause of war.

The occupation of the Ruhr by France is an example of pressure, mainly economic in this case, being brought to bear without recourse to actual war.

2. Before dealing with these factors, let us briefly consider the trend of development of war in Europe. In ancient days, war was an affair of the whole tribe or nation; it was a struggle usually for grazing areas; every individual was directly concerned; it was carried on with the utmost ferocity and to the bitter end, because each side knew that if defeated it would cease to exist.

One may wonder whether similar struggles may not arise in the future, when one looks at a map of Africa and Asia and sees that broad band of desert relieved only by a few rivers such as the Nile, the Euphrates and Tigris and the Oxus.

The next phase was due to the Feudal System, under which the king was merely the chief of powerful barons, who themselves exercised absolute power over the peasants. Countries would not submit to any form of national levy, nor could the Crown afford to pay for a standing navy or army. In case of war the king had to rely upon the barons bringing their own retainers, weapons and horses. It was thus impossible to start or continue a war without the consent of the barons, though the consent of the people as a whole was unnecessary. Wars were practically self-supporting.

About the end of the sixteenth century, the great barons disappeared and the period of autocratic rule by kings began. The country was regarded and administered like a private estate of the king, who had become sufficiently wealthy to keep a standing army and sometimes a navy. War was an affair of the Crown and not of any part of the nation; it was simply a case of the king wanting a larger property for himself or for his descendants and so trying to compel his neighbours to surrender some.

War was regarded as something quite apart from the life of the ordinary person and the people as a whole were not affected by the war unless the fighting took place in the area where they lived. Wars were begun for small causes and as easily stopped. In fact, it became the question of a balance sheet. Would the seizure of a province bring in an adequate return for the cost of the war that would be necessary? If so, war was declared; if the cost began to get too great the war was stopped. Each fighting man represented a portion of the king's capital, and as such [had] to be carefully husbanded and not lost if it could possibly be avoided.

There was thus a steady decrease in the ferocity of war; it lived in an artificial atmosphere and gradually philosophers began to dream of the approach of an age of peace, to imagine that violence was against the spirit of the times

and that its decrease in war was due to the progress of civilization. Then came a bombshell that exploded all such theories—the French Revolution. Europe now met something it had not had to face for centuries, namely, a nation in arms. The French armies lacked equipment and training but the men were devoted to the cause for which they were fighting, namely, the ideal of freedom, and knew that the whole country was ready to support them. They fought, sometimes unskilfully, but with all the vigour and ferocity of ancient war. As you all know, those armies, when led by Napoleon, swept over Europe.

After 1815 there was a temporary decrease in the violence of war, but it began to rise again in 1870 and so continued up to 1918.

We see in fact a fluctuation in the violence with which wars are waged, a fluctuation due not to progress or decay in what is normally understood by civilization, but to other causes.

3. Now return to the three points upon which I said depends the degree of force we have to use in order to impose our will upon our opponent, namely:

(a) National character.

(b) Social conditions.

(c) The cause of the war.

The first can only be fully gauged by a deep study of national history, but I suggest that a good guide can be found by examination of the books that are most widely read . . . As I have already indicated, the study of national character forms as important a part of intelligence duties as do numbers and armament. Benjamin Kidd and others maintain that the characters of a people can be changed in a generation. I think this is wrong; the surface may change but not the basis . . .

4. Now consider recent social developments as far as they affect war.

Firstly, there is the great size of the fighting forces. This means that the industry of a country is deprived of a large number of men and that practically everyone left behind has some close relative or friend at the front.

Secondly, there is the interdependence of nations for commerce, finance, raw materials and even the necessaries of life. Interference with these by a war will sooner or later affect the normal life of the individual.

Thirdly, there is the dependence of war upon industry; munitions are essential and consequently labour to make these munitions.

Fourthly, there is the growth of democracy and of trades unionism.

The whole of a nation's people are, therefore, directly affected by a war and at the same time the power of the people to stop a war has increased, partly through constitutional methods and partly through the facilities available for calling out workmen and so stopping munitions output. In fact, no government can enter on or continue a war unless the majority of the people is in favour of such a course.

A nation will not go to war lightly but only for some deep-seated cause which the people have at heart, but once started it will be carried on to a finish and no limitations.

5. The cause of a war is thus of primary importance. Perhaps it would be truer to say the cause for which the people believe the nation is fighting, which is

not necessarily what their rulers know it to be. Some three centuries ago Bacon wrote:

> For there is that Justice implanted in the nature of men, that they enter not upon Wars, but upon some at the least specious grounds and quarrels.

'Specious grounds' for a war are even more important now, when the people are more directly affected and have more power.

Both sides in the Franco-German War of 1870, as in 1914, made out the other side to be the aggressor, in order that they might persuade their people that the nation was fighting for its existence.

6. Wars may be divided into four groups according to their causes:

(a) Dynastic wars; eg, to preserve the reigning family on the throne.

(b) Wars of expansion; from the plunder of cattle to trade with an undeveloped country or to the seizure of a province for the sake of its raw materials.

(c) Wars of ideals:

(i) Religion,
(ii) Revenge,
(iii) National pride,
(iv) Freedom.

(d) Wars of existence; from a struggle for food to the preservation of an empire.

These are placed in order of intensity, the last being the one for which a nation will go to the furthest extremes.

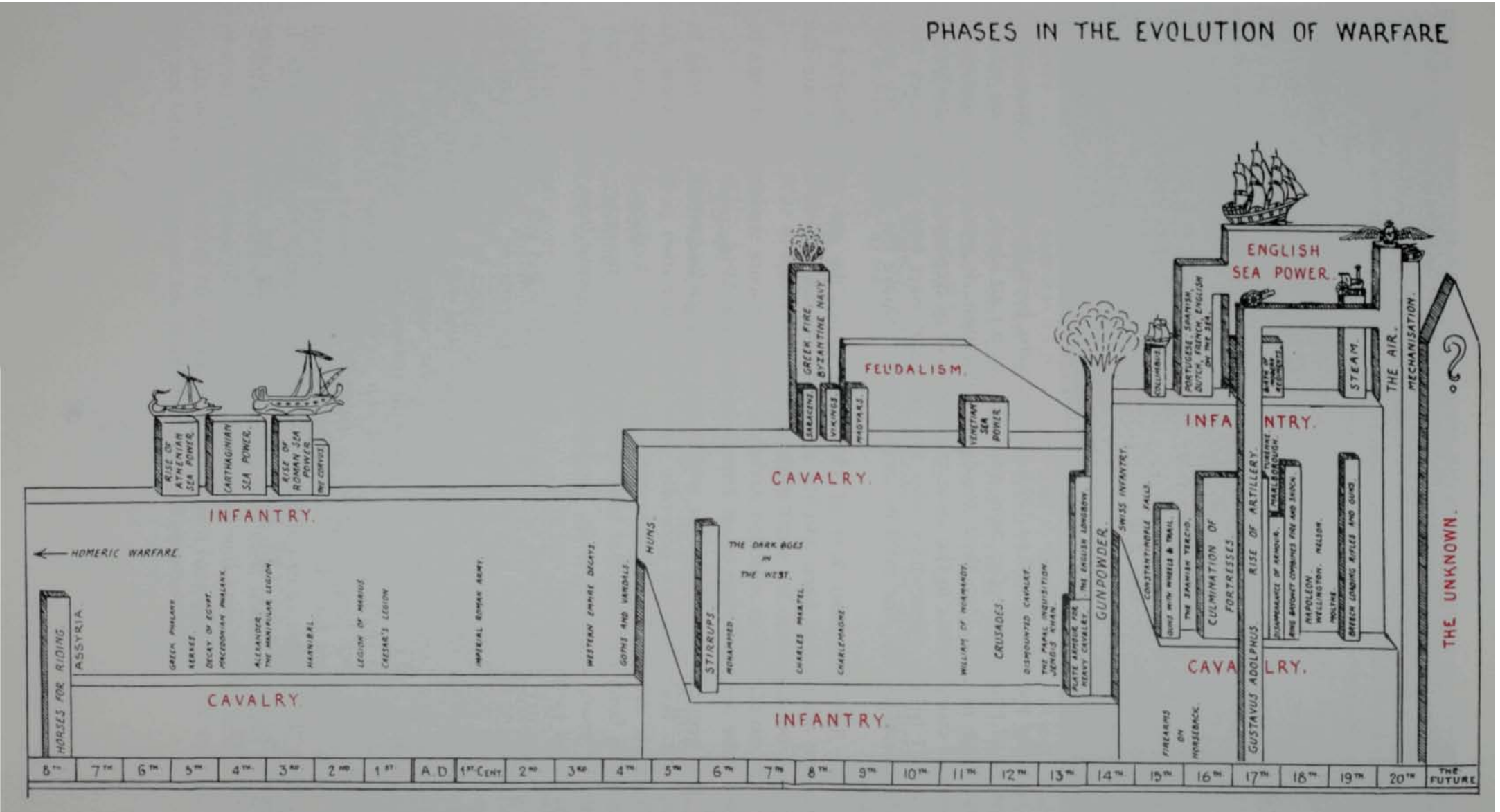
7. The basic cause of a war is sometimes difficult to see; for instance, in the War of the Spanish Succession commencing in 1702, no one cared very much whether Philip, the grandson of Louis XIV, was King of Spain or not, but all other countries were much afraid of France getting all powerful and so absorbing the whole of the trade with America . . .

The cause of a war may be different on the two sides and again may change during the course of the war. In the wars of the French Revolution at the end of the Eighteenth Century, the allies were fighting a dynastic war, ie, their rulers were afraid of losing their thrones and even their heads unless the revolution was crushed, whereas the French were fighting for ideals.

In the Napoleonic wars which were practically a continuation of the same struggle, the French were fighting a dynastic war, ie, to keep Napoleon the arbiter of Europe, whilst the allies were fighting for their national existence. It is interesting to compare the relative vigour with which the two sides fought as the cause gradually changed.

In 1914 the immediate cause of the war was probably the nervousness of the German military chiefs and their fear that they might lose all the value of their peace preparation, unless their country started the war at once. However, as far as the German people were concerned, it was mainly a war for an ideal, that of national pride. England was also fighting for an ideal, that of freedom. For France the war was a struggle for existence.

There is a lesson for us here. We must foresee the possible danger that the precipitate use of the air force may bring about a war.


PHASES IN THE EVOLUTION OF WARFARE
RISE OF ATHENIAN SEA POWER.
CARTHAGINIAN SEA POWER.
RISE OF ROMAN SEA POWER
THE CORVUS
INFANTRY.
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GUSTAVUS ADOLPHUS.
DISAPPEARANCE OF ARMOUR.
FLINTLOCK
MARLBOROUGH
FIRE & SHOCK
FIRE BAYONET COMBINED
NAPOLEON
WELLINGTON.
MOLTKE.
NELSON.
BREECH LOADING RIFLES AND GUNS
CAVA LRY.
STEAM
THE AIR.
MECHANISATION.
THE UNKNOWN.
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6TH
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THE FUTURE

FIGURE 1.1

This is a significant observation. In the middle of his discourse on the causes of war, Wrigley notes that the immediate trigger of a conflict may not truly represent the underlying causes, and, in that context, sounds a warning that the careless use of air power could lead to 'precipitate' hostilities. Wrigley's logic for that judgment is central to doctrines of air power employment, for it arises from the aircraft's singular speed, flexibility and capacity to concentrate force.

One of his major themes, recurrent and firmly stated, is that of the three forms of combat power, the air is the most suited to offensive action. An air force which is forced to defend tends to disperse and react; one which is on the offensive can concentrate, control and initiate. Wrigley warns that such a weapon must be handled with care.

Already, in the first few years of aerial combat, air power is seen as inherently more threatening than land and sea power.

Would the war have lasted to 1918 had Germany been invaded in August 1914 instead of France? The Germans were fighting for an ideal, but for one which had been instilled into their minds by education. It was not an ingrained national characteristic to the same extent as love of freedom in an Englishman. It was, I believe, Thucydides who first said that wars have great causes, but little occasions and one must be careful not to mistake the latter for the basic cause.

The Franco-German War of 1870 was started by the publication of a telegram which had been adroitly altered by Bismarck so as to infuriate the French, but the cause lay much deeper.

The murder of an Austrian Archduke by an obscure student would not in itself have been sufficient to set Europe in flames in 1914.

8. It is generally futile to argue which side was right and which was wrong in any war. Both sides are generally right from their own points of view. As Nietzsche, the German philosopher, says, the eagle looking down upon the browsing lamb contends that lamb eating is just and necessary otherwise how can the young eaglets flourish. The lamb looking upward from the grass bleats that lamb eating is cruel and evil.

A country must expand or contract. It cannot stand still and the world is not big enough for all to expand. To take an extreme case some one has calculated that if the population of the world continues to increase at its present rate for another 10 000 years, the area of dry land will be insufficient to afford even standing room. Balance of power on the continent of Europe has meant that nations had to devote the bulk of their resources to their armies and hence had but little to spare for navies. This was to the advantage of Great Britain and we have often fought in order to maintain such a balance.

It is important for officers of the fighting services as well as for statesmen to study the possible causes of friction and rivalry amongst the great nations. It seems doubtful if we had done this sufficiently in the years immediately preceding 1914.

Also it is well to remember that a nation desiring war will commence it at the moment when it has reached its peak of relative efficiency, eg, when it has just re-armed its forces with a new type of weapon.

9. Now consider how we win a war, ie, how do we break our opponent's will power and so force him to comply with our wishes? And whose will power is it that we have to break? In the era of dynastic wars, it was the will power of one man, namely, the king. Often a mere threat of damage to his property was sufficient to induce him to comply with his opponent's wishes, the property being his fighting forces on his estate, ie, the country over which he ruled.

But in the future, wars, as in the immediate past, will be an affair of the whole nation and we have to go much further.

In 1812 the defeat of the Russian army and the occupation of Moscow did not bring Russia to her knees. In 1870 the destruction of the French regular forces and the investment of Paris was insufficient. It is the will power of the enemy nation that now has to be broken, and to do this is the object of any country that goes to war. There are various resources at the disposal of a nation for attaining this object—moral, economic and physical resources. It is for the statesman to decide how to make the best use of these resources, in fact, to lay down the policy to be followed in the conduct of a war.

10. The methods whereby national will power can be adversely affected may be grouped roughly as follows:

(a) Moral.
  (i) Propaganda,
  (ii) Fear of injury to person or property.

(b) Economic.
  (i) Stoppage of trade,
  (ii) Cutting off supplies.

(c) Physical.
  (i) Disease,
  (ii) Starvation,
  (iii) Loss of all possibility of winning the war.

Many of these overlap. For instance, if an enemy nation is unable to export goods, its financial position will soon be affected and it will consequently find it difficult to purchase munitions or raw material from other countries.

Again, the effect of starvation is moral as well as physical; and cutting off raw materials may hamper the production of munitions to such an extent as to make it physically impossible to continue a war. Let us briefly examine these methods. Propaganda is slow in its effects and requires very complete organisation; and, as the Germans found in 1914, however elaborately we may organise our secret service in a foreign country during peace time, it may completely disappear in the first few days of a war.

Fear of injury to person or property includes not only physical injury but dislocation of the normal life of individuals, also their fear that unless the war is stopped their means of livelihood in the future will have disappeared.

To stop trade and to cut off supplies is always a long process and the results do not become apparent for many months, possibly years.

Spreading disease by means of germs has not yet been attempted, and would appear to present many elements of danger to the side which uses it; but it would be unwise to forget the possibility of its adoption.

Starvation is slow in its effects and will often be impossible. It may also be noted that a country may submit to privation when its armed forces are being victorious, but not when they are being defeated.

To deprive an enemy nation of the possibility of winning a war, we must destroy some, at any rate, of the means by which it carries on that war, namely:

(a) The centres of government.

(b) The Navy, Army and Air Force.

(c) Munitions factories and transport system.

It is conceivable that in the case of a nation whose factories are all centralised in one area, the occupation of that district might force it to agree to our terms.

11. Now consider how each of the fighting services can affect the national will power of the enemy.

A navy acts chiefly through economic means and through starvation; in other words by controlling overseas communications. To do this effectively it will usually have to destroy or neutralise the enemy's fighting fleet; and referring to paragraph 10 above, we may say it acts through methods (b) (i) and (ii), (c) (ii) and to some extent through (c) (iii).

An army can bring but very little direct pressure to bear upon the enemy people until it has destroyed the opposing army. It may therefore be said to act by method (c) (iii).

An air force has the power of bringing direct pressure to bear on the people of an enemy nation and of attacking the enemy centres of government. It may therefore be said to act chiefly through (a) (ii) and (c) (iii). And it can act far quicker than the other two services, in fact, at the very commencement of a war before fleets have left harbours or armies their mobilization centres.

12. It is essential that the fighting services shall remember that they are the servants of the state, that they exist solely for the purpose of enforcing the nation's wishes by force, when force is necessary. They do not form separate entities of their own divorced from other parts of the national life, but form an integral part of that life.

It is no good having a navy or an army or an air force intact if the country is being ruined and the will of the people to continue a war being destroyed. It is no good having the finest air force in the world if the country is being ruined by heavy taxation.

In August 1921, Mr Balfour made the following remarks in a Cabinet paper:

> There is a tendency in some of the papers laid before the Standing Committee to minimise the military effect on this country of air raids successfully carried out on a very great scale. In the memorandum prepared by the General Staff there is a picture drawn of Great Britain with its capital in ruins, and the Admiralty and War Office carrying on their duties undismayed in the safe but obscure retreat supplied by some disused coal mine. Even such a catastrophe as this, they say, would not force a decision; and perhaps they are right. I would, however, observe that as a matter of

history, peace has usually been arranged between belligerents long before the worsted party was reduced to so pitiable a condition, and while the positions of the General Staffs of the Army and Navy heroically carrying on their functions at the bottom of a coal-pit might in some respects be less disastrous than it seems, seeing that in the contingency supposed they would have very little to do, the enemy aeroplanes, wandering at will over the country, could carry out their work of destruction, however numerous and however heroic might be the Armies and the Navies of the country they were reducing to ruin.

13. People sometimes imagine that there is some basic difference between statesmen and commanders, between policy and strategy; that normally they tend to draw apart and that they are only kept in line by the efforts of individuals.

This is quite the wrong way of looking at the matter. In reality they are parts of one whole and if they are at variance, some individual is at fault. If statesmen know nothing about war but attempt to interfere with a commander's freedom of action in carrying out operations, they are wrong.

If commanders fail to keep the national policy in view when planning their operations, they are wrong. And in order to understand this policy, they must look at the war from the broadest aspect. This applies especially to the case of the Air Force, because even a junior officer may have to make grave decisions as to the nature of the target he is going to bomb.

Before and after a war there is seldom any question as to the necessity for statesmen having full control over policy. Such questions as censorship of the press or of financial measures or of the conditions of peace lie almost entirely within the province of the statesman. The moment for commencing a war, or the nature of goods to be declared contraband, must be decided by the statesman, though the sailor, soldier and airman are now more directly interested. Again, there comes a time in every great war when it is impossible to demand any greater effort from the nation. In such a case the statesman must decide as to the best allotment of the available energy. And, further, there are occasions in which the policy of the statesman must influence the conduct of a campaign.

14. As already pointed out, violence is only the means to an end, that end being to break the enemy's will power. But this fact has seldom been clearly recognised, with the result that violence has been regarded as an end in itself and wholesale destruction of life and property has been carried out regardless of the ultimate effects.

It must be remembered that under modern economic conditions, nations are so inter-dependent for their prosperity that destruction in an enemy country will ultimately affect the victor almost as much as the loser. Although it is inadvisable to rely on Chinese writers for guidance as to the conduct of a campaign, they are deep thinkers and it is therefore of interest to find the following remarks by a Chinese writer who lived about 500 BC:

> In the practical art of war, the best thing of all is to take the enemy's country whole and intact; to shatter and destroy it is not so good.
>
> (Sun Tzu on the Art of War. Translated by Giles, pi7).

One may say that one wants to win a war with the minimum of destruction, and in this the time factor becomes of great importance. It would appear that

air power may be a deciding factor in reducing the period required to break an opponent's will power; in other words to finish a war.

15. An air force must not be regarded as merely a new weapon. It is more than an accessory to a navy or an army. It is a new resource at the disposal of a nation for enforcing its will on its opponent.

How can we best employ an air force for this purpose and what are the most effective means of bringing pressure to bear on the enemy people?

We must have foresight and imagination. The petrol engine is not the only possible form of motive power for aircraft, and some form of ray may be more effective than explosive or gas bombs. It would be easy to quote countless instances of fighting services failing to look ahead. When the shells from that German gun reached Paris the French artillery staff refused to believe it possible and declared they were bombs dropped from an aeroplane so high up as to be invisible. A few months later they were building guns that would have out-ranged the German one.

The reference above is to the 'Paris Gun', often called 'Big Bertha', which was aimed at Paris in March 1918 from about 80 miles away. It was many weeks before anyone could believe that the mysterious explosions in the city were caused by shells from a gun. The biggest naval guns, after all, had a range of only about 20 miles.

Whenever some air development took place during the war, we usually wondered why we hadn't thought of it before and could seldom find any adequate reason. It was only lack of foresight.

It is unnecessary to emphasise the tremendous effect that would have resulted had the squadrons that crossed to France in August 1914 been equipped as efficiently as were the squadrons of 1918. We must endeavour to make our squadrons as far ahead of those of our possible enemies as the squadrons of 1918 were ahead of those of 1914.

16. And never forget that above all questions of material there is the factor of morale; morale of the commander and of the fighting man.

Leaving aside enthusiasm for the cause of war, morale is mainly a question of confidence. As regards the commander it is confidence in himself, in his plan of campaign, in his subordinates and in support from his government. As regards the fighting man it is confidence in his leaders, confidence in himself and in his weapons and confidence in his comrades and his force as a whole. It must be the constant effort of all officers to heighten this morale in peace, and in the case of the staff much can be done by ensuring that all arrangements work smoothly and by paying every attention to the welfare of units.

17. Finally, remember that in another great war, every resource that the nation possesses must be utilised, not only to its full capacity, but also in the most efficient manner, if we are to be successful.

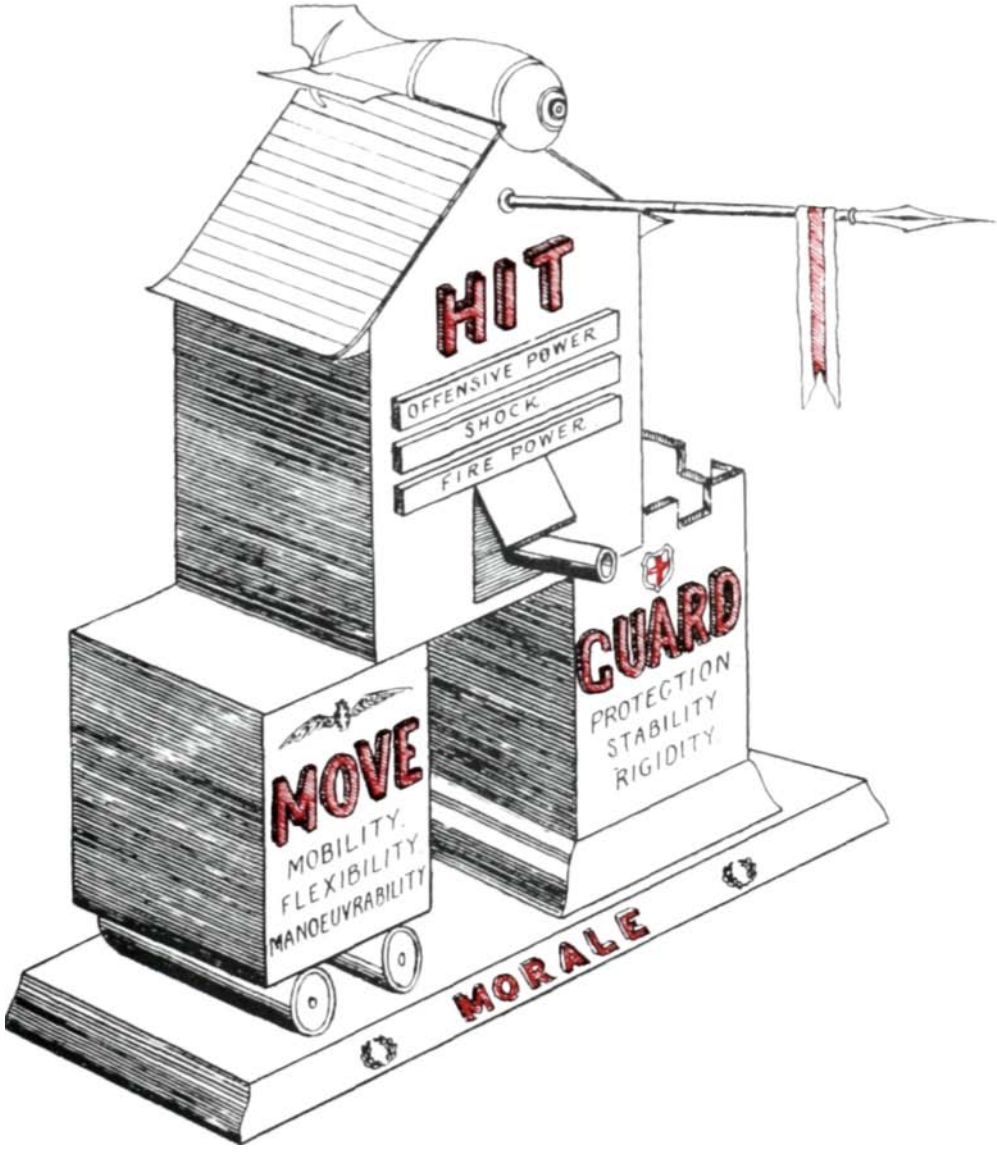
Neither a navy nor an army nor an air force [is] going to win a great war by [its] own unaided efforts. We must seek out the best methods of utilising the

special attributes; how best, for instance, to combine the mobility of a navy with the resisting power of an army and the striking power of an air force. Even this will not be sufficient; war is no longer merely the business of the fighting services. We must see how to help the statesmen to combine the effect of the three fighting services with that of propaganda and of economic and financial pressure, towards the final object of breaking the will power of the enemy nation in the minimum of time.

Wrigley's illustration of 'The Elements of the Art of War' (Figure 1.2) accurately reflects modern definitions of 'combat power'. The main elements of offensive power and fire power, mobility and manoeuvrability—all set on the foundation of morale—are present. Note the position of the air bomb, placed above all the other elements of war.

FIGURE 1.2

THE ELEMENTS OF THE ART OF WAR.



DOCUMENT 2.

The Object in Strategy

This hierarchy of strategic objectives illustrates air power's singular ability to attack national as well as military organisations. The three levels equate fairly well to the grand strategic, military strategic and operational levels of warfare discussed in our introduction. The last level, the tactical, is not listed here as it is not really part of strategy.

Grand Strategy (The Cabinet)

National Object—Security of its honour, its interests, and its existence.

Military Object—Deprive enemy of all means of resisting our will.

Major Strategy (The Department)

Navy—Control of Sea Communications.

Army—Control of internal administration.

Air Force—Disorganisation and demoralisation of national life.

Minor Strategy (The Commanders)

(a) Navy

Object—Neutralise and if possible destroy all enemy forces that can dispute control.

Course of action—Obtain contact under most favourable conditions.

(b) Army

Object—Destroy all enemy forces.

Course of action—Obtain contact under most favourable conditions.

(c) Air Force

Object—Destroy the most vital points in the enemy's national and military organisation.

Course of action—Bombard the decisive points in the most effective manner.

NB—The naval and army objectives are as taught at the [Royal Navy) Naval Staff College.

DOCUMENT 3.

Lecture on Morale

Many strategists consider morale to be one of the most important factors in armed conflict. Wrigley's lecture notes indicate that little has changed in the past 70 years. That should not be surprising, given that he is reviewing human nature.

The notes usefully outline issues which affect morale such as 'natural' instincts, racial and religious attitudes, patriotism, group behaviour, success and failure, and leadership.

As far as air warfare is concerned, paragraph 16 raises two significant points. First, under 'modern' conditions, morale is described as being a 'question of the whole nation, not only of fighting forces'. That statement follows on from the evolution of warfare described in Document 1, and is largely a consequence of the perceived likely public response to mass bombing campaigns. As something of a counter-point to that, however, Wrigley suggests that a tendency has emerged in warfare to 'attach too much importance to machinery', at the expense of the 'human factor'.

Some of the observations in this document may be considered elitist or mildly racist by today's standards. Those observations simply represent the prevailing Anglo-Saxon outlook of the 1920s, and should not be judged by current standards.

Wrigley participated in a conference on morale at the RAF Staff College on 1 December 1927.

1. In view of the paramount importance of morale in war, it is essential for all officers, and especially those on the staff, to make a study of it. But though frequently referred to, it has only been dealt with superficially up to the present and there are very few books that afford useful guidance. We must therefore investigate the subject ourselves.

Lack of literature is not the only difficulty to be surmounted when considering the subject of morale. It is still to some extent supposed to be verging on sacrilege, to be almost immoral, to investigate psychological matters. Again, in our own case, there exists a natural reluctance on the part of all Englishmen to talk fully about human instincts and emotions. This reluctance is manifested in many ways; do we not all feel somewhat self-conscious when we take off our hats in passing the Cenotaph, and half look round hoping that none of our friends [has] observed us?

2. Gustave Le Bon refers to the War of 1914-1918 as 'A vast laboratory for experimental psychology', though it will be many years before the vast accumulation of data can be sifted and the correct deductions drawn therefrom. But everyone who served in that war has gained experience which was not possessed by writers before 1914. Pre-war views on the subject of morale require modifi-

cation at the present day, and for anyone with war experience to criticize such views is not only justifiable but necessary. I would go further and say that it is the duty of every officer to draw his own conclusions and to discuss them with his brother officers and with friends inside and outside the three services.

3. It is interesting to compare the study of psychology with that of physical science. For centuries the Western World has concentrated on the latter and is only just beginning to turn attention to the former.

One of the results of this is a dearth even of words to express our meaning accurately and clearly. However, as regards this, remember what Nietzsche said: 'Do not allow your thoughts to be moulded by the words at your disposal'. What would the situation now be had the position been reversed? Electric light, for instance, would be an inexplicable mystery, whereas mental telepathy across continents would be simple and obvious. But further speculation on this line, though interesting, would not lead us much further. When brought up against any difficulty connected with psychology we are too fond of taking refuge in such terms as supernatural and metaphysical, and leaving the problem unsolved. There is, however, every reason to believe that a large part of psychology can be reduced to a science—a part, not the whole, for at the bottom there will always be a residue of human nature that follows no law. What, after all, is the meaning of supernatural or of metaphysical? Super-natural; something beyond what is natural and obvious. Meta-physical; after the physical, a branch of study that at one time was dealt with in universities, after instruction had been given in physics.

4. There would appear to be three instincts that chiefly influence the fighting man:

(a) Basic instinct (all animals)	Self-preservation.
(b) Instinct impressed by method of life (bees, ants, wolves, men)	Preservation of pack, group or tribe.
(c) Instincts special to certain races or classes	(i) Fanaticism for religious dogma (ii) Love of liberty (iii) Desire to overcome difficulties and dangers . . .

5. The deepest of all instincts would appear to be that of self preservation and it is usually manifested by fear. Fear may take more than one form. Normally it takes that of fleeing from the source of danger; but under certain conditions it may take the form of ferocity, as can often be seen in the case of horses and dogs when frightened. Fear in its normal form—that of running away—is the most important characteristic to eliminate from the fighting man.

As Carlyle says in 'Heros and Hero Worship', 'The first duty of a man is still that of subduing fear. A man's acts are slavish; his very thoughts are false, he thinks too as a slave and coward, till he has got fear under his feet'.

It is possible to make fear take the form of ferocity by the inculcation of the idea of hatred of the enemy, and perhaps this is what occurred in the case of the British sailor before the days of Nelson. There is also another method, namely to supplant the fear of death by another fear. This seems really to have

been the basis of the old Prussian system of discipline, which aimed at making a soldier more afraid of his own officers and NCOs than of the enemy.

Both the above may be termed the lower methods of subduing fear; as will be indicated later there are higher ones.

6. The second instinct referred to above—that impressed by method of life—may be called the group instinct. It is a strong one, but not so deep seated in a man's nature as that of self preservation. It must not be confused with the tendency of individuals to collect for safety, with the fear of being left alone. This is merely an aspect of the basic instinct of self preservation; a man thinks that he himself will be safer in company.

The group instinct is the desire to preserve the group, not the individual. It may take the form of patriotism or be made evident by colour problems. It may be so powerful as to be proof against any shock or stress, in which case the deeper natural instinct of self preservation will not manifest itself.

7. The third or racial instinct is still less deep seated in a man's nature, but again may be so strong that deeper natural instincts are overshadowed.

Religious fanaticism has been prominent mainly amongst Eastern races, but it would be rash to conclude that religion as a motive power is dead in Western civilization . . .

8. A branch of psychological science that is of special importance, is the behaviour of a crowd.

The theory now generally accepted is that developed by Gustave Le Bon. His ideas on the subject run through all his later books, but [were] first formulated by him in his book 'La psychologie des foules' (translated into English as The Crowd'). Very briefly the theory is as follows.

If many people imbued with one common thought, and preferably of the same race, collect together, each one tends to lose his individuality and the whole mass becomes, as it were, self-hypnotised. We then have a psychological crowd. In such a condition the mass is swayed by impulse and emotion, not by reason, and tends to look about for, and to place itself under, a leader. This leader is not necessarily, in fact usually is not, a man of strong character, but is the individual most susceptible to the semi-hypnotic influence that is generated by the crowd itself. The leader and the crowd mutually react on one another and usually proceed to extremes—extreme violence, extreme cowardice, extreme cruelty or extreme self sacrifice.

Hence we see, as in the French Revolution, law-abiding citizens becoming temporarily transformed, committing ghastly crimes, and afterwards reverting to their former respectability. But the leader may also be a man who, animated by the same ideas as the crowd and able to feel their influence, has a sufficiently strong personality to direct and guide their passions into the channel he selects. Lloyd George would appear to be a man who, being susceptible to the influence of a crowd, is able to gauge their feelings accurately. Sometimes he is strong enough to direct the crowd, at others he allows himself to be swayed by its hypnotic influence and to say or do what the emotions of the crowd direct. We can trace the effect of the psychological crowd in the speeches made by popular leaders.

On his platform the speaker can, given the right conditions, make impressions on his audience. He may utilise words as a means of conveying this influence, but they pass through the brains of his audience and merely leave behind the impression of the ideas the speaker wishes to convey. Read in the morning paper, by the cold light of dawn, those same words by which the audience were carried away and they appear dull and almost meaningless, because the hypnotic influence of the crowd and its influence is absent.

Some, at any rate, of Garibaldi's speeches to his followers appear to have been effective mainly on account of the same cause.

It is conceivable that in extreme cases the speaker might use expressions that were quite nonsense. Although the simplest case of a psychological crowd is that when the individuals composing the crowd are in personal contact, the same effects may be produced in a whole class or even in a whole nation provided there is a common idea of sufficient intensity.

9. To come now to the case of a fighting force, it is suggested that the main causes of a high morale are a product of:

(a) Enthusiasm for the cause	Spirit of self-sacrifice for ideals
(b) Confidence of each man in:	
(i) His leader	The art of leadership (see para 12).
(ii) His force	Organisation and equipment,
(iii) His comrades	Discipline and esprit de corps,
(iv) Himself	Training and physical welfare.

It is not suggested that all the above factors are necessary in order that the fighting force may have high morale. The absence of one or even more may be compensated by intensity of the others. For instance, in Garibaldi's Thousand, lack of organisation, equipment, discipline and training was compensated by [the] intense enthusiasm of the men for the cause and their confidence in their leader.

The result of a high morale is made manifest by the will to win, and courage in battle.

In the case of physics, action and reaction are known to be equal, and the same seems true of morale. There is always a tendency for morale to drop below the normal after it has been raised to an abnormal height. A well known instance of this is the case of the French Army in the spring of 1917.

10. In considering the first cause of high morale, Englishmen seem inclined, as a rule, to attribute somewhat too low ideals to their fellow countrymen. There was certainly a belief before the war that patriotism was a prerogative of the officer class in the two services. Yet in 1914 men poured out from even the slums of our large cities to fight for ideals, the ideal of patriotism if not of justice; though to all outward appearance they had little enough for which to be grateful to their country. The higher the ideals that are set before men the more intense and lasting is their enthusiasm, and the greater the demands made upon them the more readily does their spirit of self-sacrifice respond. Great leaders have never feared to appeal to this spirit. Garibaldi, for instance: T offer neither pay nor quarters nor provisions; I offer hunger, thirst, forced marches, battles and death'.

We find the same thought in Carlyle (Heros and Hero Worship):

> Difficulty, abnegation, martyrdom, death are the allurements that act on the heart of man. Not happenings but something higher. By awakening the Heroic that slumbers in every heart can any Religion gain followers.

Does the possession of a spirit of self sacrifice indicate the boundary between animals and men? We find an approximation to a psychological crowd when there is intense enthusiasm for a cause and the leader is regarded as the personification of that enthusiasm. Garibaldi and the Thousand is an instance of this.

11. Confidence has always been recognised as an important factor in morale. To quote Machiavelli: 'To conquer there must be mutual confidence between the chief and the army and also between the men themselves'.

Or another view from a different stamp of writer—Darwin: 'The superiority which disciplined soldiers show over undisciplined masses is primarily the consequence of the confidence which each has in his comrades'.

The discipline which produces the confidence of a man in his comrades is not the Prussian or lower form of discipline, but a higher form which aims to a large extent at combining with esprit de corps to develop the sense of honour in a man.

This results in the confidence that a man feels when he knows that the men round him would suffer death rather than the disgrace of deserting a comrade in distress.

It would seem that one of the great parts played by Nelson was to raise the tone of the discipline in the British Navy from a discipline based on fear to one based on honour.

It may be noted that all drills tend to bring about some of the conditions of a psychological crowd. The result of previous fighting has a great influence on confidence; but it does not seem essential that it shall have been successful. A gallant fight against heavy odds may establish confidence.

12. The following is a suggested analysis of the factors that form the art of leadership.

(a) Disinterested zeal for the cause.
(b) Confidence in subordinates.
(c) Confidence in ultimate success.
(d) Personality (see para 13).
(e) Prestige.
(f) Efficiency.
(g) Ability to judge character.

Again, and as in the case of personality below, it is not suggested that all the above are necessary for a leader. Most great leaders can be regarded as the personification of the cause for which their men are fighting.

Cromwell was the embodiment of the Puritan ideals of his troopers. Nelson embodied for his sailors the tradition of the superiority of the British Navy over all foreigners. In Nelson we see the factor of confidence in subordinates developed to a very high degree. As a Captain he always believed his crew to be the

pick of the fleet, as an Admiral he had implicit faith in his Captains, always took them thoroughly into his confidence and was ready to listen to their advice.

Confidence in ultimate success is placed under the heading of leadership, as it appears that this is transmitted downwards and seldom, if ever, exists in the lower ranks when lacking in the leader. Both Cromwell and Nelson understood the character of their men very thoroughly and knew how to develop their best qualities.

The requirements for leadership can also be found in Rudyard Kipling's 'If. The morale of the leader is chiefly a question of confidence; confidence in himself, in his subordinates and in ultimate success.

13. The following is suggested as an analysis of personality.

(a) Ability to discern realities.

(b) Resolution.
- (i) Knowing one's object clearly
- (ii) Determination to attain it

(c) Self-confidence.
- (i) Self reliance
- (ii) Love of responsibility
- (iii) Moral courage

(d) Coolness in emergencies.

(e) Attractiveness.
- (i) Knowledge of human nature
- (ii) Sympathy with human nature
- (iii) Sense of humour

(f) Energy.

(g) Ambition.

14. To take the first factor, ability to discern realities. This is the power that some men possess of seeing through the hazy medium in which we grope blindly, of seeing down to the foundation of things. Such a man will be standing firmly on a bed rock of truth, while the rest of the world is triumphantly clutching at some thing it has just seen dimly and which turns out eventually to be merely some excrescence. Such is the gift that makes a man 'in advance of his time', that gives him the power of intuition, of foresight.

Cromwell possessed this gift and, brushing aside the teachings and practice of his day, was able to apply with success those same principles of war which we, after a lapse of centuries, have at last succeeded in committing to paper.

This ability applies not only to leaders in war and men of action, but is the same gift that enables the poet to express truth in words, the artist in colours, the musician in sounds.

Carlyle defined genius [as] 'an infinite capacity for taking pains'. To my mind this is the negation of genius; the power to discern realities is the real gift of genius.

15. Now consider factors (d), (e) and (g) in the suggested analysis of personality given above. It is not sufficient to say that a man is attractive because he possesses a magnetic personality. We must think out and discover why it is magnetic.

Why does the rubbed amber attract paper? Had the Roman solved that problem completely he would have gone very near to being able to produce lightning on a reduced scale.

We often find as in the case of Nelson, that his very failings may be a cause of attractiveness in a great leader. This is probably because we like to feel that after all he is only human, and so akin to ourselves. Coolness in emergencies is not the same as personal courage. A man may be intensely brave under fire but yet quite incapable of issuing a coherent order. A leader should possess that type of brain which thinks more clearly and calmly the greater the emergency.

The type of ambition required in a leader is not a narrow craving for accelerated promotion or some extra ribbons, but something deeper.

It is possibly a throwback to that basic instinct of self-preservation, and is the desire to continue in this world after death. Napoleon expresses this very clearly when he says: T hold the immortality of the soul to be the remembrance which we leave behind in the minds of men'.

Paragraph 16 comes to the nub of the relationship between the air weapon and morale: it is the spectre of aerial bombardment which has made morale 'a question of the whole nation'.

16. Let us consider briefly the effect of modern conditions. Morale is now a question of the whole nation, not only of fighting forces. The spread of education renders some forms of discipline impossible but facilitates appeals to high ideals.

The growth of democratic ideas may reduce the influence of the personality of one individual. There is greater strain on individual fighting men. Numbers have increased causing greater difficulty of reaching individuals; but remember the improved means of communication such as aircraft and telephone. There seems a tendency now to attach too much importance to machinery. The human factor has always to be reckoned with.

To quote Captain Hopwood of the Royal Navy:

> In the age of swift invention, it is frequently believed that the pressure of a button is as good as work achieved. But the optimist inventor should remember, if he can, though the instrument be perfect there are limits to the man.

17. According to some ideas the great leader of the future will be an individual seated high up in an aeroplane, influencing the combatants below by his own will power through some form of amplifier. This is unlikely, not merely because it is fantastic for doubtless the student at Camberley 20 years ago considered Tennyson fantastic when he wrote of 'the nations' airy navies battling in the central blue', but because it is so repugnant to all ideas of individuality, the negation of the one thing known to be real.

The man who is going to win the next war is, however, not necessarily now seated in his laboratory devising some special noxious gas or some novel and deadly microbe. He is more probably some student of psychology and of human nature, who will in time to come inspire the combatant with enthusiasm for a cause and inflame the spirit of self-sacrifice for ideals . . .

DOCUMENT 4.

Reports on the Attack on Cologne, 18 May 1918

Wrigley's brief collection of reports of the attack on Cologne by Trenchard's Independent Force neatly captures the main issues associated with the still unproven concept of strategic bombardment. *Prima facie,* the results seem to confirm the 'moral' effect postulated in preceding documents, with the German sources in particular strongly conveying the sense of fear and panic hoped for by the proponents of bombing. The material effects also read impressively: for example, the high numbers of casualties and the claim that the industrial activity of Cologne was reduced by 50 per cent for five days both seem striking for the effort expended. The reported industrial damage must have been particularly encouraging, given the generally moribund nature of the Great War: perhaps aerial bombardment would confer the power to break free from the stalemate in the trenches, destroy the enemy's will to fight at its source—in his homeland—and bring the war to a rapid, decisive conclusion.

At the same time, the reports unintentionally highlight some of the fundamental weaknesses with mass bombing using conventional weapons. There is a marked contradiction between the panic and 'deadly terror' in the population reported in paragraphs 2 to 6, and the anger, resolution and courage of the citizens of Cologne referred to in paragraph 7. Perhaps even more significant is the demand for reprisal bombing raids. Even in those earliest of years it would seem that the presumed connection between strategic bombing and deterrence was questionable.

The conduct of strategic bombing campaigns is likely to become even more complex in the future. The Additional Protocols to the Geneva Convention, which are becoming widely accepted internationally, specifically prohibit the planning and execution of attacks on civilian targets including population centres and cultural objects.

The possibility that the reports of public panic in the German newspapers were deliberately overstated to generate national outrage against the British should not be overlooked.

A grim footnote can be added to this document. A quarter of a century later, Cologne was the target for the first of the RAF's '1000' aircraft bomber raids. On 30 May 1942, under the direction of Air Marshal Arthur Harris, Bomber Command dropped 915 tons of incendiaries and 540 tons of high explosives on Cologne. The official report of the raid described Cologne as 'practically a dead city'.

British Official Report

On the 18th instant a most successful raid was carried out by us in broad daylight on the railway stations, factories and barracks at Cologne. Thirty-three bombs were dropped and bursts were seen on the railway sheds. Our bombing machines were attacked by several hostile scouts, which were driven down out of control.

German Official Report

'Kolnische Volkszeitung' *[Cologne People's News]* 18th May.

This morning, shortly after 10am, the town of Cologne was attacked by several enemy aeroplanes. The anti-aircraft guns were in action. The bombs dropped did inconsiderable damage to buildings. Unfortunately there have been some victims among the inhabitants.

'Kolnische Volkszeitung' 22nd May.

Of those injured in the last air raid on Cologne a further 10 have now succumbed to their injuries, so that the total deaths now amount to 35. The number of wounded is now definitely ascertained to be 87.

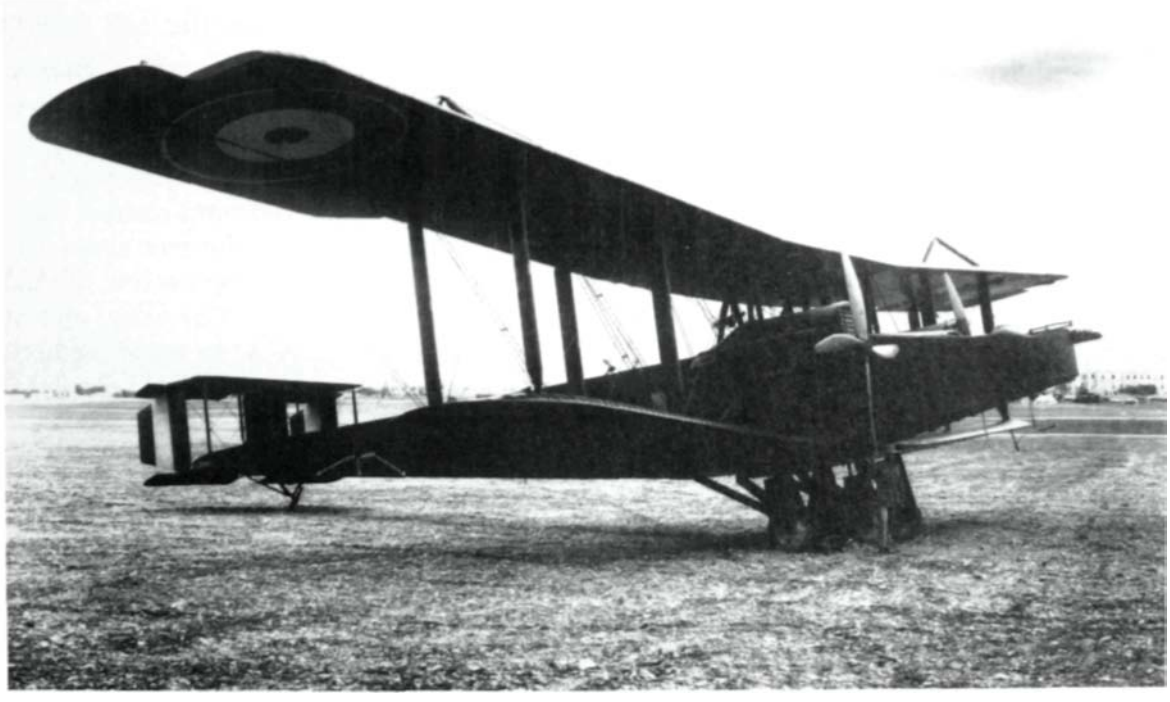
Material Results

(a) Photographs show bursts:

(i) On the railway N. of the S. Station,
(ii) On the W. end of the Neumarket.
(iii) On the railway N. of the S. goods station,
(iv) On the infantry barracks,
(v) On the gymnasium,
(vi) On the Alte Markt.
(vii) On the main railway workshops, near Nippes.
(viii) On the Rathaus.
(ix) On the town water and electric works, and other bursts on buildings in the town,

(b) From a reliable source.

(i) A man who was in Cologne during the raid on 18th May states that the authorities were taken completely by surprise, because



1. A Handley-Page bomber of No. 1 Squadron AFC, similar to those used by the Independent Force in the first strategic raids against the German homeland. AWM.

the raiders were thought to be going north or north-east. Great damage was done to the gasworks and barracks. A direct hit was obtained on a traincar, killing 17 people. The OC of the Cologne AA defences was dismissed.

(ii) Another informant states that three buildings near the station were destroyed.

(iii) From an informant: 'Many bombs fell on the Neumarket, causing much material damage. Casualties are reported to be 178 killed and 500 wounded'.

(iv) A visitor from Germany reports that the electric power station was very badly damaged. The industrial activity of Cologne was reduced by 50 per cent between 19th and 24th May.

(c) The AA guns did not commence firing until after the raid had finished and only succeeded in bringing down one of their own aircraft. The electric traincars ran away without their drivers, as the women drivers had forgotten to switch off the current on their cars.

(d) Captured letter dated 24th May: 'A short time ago enemy aeroplanes were over Cologne and did much damage'.
Captured letter dated 27th May: 'Cologne has had a dressing down and has got a proper "letter of thanks" '.
Captured letter of 30th May: 'In Rotgerberback two traincars were smashed to pieces, some people killed and badly wounded'.
Captured letter dated 31st May: 'A building used as a clothing and rifle depot was nearly destroyed'.

Moral Effect

1. 'Frankfurter Zeitung' *[Frankfurt News]* of 8th June.

General Major von Weisberg gave the following reply in answer to a question by Deputy Kuckhoff in the Reichstag on 7th June:

> The inhabitants were not given the alarm in time to enable them to take shelter as they should have done. The enemy attack seemed at first to be intended for Treves and then for Coblentz. In the meanwhile, although no news had been received the inhabitants should have been given the alarm. This was not done. With regard to mutual limitation of air raids the following can be stated: The Germans cannot make the first approaches to the enemy to stop raids on towns outside the war zone. The German Government on the contrary must wait for the enemy to approach it. Should such an offer be made, it would be conscientiously examined by Germany, and at the same time it would be considered what qualifications would have to be made to secure that German interests should not be affected.

2. The Commanders of the 15th Cologne Territorial Division have set up a special anti-aircraft commission.

3. Captured letter: 'You cannot imagine how scared the people are of hostile aircraft'.

4. From a very reliable source: 'It was by the request of the Imperial Chancellor and of the military authorities of Cologne that Cardinal von Hartman requested the intervention of the Holy See in order to obtain cessation of air raids on this town, which interfered with the movement of military trains. At the same time

the Court of Bavaria obtained the intervention of the Papal Nuncio at Munich, informing him that, according to official statistics, the industrial output of the Rhine region would be reduced by more than a third if the raids continued'.

5. The panic was terrible. Everyone in Cologne is in deadly terror of air raids.

6. Captured letter dated 21st May: 'It is really terrible. May God protect us from anything so awful'.

7. 'Kolnische Volkzeitung' dated 23rd May:

> Once already the population of Cologne has been in danger of being directly affected by the war and its horrors. The extremely painful experiences of 18th May will also have a sure and permanent effect in this direction. But Cologne has remained a fortress. That is the reason of the necessity for adapting one's nerves to unpleasant surprises from the air. It remains to be seen whether Kuckhoff's question will give the impulse to the realization of such desires which are the common property of all citizens without differences of party or creed. The naive notion that our enemies would stop their bombing raids if the Germans stop theirs would certainly meet with sharp disappointment should we make the attempt. By so doing, the German Army Command would only one-sidedly lose a means of reprisal which was wildly called for by the German nation themselves. We are altogether justified in the conviction that the citizens of Cologne will remain at least as firm and courageous as our irreconcilable enemies.

8. From a reliable source.

> It appears that the civilian population in Germany is much impressed, and is at last realizing the forcible effect of war. The conviction prevails that continuous air raids on a larger scale will do more to shorten the war than anything. It is believed that Germany will soon propose abandonment of air raids on both sides, the best proof of success and of the necessity for increasing them.

9. A reliable prisoner of war states that riots occurred subsequent to this raid, and that further raids can only serve to strengthen the hands of the people against the military party.

DOCUMENT 5.

Letter from GHQ to Armies on Low Flying Attacks

The GOC of the RFC in France, General (later Marshal of the RAF) Trenchard quickly developed an unswerving commitment to the offensive in air warfare. That outlook is evident in this letter issued on Trenchard's behalf by Haig's Chief of Staff.

Also of note is the positive effect on the morale of British troops attributed to the presence of the RFC. The army continued to hold that view: Montgomery, for example, made a similar observation during the campaign in North Africa over two decades later. Some professional airmen, however, felt that the army's predilection for always wanting aeroplanes where they could

be seen and heard was contrary to such principles of air power employment as economy of effort and concentration of force. Further, the converse side of the practice was that if the air force was not visible, then the army might consider it was not being properly supported. Thus, in New Guinea in the dark days of 1942, the failure of RAAF Kittyhawk fighters to appear when expected led to those aircraft being nicknamed 'Neverhawks' and Tomorrowhawks' by Australian soldiers.

Adv. First Army
Second Army
Third Army
Fourth Army
Fifth Army

OA 39/1

In continuation of OA 39 dated 5th, the Commander-in-Chief desires that a further development of the offensive tactics of the fighting squadrons of the RFC in direct co-operation with assaulting infantry when offensive operations are undertaken on a large scale, may receive consideration.

During the Arras battle as many as twelve machines under one leader co-operated in an infantry attack, flying at a very low height. Reports received as to the effect of low flying aeroplanes over the battlefield on the 31st July confirm the fact that good results can be obtained by these tactics, due largely to the demoralising effect produced on the enemy and to the encouragement given to our troops.

The Commander-in-Chief is of [the] opinion there are possibilities of developing this procedure in future operations with good results, especially in the attack on the further infantry objectives, even at the expense of foregoing such assistance during the earlier stages of the battle when the infantry are fresh and artillery co-operation is more assured.

(Signed) L.E. Kiggell
Lieutenant General
Chief of the General Staff

Adv. GHQ.
12th August, 1917

PART TWO

Air War Doctrine and Lessons

DOCUMENT 6.

Some Notes on Air Strategy

The Author's Approach to Air Strategy

This essay was written in July 1923 when (then) Flight Lieutenant Wrigley was Training Officer at RAAF Headquarters. It takes a very different approach than would a lecturer at a staff college of today. A modern essay might include: an analysis of national interests, geographical and other enduring factors; the nature of air power; an exposition of the three strategic level air campaigns (air bombardment, control of the air, and support for surface forces—see the editors' introduction); and the air power approach to orchestrating the various elements of those campaigns.

Wrigley's starting point, in contrast, is the nature of maritime and land operations, from which he then progresses to a comparison of surface and air strategy. The reader must remember that compared with thousands of years of history of land warfare, and hundreds of years of continental and maritime strategic thought, Wrigley had the benefit of a mere decade of air power action. Refer again to his marvellous diagram of the development of warfare titled 'Phases in the Evolution of Warfare' (Figure 1.1), and wonder *en passant* how many modern military historians could produce such a descriptive and succinct framework. No wonder he couched his analysis in terms of the thinking of the day, namely, in relation to sea and land strategy. As he notes in paragraph 3:

> Mankind is still living in the age of two dimensions. His brain is not yet accustomed to think in terms of three dimensions.

One wonders whether this comment, like so many other statements made in his notebooks, is not just as fresh and relevant today as it was then.

Returning to Wrigley's essay, most of the elements of a modern approach are in fact well represented. Take, for example, Wrigley's comment on the need 'to get down to a bed rock foundation of facts' [on the general characteristics of air power] on which to build, as 'most of these are so obvious that they are apt to be overlooked'. Nearly 70 years later as the RAAF drafted its first official indigenous manual of air power, the writing team felt the same compelling need to include some explanatory remarks on the same 'obvious' characteristics of air power.

Similarly, the three campaigns mentioned in our introduction are discussed, albeit from a different perspective and at a level of detail that today would be regarded as operational art or even tactical advice rather than strategy.

Many other themes addressed by Wrigley in this chapter are still the focus of discussion and debate today. He discusses the place of technology, upon which 'it is wrong to rely too much'; he emphasises the fundamental principle

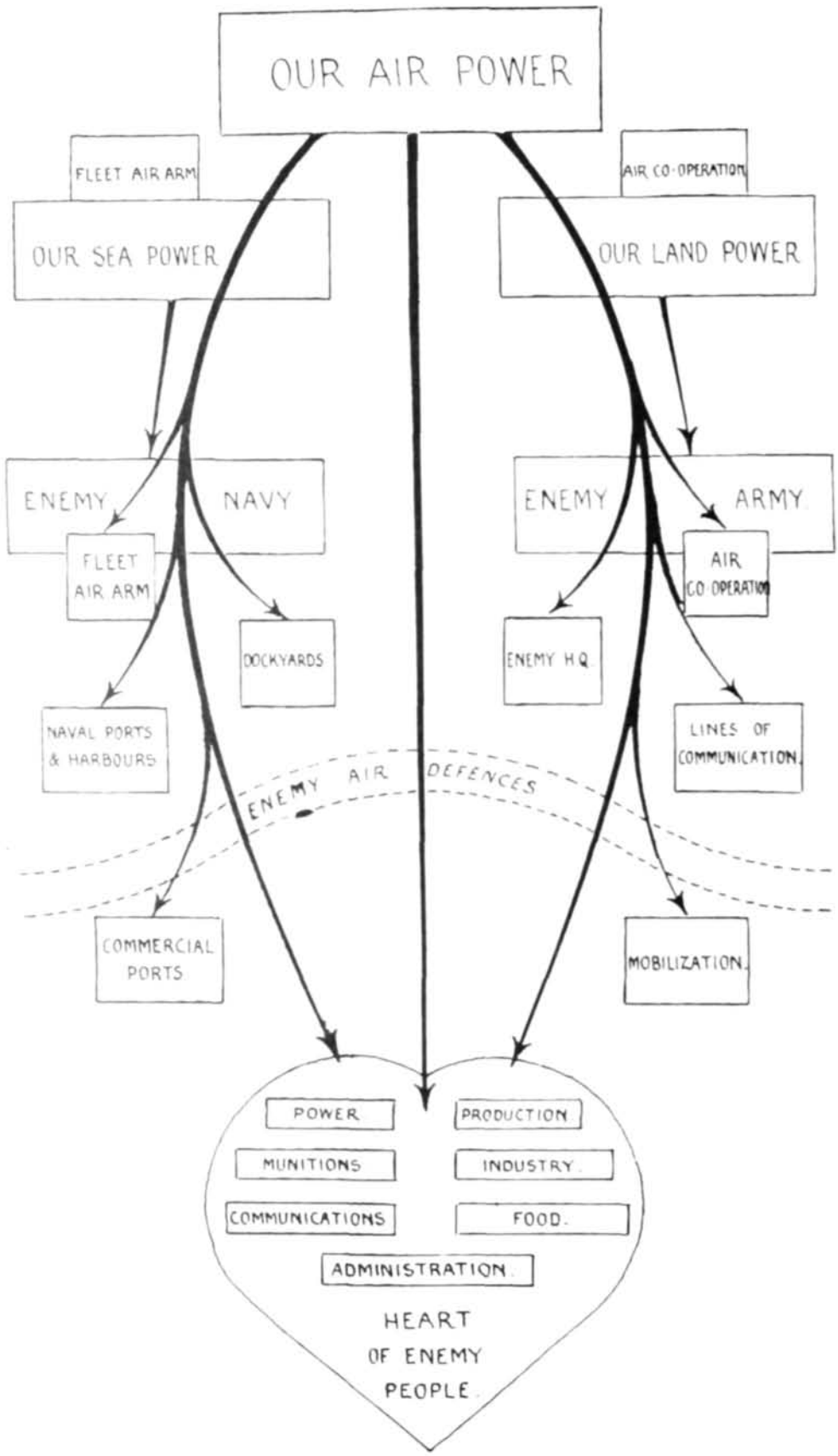

OUR AIR POWER
FLEET AIR ARM
OUR SEA POWER
AIR CO-OPERATION
OUR LAND POWER
ENEMY NAVY
FLEET AIR ARM
DOCKYARDS
NAVAL PORTS & HARBOURS
COMMERCIAL PORTS
ENEMY ARMY
AIR CO-OPERATION
ENEMY H.Q.
LINES OF COMMUNICATION
MOBILIZATION
ENEMY AIR DEFENCES
POWER
PRODUCTION
MUNITIONS
INDUSTRY
COMMUNICATIONS
FOOD
ADMINISTRATION
HEART OF ENEMY PEOPLE

FIGURE 2.1

of using air power—'victory is won by concentration at the decisive place' (a Clausewitzian tenet); develops the important theme of substitution of air power for other forms of combat power; and provides a background for the understanding of many air roles and operations, such as interdiction, counter air, protection of bases, and maritime strike.

Nevertheless, there is an unsatisfactory feeling here that Wrigley was fishing for the real nature of the beast and failed to pin it down. For example, he states at the outset that in looking for the meaning of air strategy 'the application of the principles of war to the direction of air operations . . . does not lead much further'—but then he goes on to discuss this very subject in Part III of the essay.

Strategic Schools

The question must then be asked, has Wrigley set out to define in these early stages of air experience a separate school of strategic thought? He quotes often from both of the existing traditional schools in strategy—notably Mahan for the maritime school, and Clausewitz and various army generals from both sides of the trenches for the continental school. As we have noted elsewhere, air power thinking has many of its roots in sea power. The vital concept of control of the air, the prime campaign, is clearly akin to that of sea control.

From the start, Wrigley's analysis cuts right to the heart of any strategy—its objective. He notes the army's interest in defeating the opponent's army; and the navy's interest in controlling the seas so that the lifeblood of trade may be regulated. In this respect, Wrigley reflects the lingering mercantilism of the British and the influence of Sir Julian Corbett, rather than Mahan who hankered for decisive engagements of his ever-concentrated fleet with the enemy's upon the high seas. In other respects, however he follows Mahan. He draws out the many similarities between the instruments of maritime and air strategy: mobility, flexibility, concentration, dependence upon secure bases and the inability to 'hold ground'.

This discussion does not really define a grand strategy in the true geopolitical sense. Wrigley recognises but does not attempt to guide considerations at the national level, including diplomatic, economic and political strategies. He does not present a philosophical argument for a third grand school to enter the ring with the two traditional protagonists of continental and maritime schools, somehow to form a new 'eternal triangle'. Wrigley's legacy, although quite correctly prefaced by philosophical and indeed psychological essays on conflict and morale, is essentially practical. His is the precursor of many books written to study air operations—ideas and concepts which should aid the commander in thinking about the solutions to the unique problems which face him from time to time.

Did Wrigley then fail to divine the true nature of air strategy? Certainly, his opening section does not define the subject very clearly. His definition seems somewhat circular; 'air strategy . . . bears the same relation to operations in the air, that naval strategy bears to operations at sea . . . ' and so on. Here, it seems that we are not to draw the nature of air strategy from the nature of sea strategy, but from its relationship to operations. Wrigley is

indicating a strategic way of thinking for the purpose of planning and conducting air campaigns and operations. He does not wish to engage in another Clausewitz vs Corbett, a Mahan vs Moltke or even Mackinder (who proposed the famous Heartland view of the world, centred on the Asian landmass.) He wishes rather to explain and add to the practical tools available to the military officer in the era of air power.

The three levels of warfare—the (military) strategic, operational and tactical—are represented in his work. It is clearly not a complete guide to tactics. However, the constant reminders of tactical problems and solutions serve to anchor firmly the more strategic teachings.

These latter might not amount to a new school of grand strategy, but they certainly include all the elements of air power doctrine as well as they can be defined today: the three air campaigns; the need to conduct concurrent campaigns; the reliance of air power on its flexibility and its ability to concentrate, leading to the principles of independence and unity; and finally the underlying imperative that the third dimension must be thoroughly understood by all commanders, but particularly the specialist 'airmen' who prepare to fight the air campaigns.

PART 1. FOUNDATIONS

1. The Meaning of Air Strategy

At the outset one is faced by the difficulty of knowing exactly what is meant by the term 'Air Strategy'. So far no adequate definition has been put forward. A suggestion has been made that it is—The application of the principles of war to the direction of air operations'. This is comprehensive, but it does not lead much further; it is difficult to deduce from this definition what is the object of air strategy, in the same way that the object of naval strategy may be said to be the control of sea communications and that of military strategy the destruction of the enemy's main army as a fighting force.

In this paper air strategy must simply be understood to bear the same relation to operations in the air, that naval strategy bears to operations at sea and that military strategy bears to operations on land.

When dealing with the potentialities of aircraft, I shall limit my suggestions to the developments that may be expected within the next ten years and to progress that can now be foreseen; I shall not consider any fundamental changes such as the discovery of an atomic engine.

2. General Characteristics of Aircraft

In order to get down to a bed rock foundation of facts on which to build, it is necessary to bear in mind the characteristics of aircraft. Most of these are so obvious that they are apt to be overlooked.

(a) Aircraft are unaffected by natural or artificial obstacles except, perhaps, by high mountain ranges; amongst artificial obstacles would be included mines and submarines. The sea, for instance, is an assistance to attacking aircraft provided the width to be crossed does not exceed say, 100 miles, because it facilitates surprise.

(b) They have the power of very rapid action over medium distances.

(c) Their ability to move in three dimensions confers the power to carry on a war of areas, not, as heretofore, merely a war of fronts.

(d) As a minor point may be mentioned the fact that aircraft bombs can contain a much greater percentage weight of explosive than a shell; for instance, a 112 lb bomb contains more weight of explosive than a 9.2 inch high explosive shell although the total weight of the latter is 380 lbs. [See Figure 2.2].

FIGURE *2.2*

Table Showing Relative Proportion of Explosive.

Bombs.
(Percentage for new types not yet settled).

Total Weight in lbs.	Weight of Explosive.	Percentage Weight.	Remarks.
112	28	25	Thick cased.
550	184	33·5	Thick cased.
230	100	43·5	
350	220	62·9	Thin cased.
520	337	64·8	Thin cased.

Projectiles.

Gun.	Weight of Projectile in lbs.	Weight of Explosive.	Percentage Weight.	Remarks.
7·5 Gun.	200.	22 lbs. 10 ozs.	11·3	H.E. shell.
		19 lbs.	9·2	C.P.C. shell.
		4 lbs.	2	A.P.C. shell.
8" Howitzer.	200.	31 lbs. 9 ozs.	15·1	Low muzzle velocity.
9·2 Gun.	380.	22 lbs. 14 ozs.	6	H.E. shell.
		24 lbs. 3 ozs.	6·5	C.P.C. shell.
		7 lbs. 13 ozs.	2	A.P.C. shell.
9·2 Howitzer.	290.	43 lbs. 11 ozs.	15	Low muzzle velocity.

On the other hand aircraft have certain limitations.

(a) Their efficiency is seriously reduced by fog or even low clouds, though it might be remembered that pilots operating over the sea will not have the constant fear of running into obstacles, as in the case of pilots flying over land in low clouds.

(b) Aircraft cannot close with an enemy and have no physical stopping power, such as would be afforded by barbed wire and bayonets.

(c) They are very vulnerable when on the ground.

(d) To operate they must cross over into enemy territory, unlike a gun which fires from inside the security of its own lines.

The mobility of aircraft is limited by the distance aircraft can fly without the need for refuelling, or by the possibility of using carriers . . . This shows that the development of aircraft bases and air routes is of great importance. Mahan says, 'Bases are the indispensable foundation upon which the superstructure of the offensive is raised', and this saying applies with equal force to aircraft as to navies.

Alfred Thayer Mahan, Sun Tzu and Clausewitz had a strong influence on British military thinking. Mahan in particular was well regarded by the British since his historical analysis of the development of sea power was flattering to the Royal Navy's exploits. Additionally, Mahan's theory of sea power as stemming from the ability to control sea communications was most apposite for an island nation. As pointed out elsewhere in editorial comment, the analogy between sea and air power is strong. This particular example draws attention to the importance of bases for both forms of combat power. The security of those bases plainly will be vital.

3. Comparison of Sea with Land Operations

Mankind is still living in the age of two dimensions. His brain is not yet accustomed to think in terms of three dimensions. Therefore when considering air problems it is usually easier to start from the basis of sea or land operations and then to draw comparisons with operations in the air.

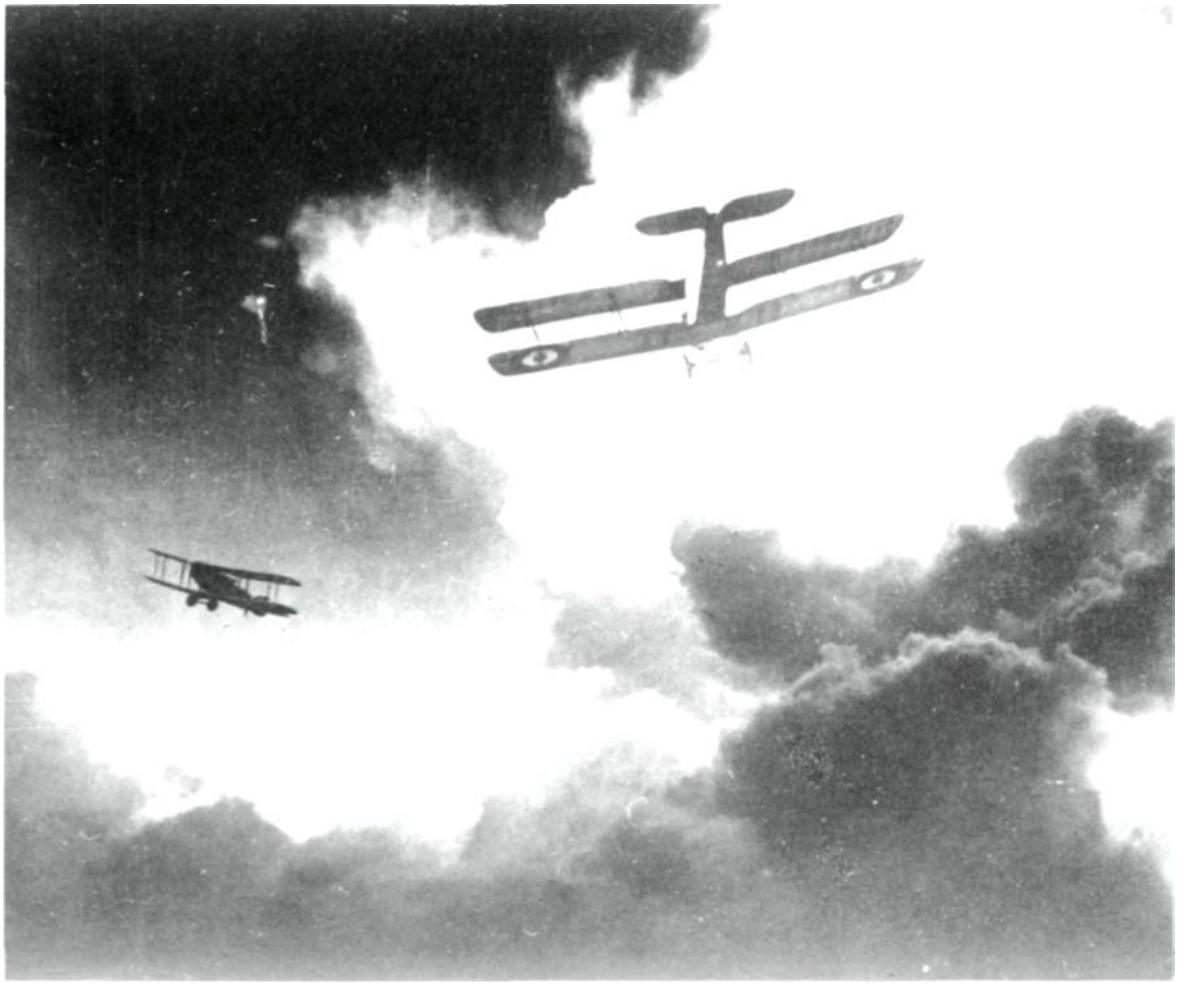
Let us first compare operations at sea with those on land.

(a) On land the possible lines of advance are few and definite, at sea they are many and uncertain. The use of cross country vehicles may modify this.

(b) Armies are tied, more or less rigidly, to their original line of advance as they must have lines of communication reaching right up to the battle line; whereas a fleet at sea is free to move in any direction at any period of a campaign, and is not tied to its base by a fixed line of communication.

(c) Natural obstacles on land are numerous but are few at sea. Armies can pass through or over natural obstacles; fleets must go round. An army can make use of obstacles as well as be hampered by them.

(d) Fleets come into action and carry through an action quicker than armies.



2. 'Their efficiency is seriously reduced by fog or even low clouds . . .' Aeroplanes of the AFC flying at top speed to reach their aerodrome before the gathering storm bursts. AWM.

(e) Fleets must be ready for instant action at the moment war breaks out; armies usually have several days in which to concentrate.

(f) Expansion of an army can be carried out quicker than the expansion of a fleet.

(g) An army is not dependent on daylight. A land battle may continue throughout the night and in any case a battle that dies down in the evening will be resumed again next morning with the armies in much the same relative positions. In the case of fleets, the ships will usually break apart during the night and may be out of sight of each other the next morning.

4. Comparison of Air Operations with Those at Sea

Turning now to air operations we find that they are similar to operations at sea in many respects.

(a) The choice of possible lines of advance. The directions in which aircraft can move are even more numerous and more uncertain than in the case of ships, because of the former's power of movement in three dimensions.

(b) The necessity for secure bases and for a secure line of communication to these bases from the ultimate sources of supply.

(c) Freedom of operation. Air forces, like fleets, operate directly from their base and are not dependent on a line of communication running all the way from that base to the battle front. For the short period that each particular operation lasts, aircraft carry with them all the supplies necessary.

(d) Freedom from natural obstacles, even greater than in the case of the sea.

(e) Speed of action, considerably more than in the case of ships.

(f) Necessity for instant readiness.

(g) Inability to continue an action throughout hours of darkness, or to remain on the field of battle during the night.

5. Limitations to Direct Comparisons between Operations on the Sea and Those in the Air

(a) It will be seen from paragraph 4 that in many cases the points on which operations at sea differ from those on land are accentuated when we come to consider operations in the air. This has led many people to the false conclusion that analogies between sea and air can be drawn in all cases, and thus to many incorrect deductions.

(b) Consider for example the question of communications. It is inconceivable that a country can ever become as dependent for its existence upon the maintenance of its air communications to anywhere near the same degree as it may be dependent upon sea communications.

(c) Another misleading analogy is that regarding the size of aeroplanes. The term 'battleship of the air' has become as dear to the hearts of many writers as the one to the effect that Egypt is the Clapham Junction of the air. The point is worth some detailed attention . . .

There follows a very detailed analysis of what happens to useful loads and speeds when the size of aircraft, ships and weapons are varied, leading to the following conclusions:

(m) To sum up, it has been shewn:

(i) That whereas increasing the size of a battleship enables the designer to obtain any required combination of speed, offensive power and defensive qualities, this is not the case with aeroplanes,

(ii) That the big gun, ie, I [pounder] or upwards, is not likely to be a decisive factor in air combat,

(iii) That complete armouring of the vitals of aeroplanes is impracticable.

The analogy, therefore, between aeroplanes and battleships in this respect falls to the ground.

Not just 'falls down' as in modern usage: one looks long and hard in Wrigley's work for humour but perhaps this is a gentle pun trying to push through the stiff style.

(n) It is not contended that one small single seater will be able to take on one large multi-seater, but that an equivalent weight of small aeroplanes will probably defeat an equivalent weight of large ones.

For instance, could one Vickers Vimy compete against the equivalent weight of Snipes, ie, five of them?

(o) There is, further, the question of handiness to be considered. As ships or aeroplanes increase in size they become less handy and manoeuvrable. This is a disadvantage in both cases, but more so in the case of aeroplanes.

(p) The difficulty of handling large aeroplanes on the ground and of preparing suitable aerodromes must also be borne in mind.

(q) Large aeroplanes will doubtless be required to take very large bombs or torpedoes, but these correspond more to cargo vessels whose duty it is to deliver goods at a certain place; their primary function is not fighting so they are not analogous to battleships.

(r) Airships have not been considered. In their case, as in that of ships, the carrying capacity increases as the cube of their linear dimensions, hence the larger the airship the greater the proportion of useful load to total weight.

6. Progress in the Air is Due as Much to Change of Attitude of Mind as to Technical Development

Technical improvements in aircraft and their equipment will always be of great importance in air operations. It is unnecessary to recall the effect of the appearance of the Fokker in November, 1915 [see Document 15J or of the SE5 in the spring of 1917.

Aeroplanes are quicker to produce than ships, and development therefore may take place during a war, though it must be remembered that even in the case of aeroplanes new types take many months to reach the production stage.

But a factor of even greater importance for progress is that of attitude of mind. Manoeuvres that are believed to be highly dangerous one year, become part of the early training of pilots the next.

As late as 1915 it was believed that getting into a spin would usually lead to a fatal accident, but as the result of scientific investigation at the Royal Aircraft Establishment spinning in 1916 became a recognised manoeuvre in air fighting.

In 1914 looping was forbidden in the Royal Flying Corps, and the civilian pilots who joined at the beginning of the war had to sign a certificate promising not to attempt any trick flying such as looping during the time they were serving with the Royal Flying Corps.

If Dr Stefansson's ideas were correct, the normal route for fast traffic to China may quite well become by air over the Arctic Circle.

It is wrong to rely too much on technical development for gaining superiority in the air. Success depends more upon the way in which aircraft are used, while the most important factor will always remain the spirit animating the combatants.

7. The Nature of Modern Wars and the Effect of Aircraft

(a) There are two main features that characterised the War of 1914-1918 and seem likely to exist in any future war on a large scale.

The first of these features might be thought of today as the ability of air power rapidly to apply combat force at the 'centre of gravity'. The defeat of the will of an enemy (or potential enemy) by military means is the result of his perception of being confronted or engaged with combat power in a decisive form in time and space: that point in time and space is referred to as the enemy's centre of gravity. The notion is pure Clausewitz.

> Firstly, the great importance of material and of means of transport. Victory is won by concentration at the decisive place. Formerly this place might have been a hill, eg, Pratzen at Austerlitz or the flank of a position as at Gravelotte; but in future it seems more likely to be factories, including dockyards, and means of transport. This fact may enable an air force to render an army or a navy useless, by depriving it of its means of action.
>
> To meet this menace factories must be echeloned in depth and not concentrated in one area. This may necessitate some civilian establishments away from their source of raw material and therefore subsidising them to compensate for the increased cost. It will be remembered that the French are taking steps to establish branches of their aircraft factories away from Paris where they have a tendency to congregate.
>
> In 1917 part of the ironworks at Isbergues near Aire were moved back to Rang du Fliers and, incidentally, are there still.
>
> This system will in most cases entail increased transport and so to some extent will simply mean a change in the objective for an attacking air force, ie, communications may become a more suitable bombing target than sources of supply.

The second 'feature' is more general and, therefore, relevant today but with less force. However, Wrigley's comment is very fair and indeed, as we shall see again shortly, his predictions accurate. In this case he discerns a trend towards the importance of economic factors and to the interdependence of nations, strong flavours in much of the writing on security issues in the late twentieth century.

> Secondly, it was truly national.
>
> This is merely a reversion to the characteristics of ancient warfare, and it means not merely that the morale of the enemy nation is the most important objective, but that it is not sufficient to defeat the hostile fighting services; the whole nation must be crushed so as to

render it impossible to raise new forces. It is doubtful whether any nation will enter on a big war in future unless the issue is of supreme importance, and the people as a whole realize this and are determined to fight to the end to attain their object.

(b) In this connection it is important to bear in mind the economic and social development of the last few years.

The prosperity of nations is so closely inter-connected that war must mean hardship and privation for the civil population.

The masses of most countries have been steadily gaining a greater influence over national affairs, owing to the growth of democratic ideas; and the organisation of labour makes it possible to bring about cessation of work in any particular trade and this may lead to serious reduction or even complete stoppage of munition output.

Any national war must involve directly most of the individuals in the belligerent countries; every family will have one or more of its members in the fighting services.

Thus while the people as a whole have been more directly affected by war, their power to stop it has increased; in fact, a government cannot enter a war or continue a war unless the majority of the people are in favour of such a course.

(c) What means are at the disposal of a government for affecting the people of the enemy nation, for breaking their will power, for inducing them to compel their government to sue for peace?

They may be grouped as follows:

(i) Moral means.	Propaganda. Fear of personal injury.
(ii) Economic means.	Starvation. Stoppage of raw materials. Financial pressure.
(iii) Physical means.	Destruction of their fighting forces, and the means of carrying on the war.

The above are all closely interconnected. Starvation, for instance, lowers morale, and destruction of the fighting forces is evidence of the impossibility of winning and thus also a moral factor. In order to win a national war, the fullest use must be made of all these means.

(d) Propaganda and financial pressure are outside the sphere of the fighting services.

A minor point, but activities such as leaflet dropping can come into the ambit of 'propaganda'.

(e) A navy acts mainly by economic pressure, though the physical destruction or neutralisation of the hostile navy is an essential preliminary.

An army makes use chiefly of physical means, ie, the obstruction of the fighting power of the hostile army. Neither an army nor usually a

navy can bring direct pressure to bear upon the enemy people in the early stages of a war.

(f) Air forces, however, can act more directly on the morale of the enemy nation than either armies or navies, and may be able to bring home the fear of personal injury to the people soon after the commencement of a war. Air power, therefore, is a further means at the disposal of a nation for imposing its will upon that of its enemy, and it affords a method of waging war additional to the traditional methods afforded by naval and military power.

8. The Effect of Air Power on Naval Operations

This section reflects the immaturity of air capabilities at the time. The next world war, notably in the Pacific theatre, was to add tremendous weight to the importance of air power which extended over key maritime lines of communication, not only in reconnaissance but also in the strike role. Even then, the effectiveness of both land-based and carrier-borne aircraft (both were developed during World War I) was constrained by poor weapons system accuracy, limited communications and decidedly haphazard navigation and target location. The advent of guided missiles, accurate systems and space-based target information has been of great strategic significance to an island nation such as Australia.

(a) When co-operating with a navy, reconnaissance is one of the most important duties of aircraft.

The main advantages of aircraft reconnaissance are:

(i) It is very rapid.

(ii) It can observe main bodies, not merely covering forces.

It has been stated that at the Battle of Jutland, the Commander in Chief was unaware of the exact position of the enemy fleet until the flashes of their guns were observed from the bridge of the British flagship.

Air reconnaissance at sea suffers from this disadvantage as compared with that carried out over land, namely, that the reconnoitering aircraft has to find a carrier instead of being able to come down anywhere inside its own lines and deliver its report. Wireless, if permissible, will, however, reduce this disadvantage. As a result of the better facilities for reconnaissance it will be easier than in the past for a fleet to avoid decisive action if it wishes to do so.

(b) Air bombing or torpedo attack may force a fleet to break station or to adopt an open formation in either of which case it will be at a disadvantage if in action with a fleet that can retain its battle formation. A fleet may also by the same method be forced to alter course so as to place it at a disadvantage.

(c) Air power may render naval bases insecure. Could we base a fleet on Malta or Gibraltar if at war with Italy or France? Will Scapa be safe in the event of another war with Germany?

This refers to the major British naval base at Scapa Flow in Scotland whose defences were penetrated by an audacious German raiding party from the sea. The Royal Navy suffered a serious blow to both ships and dignity. Harbour defences were subsequently improved to prevent a recurrence, but the point here is that the next raid may avoid such defences by coming from the air.

9. The Effect of Air Power on Military Operations

Technology has made an impact on air-land operations too, but as the following section shows, the shift has been less pronounced than in air-sea operations.

(a) Air reconnaissance is now almost essential to military operations but it suffers from certain disadvantages:
    (i) It cannot identify units, hence it is most important to make frequent reconnaissances and never lose touch with a formation once it is found.
    (ii) Negative information may sometimes be misleading.
    (iii) In mobile warfare it is not easy to find the exact front occupied by leading hostile troops . . .

(b) Air attack, mainly by bombs, may be expected to have the following effects:
    (i) Concentration and embarkation areas will have to be chosen with due regard to danger from the air.
    (ii) Lines of communication will have to be duplicated. A start was made in this direction during 1918, when, owing to the danger from German night bombers the bridge near Etaples on the Boulogne-Abbeville railway was duplicated by another about two miles away.

3. The first role of air power. An RE8 and Bristol Fighter of the AFC starting up for a reconnaissance sortie. AWM.

(iii) Dumps and depots will have to be dispersed. As an instance of a bad depot, the one at Audricq was sited and laid out without any regard to aircraft. A large portion of it was destroyed as the result of bombing from a single German aeroplane on the night 20/21 June, 1916, and over 12 000 tons of ammunition was blown up. On the other hand, the ammunition depot at Dannes was carefully sited and laid out and would have been difficult to damage seriously by aircraft bombing,

(iv) It will be dangerous to move large columns of troops or vehicles along the road by day or even by night,

(v) Dumps and billets will be liable to bombardment at any distance behind the front and must be dispersed,

(vi) A retreat is likely to be turned into a rout. There were three well known examples of this in the War of 1914-1918—

The Turks, September, 1918, in Palestine.
The Bulgarians, September, 1918, in Macedonia.
The Austrians, October, 1918, in Italy,

(vii) The dominating factor in the choice of zero hour may be the effect of air observation. In Nivelle's attack of 1917, the Germans had air superiority and the French were obliged to fix zero hour earlier than they wished in order to avoid observation by German aircraft.

(c) How far an air force will be able to stop an advancing army with its morale still high is doubtful, and there is but little data on which to form an opinion. On 7th December, 1917, after the Battle of Cambrai the German advance against the retreating 177th Brigade was checked by machine gun fire from the aeroplanes of No 84 Squadron and the rear guard was enabled to get clear. On the French front on 4th June, 1918, parts of the Division Aerienne were warned that German troops were massing for an attack in the valley of the Saviere on the eastern edge of the Forest of Villers Cotterets. About 80 bombing and 40 fighting aircraft were sent against them, the Germans dispersed, and no attack was made.

(d) The Royal Air Force must consider the moral effect on troops on the ground of seeing their own observation aircraft flying low and being driven home by enemy fighters, whatever may be the result of fighting 20 000 feet in the air or 20 miles on the enemy side of the line.

In this connection it should not be forgotten that close reconnaissance squadrons are now equipped with better aircraft than during 1914-1918, and are therefore more capable of defending themselves.

Wrigley again reminds us of the importance of seeking to penetrate to the very heart of the opposition.

(e) By using aircraft to attack different parts of the enemy's front in rapid succession, it may be possible to affect the nerves of the hostile Com-

mander in Chief, since he will never know where to expect the next attack.

Predicting the future holds no fear for this thorough and analytical writer. Wrigley often suggests the way air power will develop, as we have seen above in paragraph 6 regarding a polar air route.

The three predictions which follow provide further examples. It is almost as though Wrigley had a sneak preview of the Allied Pacific campaigns during World War II, to which we refer in greater detail in Document 7. Those campaigns relied almost totally on the 'possible future developments as regards military operations' he had described exactly 20 years earlier.

To Australian readers, this is more than just an academic interest. Australian forces participated in full measure in those operations. Although some historians have complained about the (alleged) subjugation of Australian interests under MacArthur, RAAF squadrons based initially in Townsville and Port Moresby but eventually in many islands throughout the area, conducted highly effective air deployments, resupply and air superiority, so that land and sea forces could advance securely. At other times, land forces were directed primarily 'to secure an area required by an air force for aerodromes'. Far from being a second-rate effort, this major campaign by the RAAF and other Australian services was a proud phase of its history. Air Vice-Marshal Hewitt, at one time commander of the RAAF's No. 9 Operational Group, recorded that the 'smaller brother' had made a contribution at least in proportion to its numbers. Students of air power not familiar with this phase of RAAF history would be well advised to return to Buna, Milne Bay, the Bismarck Sea and Goodenough Island.

(f) Possible future developments as regards military operations:

(i) Formerly an army was unable to cross the sea until the navy said it was safe to do so. In future the passage and landing must also be secured against air attack before being attempted.

(ii) The first duty of an invading army may be to secure an area required by an air force for aerodromes.

(iii) Napoleon always tried to act against his enemy's lines of communication to cut him off from his sources of supply. In future this may be effected by means of aircraft, which by continual bombing of sources of supply and means of communication may impede the supply of food and ammunition to such an extent as to render it impossible for the enemy's army to fight a prolonged action in a forward position. If so, the action of the army will merely be to advance and reap the fruits of a victory that has been won by air power. The advancing army will thus occupy the enemy country and eventually his capital, not as the result of severe fighting on the ground, but as the result of air action.

(g) The following extracts from a paper on air operations by General de Castlenau, dated 26th June, 1918, are of interest in this connection:

Military operations consist in reorganising forces, creating new ones, and moving masses of troops to the area where the next blow is expected. The

battles constitute the tragic moments of these operations. Owing to their limited capacity for movement and their limited sphere of action, infantry and artillery can only carry out their work of destruction during the battle itself. On the other hand Aviation, which is more rapid and more free acting, can carry out its work not only in the battle but during the whole course of operations and in an area which grows more and more deep as science progresses.

He goes on to point out that aircraft:

(i) Can act strategically by attacks on lines of communication,
(ii) Can disturb troops withdrawn to rest areas,
(iii) Can damage production.

He recommends that the attack of air bases should be the first object of an air force and compares such action to counter battery work or the bottling up of the German fleet and submarines,

(h) It is interesting to note the growth of the relative importance attached to air power during the War of 1914-1918.

. . . |OJne of the advantages of air power lies in the fact that through its use greater effect can be obtained with fewer men. For instance, the following figures have been worked out for the War of 1914-1918:

Personnel required in France including Base Depots:

Per field gun at the front	53 men
Per 6 inch howitzer at the front	58 men
Per aeroplane at the front	46 men

The total personnel required at home and abroad to keep every aeroplane serviceable at the front was 83 inclusive of training establishments.

The point of the preceding table of personnel numbers was to suggest that aircraft are cheaper to support than field guns or howitzers. Given the totally different roles and capabilities of the three weapons systems, the comparison has little validity.

The next section might not seem to be very revolutionary. However it actually presages some of the more bitter and long-running disputes which were to surface in the Australian defence community shortly after this essay was written. The Royal Australian Air Force for the first few decades after its formation in March 1921 faced a continual struggle for survival. One of the main issues was the use of aircraft in coastal defence. Despite the strong endorsement given to air power by Lord Jellicoe in 1919 and Sir John Salmond in 1928, Australia's naval and military commanders insisted on retaining far less flexible ships and fixed shore batteries as the cornerstones of coastal defence.

Today, the defence of Australia's air-sea gap is clearly identified as a high priority. However, debate is still very much alive as to the relative merits of maritime detection and exclusion, security of the littoral and hinterland against those who escape detection; and the contributions to be made by the various land, sea and air force elements.

10. Aircraft and Coast Defence

At present reliance is placed chiefly upon heavy fortress artillery for coast defence. This is not only very expensive to install but requires aeroplane observation to be of much value.

Would it not be far preferable to use aeroplanes for direct action against enemy vessels by torpedo or bomb attack and so do away with coast defence guns? It would then be possible to organise a series of mobile coast defence units, and the serious error of immobilizing aircraft by allotting them to stationary defences would be avoided. Aircraft will render a landing on a hostile coast more hazardous than ever. During the process of landing, troops in small open boats will offer a fine target for low flying aircraft, while both transports and supply ships are very vulnerable to torpedo and bombing attacks. Even, therefore, if an invading force does succeed in landing, air power may cut off its supplies and reinforcements, and so reduce it to impotence.

11. Miscellaneous Uses of Aircraft

(a) Troop carrying.

A proposal was put forward at the end of 1917 to use aeroplanes during our offensive for landing infantry with Lewis guns behind the German trenches, in the zone of their heavy artillery. These aircraft were to be sent over as soon as our infantry had progressed beyond supporting range of our field guns and were to land close behind the enemy heavy gun positions.

The infantry were then to attack gun detachments, cut telegraph and telephone wires and generally create confusion.

If many of Wrigley's predictions were accurate, the following observations are wide of the mark. He is correct in pointing out that aircraft should not be regarded as mere trucks, but he failed to perceive the growing importance of air mobility. Aircraft capabilities had so developed within about a decade that air transport and mobility was probably the major development of air power in World War II.

It was proposed to use 300 aircraft each carrying 50 men. This proposal would have been a misuse of valuable material, and the equivalent number of aircraft could have been better employed on bombing or other offensive duties. Apart from this, the landing of so many aircraft in a small space would be impracticable.

The Germans landed troops on the island of Runo, in the Gulf of Riga, 13th October, 1917. The force consisted of one officer, three NCOs, and thirteen men armed with four light machine guns on wooden sledges, 16 carbines, 2500 rounds of ammunition, spade axes, Very lights, and provisions for two days. They were transported in 'G' aeroplanes and despatched at the rate of three men per aircraft. This party started with air escort on 13th October, 1917 at 0615 hours from Angernsee and landed at Runo at 0700 without incident. The distance is about 45 miles across the sea.

On 21st and 22nd February, 1923, ten Vickers Vernons were used to convey two companies of the 14th Sikhs from Kingerban to Kirkuk in Iraq at a time when the roads were impassable owing to rain. The operation commenced at 0945 on the 21st and was completed by 1345 on the 22nd. The total number so conveyed was 338. The officers and men had their kits, full equipment and 100 rounds each, and an extra 30 000 rounds of SAA were taken in boxes. The distance from Kingerban to Kirkuk is 70 miles and the total military load carried amounted to 73 250 lbs. The total number of aircraft trips was 28.

The possibility of getting special forces in and out by air was recognised early, although sometimes the results may have left something to be desired.

(b) Landing demolition parties behind the enemy lines

In March and in April, 1917, the Germans sent an aeroplane to cut the water pipe line and railway serving our troops advancing into Palestine. They succeeded in damaging the pipe line on the first occasion but it was soon repaired and caused no delay to our movements.

In Mesopotamia on 7th March, 1917, two aeroplanes conveying two engineer officers were sent off from a landing ground near Ctesiphon to destroy the railway between Baghdad and Samarra. The party landed safely but was discovered by Arab horsemen before any damage could be done and had to return.

In October, 1918, the French arranged for a detachment of eight men under Commandant Evrard to be landed behind the German lines to blow up railways. They were provided with food, explosives and means of communication. The expedition started on 20th October in four Voisin aircraft but as soon as the first aeroplane had landed it was attacked at once, and the other three flew back without attempting to land. Commandant Evrard with one other officer and one man who had escaped from the first aircraft managed to do some slight damage.

In the Independent Force in 1918, arrangements were being made to land a party at Mannheim to damage a factory at that place.

There was also a project at one time for landing a seaplane on Lake Tiberius and for the observer to swim ashore with a light skiff containing explosives and then to blow up the Hedjaz railway. Although in these cases the project was either abandoned or failed to achieve much result, opportunities for more successful attempts may occur in future.

(c) Supplies dropping

On several occasions aeroplanes have been used to convey supplies of food and ammunition to ground troops.

It was calculated in 1918 that a Corps squadron would be able to drop 20 000 rounds a day in addition to its other duties, also that none would be required until after zero plus 6 hours. As a military operation sending troops by air and relying upon air transport for supplying them afterwards, is hardly practicable unless superiority in the air has been first obtained.

(d) Aircraft for control of a semi-civilized country

In the control of a country an army acts mainly defensively. It marches into a district but then establishes posts which literally or figuratively surround themselves with barbed wire and remain stationary.

Aircraft on the other hand are housed in the security of their own territory and control a country by means of very rapid offensive action. This has the great advantage that the necessity for subsequent withdrawal is obviated. In the case of an army this has frequently led to unfortunate incidents.

Aircraft cannot occupy a country in the same sense as troops do. Men in uniform, for instance, are not seen daily in the streets and bazaars, but the use of weapons that can appear anywhere from any direction at any moment has a great effect upon the nerves of any native population.

PART II. PREPARATION

In this part, the author draws our attention to the importance of preparing in peacetime for possible contingencies in the future. He looks at the importance of the industrial base and civil assets, and suitable organisational arrangements.

However, most of his comments concentrate on the vital question of training, professional development and doctrine. His purpose seems to be to record the distilled experience of the war to guide the peacetime development of the air force into the 1930s.

12. Peace Preparation and Mobilization

(a) To enable any fighting service to start operations immediately on the declaration of war, very thorough preparation in peace is essential. In the case of an air force as in that of a navy or army, the two main requirements in peace preparation are:

(i) Sound organisation,
(ii) Thorough mobilization scheme.

In addition a navy requires refuelling facilities and secure bases, whilst an army needs good communications, including strategic railways and frontier defences. As regards an air force the additional requirements are:

(iii) Good communications, ie, development of air routes,
(iv) Secure aerodromes from which to operate.

(b) The organisation of the Royal Air Force has to provide for:

(i) Operations in small wars under a Royal Air Force Commander.
(ii) Operations in co-operation with the Navy and the Army in either large or small wars.
(iii) Operations against an enemy's sources of supply and centres of control in conjunction with the Navy and Army but not necessarily under a common Commander.

Also the Royal Air Force has to provide not only for instant action as in the case of the Navy but for a large expansion as in the case of an Army.

In the years since these notes on the importance of having an expansion capability were written, air forces have become even more reliant on technology. Thus, it is far more difficult to expand rapidly, especially for a highly technical organisation like an air force.

To obtain full value from the mobility of aircraft and of a united service, the Air Council should be able to allot squadrons for any duty and not have to reserve them in war for particular work which they have been mainly carrying out in peace. In certain cases this will be impracticable, eg, spotting for the fleet, but a day bombing squadron may well be required for army reconnaissance, and the system of training should be arranged with this in view. The organisation of the Royal Air Force has, therefore, to allow for many varying conditions and it is essential that it shall remain flexible. There is no rigid establishment for any formation, and a wing may consist of any number of squadrons of any type, whilst a group may contain any number of wings.

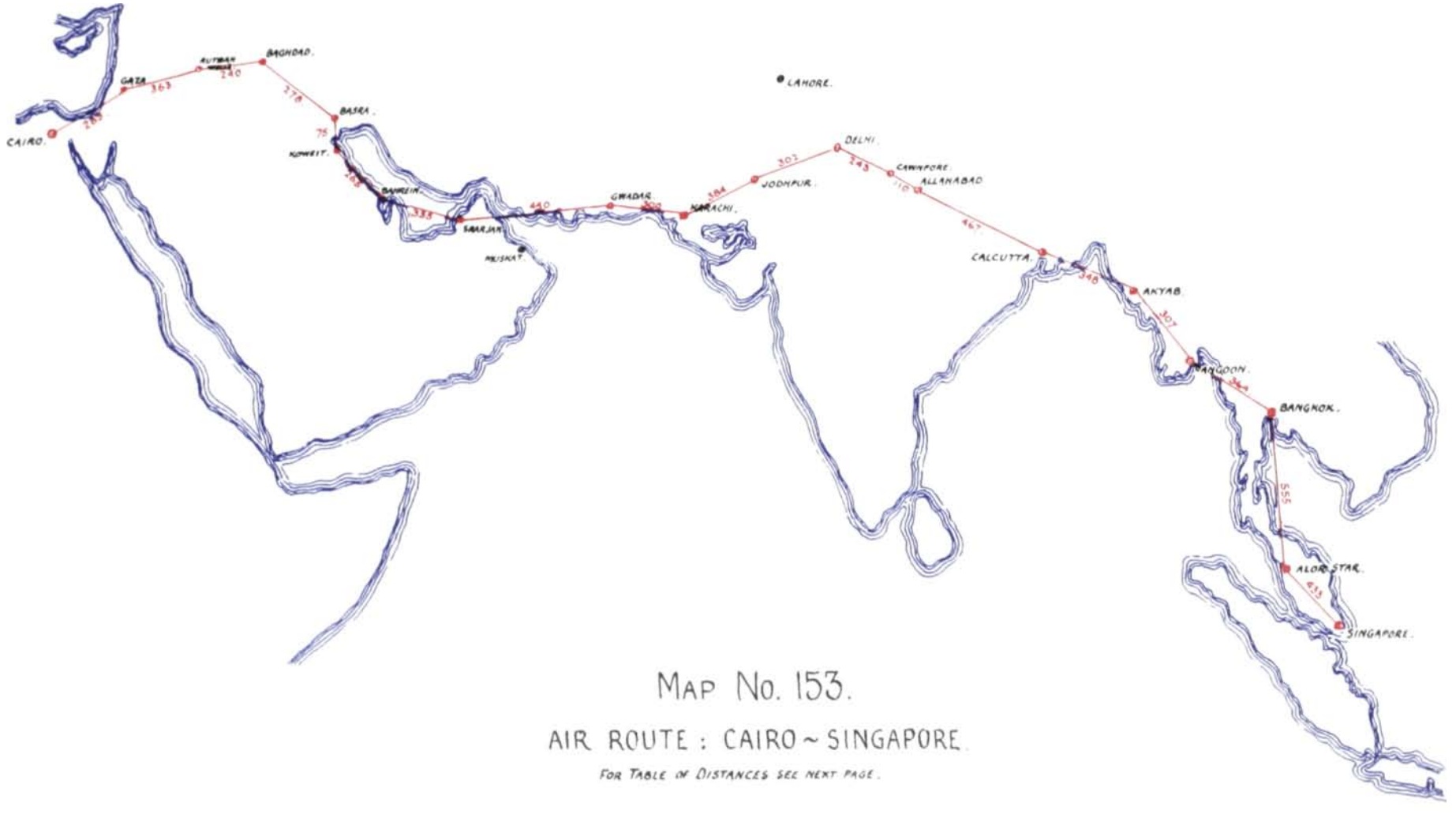
(c) As an air force must be ready to operate immediately it is essential that air intelligence shall be absolutely up to date. This must apply not merely to the strength and location of the enemy's units, but to his technical and tactical developments and to the position of his depots and factories.

(d) It may be necessary to mobilize part or even all the Royal Air Force before the Navy or Army, and in any case the Royal Air Force must be prepared for action the instance war is decided on . . .

One of the great advantages of aircraft is their mobility. The examples used in the next section vary from the worldwide interests of the British Empire to short-range tactical logistics. Neither situation might seem particularly relevant to the modern reader, but it is worth pausing for a moment to absorb the extent of the tasks being attempted in the aircraft of the day. Whereas a modern airliner lands for fuel rather reluctantly once or twice in the course of a journey half-way round the world, in 1928 it was still a major undertaking. Glance across at Figures 2.3 and 2.4.

(e) To obtain full value from aircraft for the defence of the British Empire we must develop air routes, the aerodromes on which will correspond to coaling and oiling stations. The length of each stage of these air routes, in other words, the distance apart of the aerodromes must be suitable to the type of aircraft that will use them. It would be impossible for a fighter squadron, of which the aircraft have sufficient fuel for, say, 400 miles, to use an air route on which there was a 700 miles stage.

It should be remembered, however, that extra tanks can be fitted to the wings of aeroplanes as a temporary measure to increase the radius



MAP No. 153.

AIR ROUTE : CAIRO ~ SINGAPORE.

FOR TABLE OF DISTANCES SEE NEXT PAGE.

FIGURE 2.3

	CAIRO.	GAZA.	RUTBAH WELLS.	BAGHDAD.	BASRA.	KOWEIT.	BAHREIN.	SHARJAH.	GWADAR.	KARACHI.	JODHPUR.	DELHI.	CAWNPORE.	ALLAHABAD.	CALCUTTA.	AKYAB.	RANGOON.	BANGKOK.	ALOR STAR.	SINGAPORE.
CAIRO.	—																			
GAZA.	289																			
RUTBAH WELLS.	652	363																		
BAGHDAD.	843	603	240																	
BASRA.	1121	881	518	278																
KOWEIT.	1196	956	593	353	75															
BAHREIN.	1461	1221	858	618	340	265														
SHARJAH.	1796	1556	1193	953	675	600	335													
GWADAR.	2230	1996	1633	1393	1115	1040	775	440												
KARACHI.	2530	2296	1933	1693	1415	1340	1075	740	300											
JODHPUR.	2914	2680	2317	2077	1799	1724	1459	1124	684	384										
DELHI.	3216	2982	2619	2379	2101	2026	1761	1426	986	686	302									
CAWNPORE.	3459	3225	2862	2622	2344	2269	2004	1669	1229	929	545	243								
ALLAHABAD.	3569	3335	2972	2732	2454	2379	2114	1779	1338	1039	655	353	110							
CALCUTTA.	4036	3802	3439	3199	2921	2846	2581	2246	1797	1506	1122	820	577	467						
AKYAB.	4384	4150	3787	3547	3269	3194	2929	2594	2145	1854	1470	1168	925	815	348					
RANGOON.	4691	4457	4094	3854	3576	3501	3236	2901	2452	2161	1777	1475	1232	1122	655	307				
BANGKOK.	5055	4821	4458	4218	3940	3865	3600	3265	2816	2525	2141	1834	1596	1486	1019	671	364			
ALOR STAR.	5610	5376	5013	4773	4495	4420	4155	3820	3371	3080	2696	2389	2151	2041	1674	1226	919	555		
SINGAPORE.	6043	5809	5446	5206	4928	4853	4588	4253	3804	3513	3129	2822	2584	2474	2107	1659	1352	988	433	—

AIR ROUTE : CAIRO ~ SINGAPORE.

TABLE OF DISTANCES.

FIGURE 2.4

of action, and this has already been tried with success on DHlas on the cross desert route to Baghdad, an extra 30 gallon tank being fitted underneath each of the two upper planes.

As a basis on which to work, the maximum length of stage might be fixed at 470 miles which is that from Amman to Ramadi, and all aircraft might be provided with detachable tanks to enable them to cover the distance under normal weather conditions. The squadron personnel could be conveyed in troop carriers and spares could either be stocked at important centres or in some cases conveyed by special carrier aeroplanes.

Once all this is organised we should have the power of reinforcing many parts of the British Empire with great rapidity and the permanent garrison could consequently be reduced. As an instance of the conveyance of aircraft stores by air the following occurrence may be cited:

> In October, 1917, the Germans operating in the Gulf of Riga captured the island of Osel. It was decided to equip two seaplane bases and one land aerodrome on this island at Arensburg and Papensholm. All the aeroplane material and personnel necessary were transported by air from Angernsee and Windau, by eight Fredrichshafen twin engine aircraft. The distance from Windau to Arensburg is 70 miles about half of which is over sea.

Pursuing this theme, the author poses a question on mobility which is remarkably relevant for modern air force chiefs. Perhaps we cannot do without electric light; and an Fill being towed on road wheels behind a tender would cause heads to turn. The mechanics of achieving mobility are not so important, as they will differ markedly from the Flanders fields to, say, the far north-western expanses of Australia in the wet season. The point is to work on the problems to ensure that the inherent mobility of the air can be realised. Innovation and improvisation will remain valuable commodities.

tf) Is the Royal Air Force making serious efforts to keep really mobile? If we insist on being tied to dozens of heavy lorries it will only result in squadrons being left behind owing to limitations of road or sea transport or of landing.

Does not the present day Royal Air Force officer place too much reliance on sheds, machine tools and electric light?

We must have aeroplanes that can be transported easily on board ship and be handled and erected easily at the journey's end. We must try and do without the unwieldy aeroplane case, so [it] should not be necessary to take out engines for a sea voyage or to remove the centre section. Arrangements should be made so that aircraft can be swung from the end of a crane or derrick without damage.

Road wheels should be provided as a standard issue so that aeroplanes without their wings can be towed behind a light tender.

Squadron Commanders must work out complete schemes for carrying out their work whilst moving. Squadron personnel must learn to improvise, to make use of the means at hand and not sit down with hands folded because the exact type of split-pin required is not in store.

13. The Allotment of Available Strength

Little comment need be made on the content of this section, since it is covered more fully elsewhere. The matter of allocation of available strength has now been translated into questions of command and control. The substance has changed little over the years. Centralised command of flexible, fast assets of which there are limited numbers is a fundamental tenet of air power doctrine. Only through that arrangement is the most effective allocation of assets to best meet the prevailing circumstances likely to occur.

(a) Like cruisers, the number of available aircraft will always be insufficient to meet demands and the question of how best to allot them in order to obtain the object in view, ie, to impose our will on the enemy, will always be a difficult one to answer. It is really a matter of concentrating all available force at the place where the Government intends to bring about a decision. If the policy laid down by the Government is to win the war by action at sea, all efforts must be primarily devoted to that end. But even then gaining of air superiority will be the main essential to effective co-operation.

(b) Should gaining superiority in the air be counted as separate work or not? It seems better that it should normally, since the work may necessitate distant bombing of depots and factories. Also the strength required to gain superiority bears no relation to size of a navy or army.

(c) A problem that will frequently present itself in future is whether a given operation should be a combined one, say, Air Force and Army, or whether it should be a single operation with, say, the Air Force placed under the orders of the Army Commander in Chief.

Generally the question can be answered by geographical considerations.

If both the area from which the Air Force will operate and the Air Force objectives are the same as those of the Army, then it would be desirable to place the Army and the Air Force under one Commander in Chief, and assuming that the Government have decided to win the war mainly through fighting on the ground, this would be the Army Commander in Chief. Where the primary objectives of the two services are different and widely separated it would be desirable to make the operation a combined one, ie, to have a separate Commander in Chief for the Air Force.

Even then difficulties may arise if the separate Air Force is operating from the Area occupied by the Army. The latter will have fighter squadrons allotted to it as well as air units for such work as reconnaissance and artillery observation. Co-operation between the army air units and those of the separate air force will be most important; for instance, offensive patrols carried out by the former would often protect bombing squadrons of the latter when passing through dangerous areas. It will not be easy to arrange this co-operation unless they are all under one commander. It is difficult to lay down any definite rules on this matter

and each problem will have to be solved as it arises,

(d) It is impossible to lay down any hard and fast rules as to the number of squadrons that will be allotted to an army of a given size.

So much depends upon the nature of the operation, the enemy's armament and the topography of the theatre of operations. Generally it may be expected that for a force of four divisions or less there will be one army co-operation squadron per division, for a larger force there might be only one such squadron per corps. One or more long distance reconnaissance squadrons would be allotted to GHQ.

Modern air power doctrine would not accept the arrangement detailed above by Wrigley, where specific air assets were allocated to specific divisions, corps and headquarters. That system may have been acceptable when large numbers of aircraft were available and their capabilities were relatively limited. Now, however, when there are far fewer aircraft available, and in general those aircraft have a wide range of capabilities, centralised control is considered essential for the efficient employment of air power. In order to take advantage of the air weapon's unique ability to concentrate force rapidly, assets should be centralised, and allocated as and when required to the areas of greatest need.

Fighter squadrons will be wanted by any army both for low ground attack and for maintaining air superiority, but the number that it will be possible to allot must depend upon the degree to which superiority has been obtained in the main air fighting.

Much the same applies to the allotment of bombing squadrons. These may be urgently required in the struggle for air superiority and the Government may have decided that the war in the air is more important than the war on land. If such is the case the army may have to do without any bombers.

The next point is also covered in other documents but is worthy of note as an early succinct statement of the essentiality both of air power and the ability to conduct concurrent campaigns.

(e) Perhaps the strongest argument in favour of having a unified air force is the operational one. Having a unified service is the only means of concentrating every possible air effort in the area where the Government intends to gain the decision. If necessary, the army could be left with no air units at all should the Government mean to win the war by some naval operation, or entirely by air power.

This concentration of effort was not achieved in the War of 1914-1918. A Royal Naval Air Service squadron was attached to the Royal Flying Corps on 26th October, 1916, but there was a period before that when the squadrons at Dunkirk had not much to do while the Royal Flying Corps was overworked.

Again, in July, 1916, No 3 Squadron, Royal Naval Air Service, was formed and proceeded to Luxeuil in order to carry out bomb raids into Germany. This was at a time when every aeroplane was urgently wanted for the Somme battle. The formation of this squadron must be considered wrong since:

(i) It absorbed aircraft that otherwise would have been used at the point where the Government intended to get a decision,

(ii) It was not kept up to strength owing to demands for aircraft from the army and hence was not able to carry out its own work effectively.

14. The Specialisation of Aircraft

And now to what we might call the perennial questions of multi-role and multi-place aircraft. Again the problems that surfaced so early in the history of air power have remained topical over the years.

(a) In 1914 there was no specialisation of aircraft for different duties. Every aeroplane was supposed to be capable of carrying out any of the duties that could be allotted to the air units.

Towards the end of the war there was a tendency to over specialisation . . . but the reverse tendency is also wrong. Any attempt to design a universal aeroplane would only result in the production of a hybrid that could do nothing well.

(b) The increase in the importance attached to air fighting during the last war is very noticeable.

In 1914 there was no means of firing forward on a tractor, as the pusher was regarded as the best fighting aircraft. Small single-seaters were not regarded primarily as fighters, but as reconnaissance aircraft. There were two reasons for this. First, they were the only type of aeroplane that could make much headway in a strong wind. Secondly it was supposed that being light and unarmed they would be able to climb out of reach of the fighter aeroplane which it was thought must be a two-seater and therefore heavy, especially with the weight of its armament. The idea that the fighter must be a two-seater arose from the belief that no pilot would be able to use a gun in the air as well as control his aeroplane.

One flight of special fighting aircraft arrived in France in September, 1914. They were Maurice Farmans armed with Lewis guns. During the retreat from Mons, however, the importance of performance for a fighting aeroplane began to be recognised and it also became evident that the limits of human capacity had been wrongly gauged in peace time and that a pilot was able to do many things besides controlling his aircraft.

It was soon evident that the fast single-seater was the correct type of fighter and two of these were allotted to each squadron after the Battle of the Aisne.

And so we have the answer—except that the same argument was alive and well in the 1970s, when aircraft like the F14, F15, F16 and F/A-18 were coming into wide service, albeit in differing roles. The attraction of the two-seat fighter was still the problem of easing pilot workload in a 'target-rich' environment.

> The policy of having complete squadrons of fighters was first advocated by Sir David Henderson. By the summer of 1917, forty single-seater fighter squadrons were considered necessary for the Royal Flying Corps on the Western Front and an efficient fighting aeroplane was put down as the most important requirement . . .

(c) Although as already stated it may be possible to produce aeroplanes embodying lessons learnt during a war, before that war is ended, a long period must elapse between the submission of demands and their fulfilment.

This emphasises the importance of foresight. During the War of 1914-1918 time was in our favour, but this may not be the case in the next war. We may not be able to wait next time, hence the necessity of looking forward in peace and keeping touch with every scientific development in order to ensure that nothing is neglected which might lead to improved equipment for our squadrons or to better methods of operation.

(d) It is worth considering whether with our present size of staff, officers have sufficient time to spare from their routine duties for the purpose of calmly thinking out such problems.

Looking back some ten years, there seems no reason why most of the air development that took place during the war should not have been foreseen if there had been a small body of men, gifted with imagination, in close touch with scientific and mechanical development and having enough time for thought.

Many people realised, as far back as 1911, the importance that air fighting would play in future wars, but we never carried this idea through to its logical conclusion and had aeroplanes designed for the purpose. Again in September, 1912, a report was sent to the War Office drawing attention to the great value of air observation for artillery fire and adding that it could never be really effective until all aeroplanes doing this work were fitted with wireless. But only two of the aircraft that we took across in August, 1914, were equipped with wireless apparatus. I feel that the real reason for this lack of progress lay in the fact that the officers who should have been responsible for development in the years before the war were too fully occupied with their ordinary duties, too busy coaxing aeroplanes up into the air and trying to teach pilots to bring them down again to the ground without breaking their necks, that they had but little real opportunity for thinking things out to their logical conclusion, and indeed hardly thought it their business.

The result of equipping the 1914 squadron in the same way as the 1918 squadron needs no comment.

We must make every effort to equip the 19 hundred and 'X' squadron as far ahead of those of our enemies as the squadrons in 1918 were ahead of those of 1914.

(e) Technical development in peace must progress slowly because it is essential to economise and thus to make certain that a new type of aeroplane or engine is thoroughly satisfactory before placing orders for bulk production.

The policy of the Air Ministry since the war was based on the Cabinet decision of 1919 that no big war need be considered likely before 1926. It was decided, therefore, to devote all funds available during the first few years after the armistice to experiment rather than to new equipment. By this means we should be more likely to have really good aeroplanes and engines ready to go into production by the time another big war was a possibility, whereas had all the money been spent at once on production orders, the squadrons might have been slightly better equipped for a few years whilst all was peaceful, but there would have been no aircraft showing real substantial progress ready for them when the prospect of war became close.

Again, the preceding statement reflects a sophisticated appreciation of warfare. If research and development and operational analysis are not supported in times of peace, armed forces are likely to find themselves inadequately equipped should war occur. Further, indigenous 'R & D' and 'OA' capabilities are essential both to achieve any degree of national defence self-reliance, and to develop systems specific to a country's special needs. Air forces are particularly sensitive to that kind of support because of their highly technical nature.

The stages in the peace development of a 'New Type Aeroplane' are shown in Figure 2.5.

15. The Importance of Civil Aviation and the Aircraft Industry

(a) At present it appears somewhat optimistic to rely to any great extent upon civilian aeroplanes for reinforcing the Royal Air Force.

There are not more than 50 civilian aircraft in use in England that could be of value for war and even these are of many different types.

An attempt is now being made to develop an aeroplane that can be used for civil transport in peace and yet be a useful bomber in war . . .

Civil aviation centres are proving of value for the purpose of training reserve pilots, but the chief value that may be obtained from civil air transport seems to be in the development and maintenance of air routes. If air transport companies can be induced to operate along routes that are likely to become of strategic importance in war, they may prove of enormous benefit.

Aerodromes forming stages along these routes would be kept in order, supplies and stores would gradually accumulate and a mass of data regarding the flying conditions would be collected.

FIGURE 2.5

Sequence of Procedure and Time Taken to Produce a New Type Aeroplane.
(Peace time).

Detail	Time Taken Months.	Total Months
1. Requirements to be fulfilled having been decided by the Air Staff, the detailed specification is made out by D. of R. and issued to designing firms.	1	1
2. Firms send in their proposed designs to D. of R.	3	4
3. The various designs are studied, the two best are selected and orders placed for 2 or 3 experimental aircraft of each type.	2	6
4. The experimental aircraft are built and delivered for test at an experimental station	12	18
5. The aircraft is tested for performance, etc., and any necessary technical modifications are made.	2	20
6. The experimental aircraft are sent to a service station, tested for service use and any necessary modifications made.	1	21
7. One of the two types is selected and a small production order is placed embodying all the modifications made to the original design.	1	22
8. The production aircraft are delivered and sent to a squadron for prolonged tests under service conditions.	9	31
9. Production aircraft are tested out and further modifications agreed upon.	6	37.
10. The master tracings are brought up to date and are filed, together with details regarding method of production, ready for use when further production orders are necessary.	1	38

In case of necessity the procedure could be curtailed by increasing the number of aircraft ordered under 3 above, or carrying out tests under 5, 6 and 9 simultaneously.

In war 2, 3 and 9 could be cut out and the time for 4, 5 and 6 reduced, but it is doubtful if the period between the formulation of requirements and the commencement of delivery of the new type of aeroplanes in quantity will ever be less than 12 months.

Consider what would be the value of such a route running from Egypt to Australia via Iraq, India and the Malay States.

(b) A flourishing aircraft industry is an essential for rapid expansion. At present the orders from civil air transport companies are insufficient to assist constructors to any great extent and reliance has to be placed mainly on Royal Air Force requirements. The policy of the Air Ministry has been to give sufficient experimental orders to enable certain selected firms to maintain their designing staffs. It was realized after the Armistice that it would be impossible to find work for all the aircraft constructors and that some would have to turn to some other form of activity, but every effort was made to enable the best established and most up to date firms to continue designing and building aeroplanes and engines. It must be remembered that a designing staff does not consist merely of one individual, but of a small body of designing draughtsmen who can command high wages in any branch of engineering.

(c) An aircraft industry cannot be developed quickly. It has recently been calculated that in three months from the date of the order, England could be turning out aeroplanes at the rate of twenty a day. It would, however, take longer to produce aeroplane engines in large numbers . . . To ensure rapid production in emergencies stocks of raw materials should be stored at the various factories and complete sets of working drawings of every type of aeroplane, engine and accessory that will or may be required in war must be kept at the Air Ministry ready for duplication.

16. Power of Aircraft to Concentrate Rapidly at the Decisive Point

(a) Concentration is obtained by air forces with comparative ease owing to the power that aeroplanes possess of operating from different aerodromes either directly or by spending the day on some landing ground.

Foresight is necessary in the preparation of aerodromes in order to gain full advantage of the mobility of aircraft and to have power of concentration. This was fully xealised by Foch in 1918, and he had a great number of aerodromes prepared all along the front.

(b) There is also the possibility of keeping squadrons mobile by quartering them on railway trains. The Germans had a bombing squadron so organised as early as September, 1914 . . .

That procedure has been used in the late 20th century to make ICBMs more mobile and, therefore, more difficult to target.

(c) The French on 15th May, 1918, formed a Division Aerienne in order to facilitate concentration of aircraft at the decisive point. It was moved about the front as required and took part in all the battles in 1918 . . .

17. The Necessity for the Offensive in Air Operations

Suitably updated, the following could be usefully taught to the student of air operations in any age. However, it is worth remembering that the author is speaking from the airman's viewpoint, not that of the politician. Implicit in his discussion of the offensive is the recognition that an overtly aggressive approach may not be expedient from a national perspective at all stages of tension or conflict. It may also be the case that an offensive cannot be mounted at various stages of a campaign.

(a) A fleet can take refuge from another stronger fleet in harbour. One army can shelter itself from another behind an obstacle or a covering force. The defensive side in each case merely awaiting a favourable opportunity to attack. The only way in which an air force can assume a defensive attitude is by removing itself out of reach of the enemy air force, in which case it will lay a large portion of its own country open to air attack. Such a course of action is unthinkable. Strategically, therefore, an air force must act offensively.

Now consider the tactical aspect. Owing to the power of movement in three dimensions, the possibility of advance from any direction, the difficulty of seeing aeroplanes in the air, and accidents of wind and cloud, it is impossible to keep off hostile aircraft by adopting a waiting attitude. The only method is to seek out the enemy and attack him.

Radar has altered the detection and interception equation to some extent but the principles still apply. It is very demanding on aircraft, pilots and ground support to mount continuous combat air patrols. Further, continually reacting to the enemy's actions, rather than taking the initiative, can undermine morale.

Then again consider the difficulties of defending a place near the frontier. If we wait up in the air for the attackers to come, we shall probably be running out of petrol by the time they do arrive even if we are successful in intercepting them. If we remain on the ground, shall we get enough warning to enable our aircraft to get off the ground and up to a sufficient height to attack the enemy?

This is a matter of calculation.

Suppose the place to be defended is 30 miles from the frontier, ie, 30 miles from our advanced listening posts, then we cannot get warning of the enemy's approach until he is within, say, 35 miles of his objective. This distance he could cover in, say, 20 minutes. If he is flying at 15 000 feet will this 20 minutes warning be sufficient for the defending aircraft to reach him?

It is questionable whether the distance of London from the coast is enough to enable adequate warning to be given to defending aircraft unless the latter consist of aeroplanes having a very rapid rate of climb.

It must be remembered that it will not be sufficient to bring down attacking aircraft on their way back. They must be stopped before they

have dropped their bombs at their objectives. Finally, adoption of the offensive is the only way by which full use can be made of the mobility of aircraft.

When operating with the other services, the air must continue to be offensive even though the other services may be on the defensive . . .

(b) The story of the operations at Verdun in 1916 is instructive in this connection. Both French and Germans then resorted to direct protection for their artillery aeroplanes and the French were able to do what and go where they liked.

Later on many new pilots joined the French and gradually a demand arose for direct protection of close reconnaissance aircraft, the French were induced to adopt defensive methods and they at once began to lose air superiority and consequently were only able to carry out very little day reconnaissance whilst their artillery aeroplanes worked from well inside their own lines. Later again, mainly through the efforts of Commandant du Peuty, the French went back to the offensive and regained air superiority and with it the advantages they had had previously.

(c) The following are some notes by Commandant du Peuty on the lessons of the Verdun operations:

(i) All fighting aircraft in an army should be grouped under one command, though not on one aerodrome.

(ii) Fighting squadrons should preferably live on or near the aerodrome of the Corps squadrons in whose sector they carry out offensive patrols, so as to establish camaraderie.

(iii) The organisation of an air force must be flexible.

And it seems he longed for an air-to-air missile

(iv) Long range firing will be necessary for future fighting in the air. He concluded; 'It is by combat, by constantly attacking, by continuous offensive patrols, that French Aviation has succeeded in gaining superiority.'

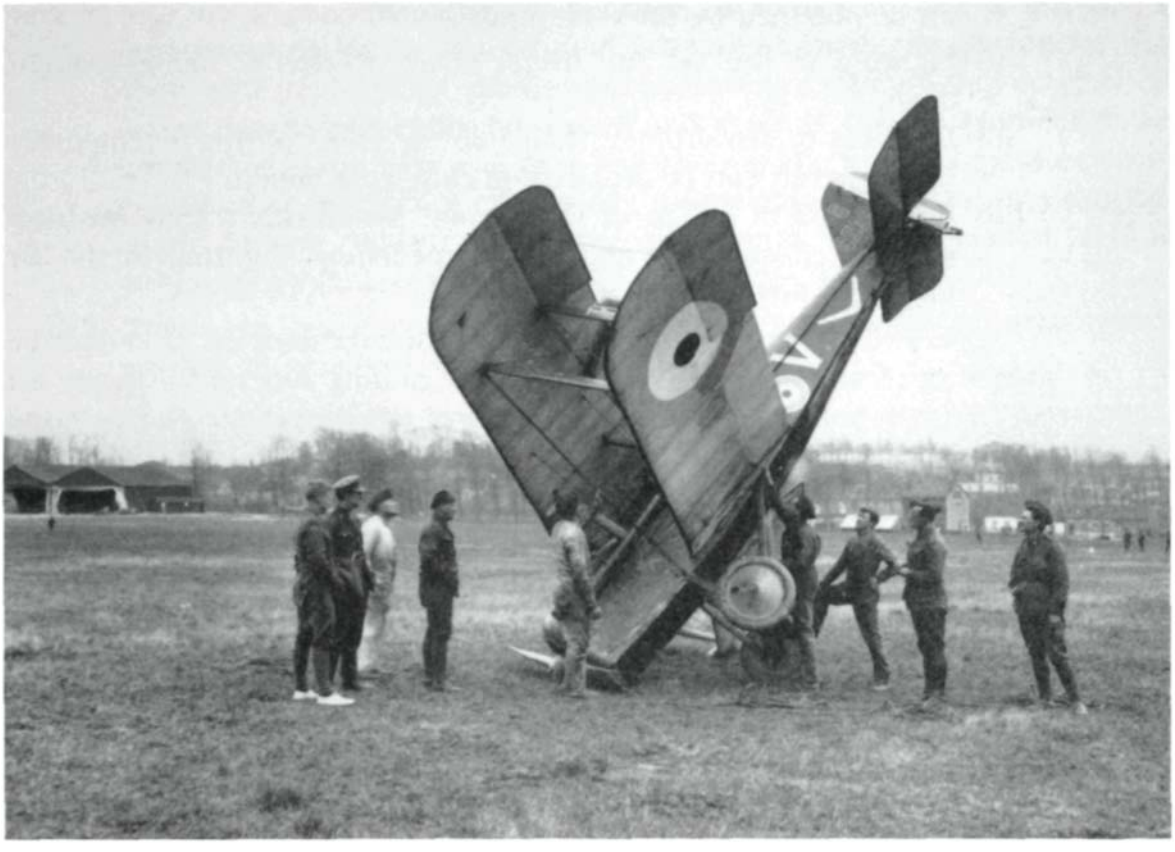
(d) With regard to (i) of du Peuty's notes:
At one time there was a group of fighter squadrons at Bar le Due. It was broken up on 19th March, and the squadrons distributed to sectors of the Verdun front.

This gave poor results as continuous offensive patrols were not obtained, co-ordination was difficult and at times there were too many aircraft in the air whilst at other times the front was clear.

The fighter squadrons were therefore reformed into a group under one commander, though not concentrated on one aerodrome.

(e) The following extract from a memorandum by General Trenchard dated 29th September, 1916, is also worth remembering :

The policy which has enabled us to gain and to keep the predominance in the air which we now enjoy is that of seeking out and fighting the enemy over his own aerodromes. It is of no use to fight him on the front line where,



4. Trying to teach pilots to bring them down again to the ground without breaking their necks' (p. 55). An overturned SE5 of No. 2 Squadron, AFC, at Savy in March 1918. AWM.

> no matter how many machines we put up against him, he can still interfere with our work and carry out his own. In other words, an offensive policy, as against a defensive one, is essential.

18. Methods of Gaining Superiority in the Air

(a) Air superiority may be defined as a condition necessary to permit of a comparatively free employment of an air force and as being manifested by the constant ability to maintain the air offensive.

Modern definitions vary only slightly. Some eschew the term 'superiority' in favour of degrees of 'control' of the air, a term more amenable to qualification. Wrigley would have been comfortable with this notion, as he has just expounded at length on the similarities between sea and air strategies; control was of course a favourite concept of Mahan's. Current definitions tend to take a more even-handed joint view, a position tenable now by virtue of the more firmly established *bona fides* of the air arm. Thus the definition now might read: '. . . free employment of the armed forces'.

Today's theorists would also agree with Wrigley that air superiority is a 'necessary' condition for success in all operations. That superiority may have to be fought for, or, in the absence of an enemy air capability, may exist in a *de facto* form. How it is achieved does not matter: it is the possession of air superiority that counts, as it is a condition which permits the other air and surface campaigns to be prosecuted free from air attack.

It can be obtained by three methods:

(i) Fighting in the air and moral effect of aircraft being brought down,

(ii) Bombing of aerodromes. As a rule the effect of this is temporary since aircraft can be replaced quickly from depots,

(iii) Destruction of means of production. Necessarily a long business and the effect is not apparent immediately. Fighting in the air may be a first step towards it.

Superiority in the air must be fought for continuously. It cannot be gained once and for all. Hence, although gaining superiority in the air may be counted as a separate function of the Royal Air Force at the beginning of a war, a navy or an army will always have to have a certain number of fighter squadrons, apart from any required in the case of an army for attack of ground targets.

Victory in the air cannot be gained, as on land and to a certain extent at sea, by getting round the enemy and cutting him off from his base as an air force in action is not tied to a definite line of communication or line of retreat. There was a great difficulty, for instance, in cutting off any German bombers on their return from England.

Adequate means for rapid replacement of wastage in personnel as in aeroplanes is a very important factor in gaining and maintaining air superiority.

The structure of the rest of this section does not strictly follow **the** three 'methods' listed above. Point (b) relates to fighter operations, **while** the **remainder** discuss various aspects of bombing operations by both protagonists.

(b) Fighting in the air may confer local and temporary superiority as on the Somme, but this does not last and the tables were nearly turned by the following spring. The possibility of this was fully realised at the time it occurred owing to the Germans getting a new chief of their air service and their production of new fighting aircraft.

In September, 1918, in Palestine we obtained complete superiority in the air by fighting and bombing of aerodromes but in this case the Germans had great difficulty in replacing wastage. Even for overhaul, their engines had to be sent all the way back to Germany. Local superiority was obtained for a short period by the Germans over the forest of St Gobain whilst installing their long range gun in March, 1918, in order to prevent the French seeing the work being done.

(c) Fighters can only operate effectively by day but bombers can attack the opposing air force by night as well. In some ways then it would appear that bombing aerodromes is a more effective way of attacking the enemy's air force than seeking him in the air, but it is doubtful if any amount of bombing would permanently cripple an air force as long as the supply of aircraft from depots and the trade was left uninterrupted.

One of our squadrons, for instance, on 15th April, 1918, lost all its aeroplanes owing to the German advance through the Portugese, but they were replaced by next evening. However, temporary cessation of an activity might easily be caused and there is the moral effect to be considered. Also there will be a reduction in the work that can be done by pilots or mechanics on the day following a night raid or even the alarm of one, whilst much time and energy will be wasted if it is necessary to shift aerodromes.

(d) There are many lessons to be learnt from the attacks on aerodromes carried out during 1914-1918 . . .

Interesting details of air attacks are now given. Only those which do not repeat the content of Document 13 have been retained here.

(iv) The following is an extract from Weekly Summary of Aeronautical Information (HQ, Royal Air Force) dated 29th September, 1918, on the effect of our bombing of hostile aerodromes:

> During August and September, the aerodromes at Boulay, Buhl and Morrange have been continuously bombed. At first, the hangars destroyed were gradually rebuilt, but during the last half of September the enemy has given this up, and has, on the contrary, taken down further hangars in order to disperse them.

The Independent Force made 160 attacks on hostile aerodromes which is about 30 per cent of the total attacks made on all objectives. Of these attacks, 57 were made by day and 103 by night. As far as statistics are available, it appears that we lost on an average two-thirds of one aircraft wrecked and missing per attack, whereas the Germans lost an average of two at every attack we made, an advantage in favour of the attacker of 3 to 1. This takes no account of the moral effect.

(v) Our depots in France were not often bombed. The Royal Naval Air Service Repair Depot at Dunkirk suffered severely on the night of l/2nd October, 1917, many Rolls Royce engines being destroyed, as well as 23 fuselages without engines and 6 complete aircraft. No 1 Aeroplane Supply Depot at Marquise was bombed at night in the summer of 1918 and though several casualties were caused to personnel, the material damage was small.

In March, 1918, No 2 Aeroplane Supply Depot at Fienvillers was bombed at night and several aeroplanes damaged. Aircraft, some 70 in number, had been flown away the previous afternoon. Later in 1918, the shed that had contained all the engine spares of No 1 Aircraft Depot was practically destroyed by night bombing, but the last lorry load of spares had left the day before.

During the war, sufficient attention was not paid to laying out the depots so as to minimise the risk and effect of hostile bombing, and the last two cases show that the Royal Air Force depots were very lucky to escape as lightly as they did.

(e) There are various precautions which can be taken against aerodrome attacks:

(i) Dispersal. The ideal would be to have not more than one squadron per aerodrome, but this will generally be impracticable.

(ii) Aerodromes should be sited so as to be difficult to find. They should not, for instance, be near a canal or river, nor on a line that hostile aircraft would naturally follow on their way to some important target.

(iii) Disposition of sheds. They should be scattered and not in any regular formation.

(iv) As few aeroplanes as possible to be kept in each shed,

(v) Aerodromes to be camouflaged and dummy aerodromes made.

(vi) The ordinary routine precautions must also be taken such as putting out lights, sand-bagging sheds, and arranging dugouts for personnel. In this connection it may be noted that the position of a camp in a wood at Ochey was in 1918 given away by the light of an incinerator.

(vii) There should be an AA defence scheme for aerodromes including orders for the event of hostile aircraft landing on an aerodrome in order to destroy its contents.

(f) The following is a paper issued from Headquarters, Independent Force on 5th August, 1918:

Signs are not lacking that the enemy intends to take counter bombing measures against the activities of the Independent Force. This has been foreseen, and will be met. In addition to such protective measures as are possible against hostile bombing it only remains to fight out the bombing battle. This can only be done by carrying out bombing operations more extensively and more determinedly than the enemy. The enemy's objectives will undoubtedly be the aerodromes of our squadrons. In order to ensure complete success our operations both by day and by night *must* continue. Until the enemy has been beaten in the bombing battle it may become necessary to allot a large proportion of our forces to the exclusive attack of aerodromes.

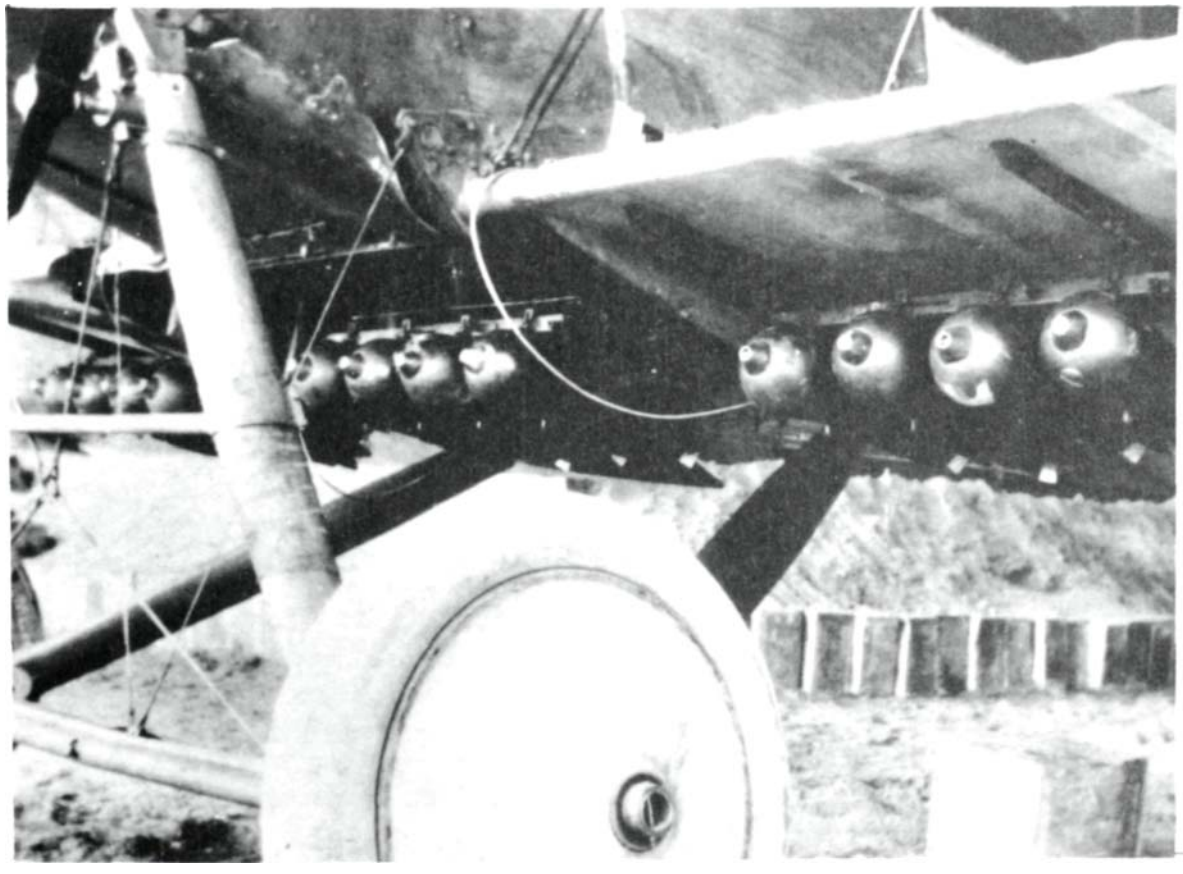
That losses of machines by hostile bombing are inevitable has been recognised. The GOC has foreseen, and is quite prepared to meet this contingency, and in this connection it must be borne in mind that the balance of power is all in favour of ourselves. Our facilities in replacing casualties to machines are vastly greater than those of the enemy. It is well known that the German is experiencing difficulties in maintaining the strength of his squadrons in aeroplanes at the front. At the same time every precaution that is possible must be taken to protect aircraft. It is extremely unlikely that invisibility alone can achieve this end, and the fact of placing hangars inside a straight edged wood is in all probability of little use in protection from hostile attacks. The German will inevitably find the aerodrome, and if he does not see the sheds in the open he will take it for granted that they are in the wood and will bomb it accordingly as we did at Havrincourt with marked effect. It may even be that it is an advantage to the Hun [Germans] as the wood will be easy to see at night.

The question of the protection of the personnel is another matter and of vastly greater importance than the protection of machines which can be

replaced. Deep narrow trenches must be provided by all squadrons for all their personnel. Very explicit orders must be issued in each squadron as to the measures to be adopted in the case of hostile raids. If these instructions are carried out thoroughly it matters little if the huts are blown to bits. It is realised that these precautions entail a certain amount of discomfort but at the same time bombing will not take place so frequently as to affect it to any degree, and if our bombing attacks are the more vigorous and the more frequent, the enemy suffers greater discomfort than our men.

The moral factor must ever be to the front in the minds of officers and other ranks. The damage done by our bombing operations will be revealed to a certain extent by photography, and at varying periods after the operation has been carried out, through the agency of spies, repatries, etc. These reports and photographs should invariably be brought to the notice of the squadron personnel in order that they may realise more effectively that the boot is not on one leg only. It is the duty of Wing and Squadron Commanders to maintain the high moral standard at present existing in squadrons, both in the ranks of their pilots and of the mechanics. Squadron Commanders must realise and foresee that the morale of their personnel may be affected by the bombing attacks of the enemy. It must be constantly pointed out to the squadron how best to meet it, and how if our aeroplanes get off the ground first, and get to the German aerodromes first, the enemy will be prevented from leaving his aerodromes.

Up to date, with the exception of the large sheds at Ochey, on no occasion has the enemy's bombing operations ever succeeded in making the Royal Air



5. Twelve 20 lb bombs make up the load for a Martinsyde about to go on a strike mission. AWM, donated by Wing Commander E. G. Roberts.

Force abandon an aerodrome. The same cannot be said of the Hun. Instances of this are the aerodromes at Ascq, Lezennes, and others.

In conclusion it only remains to be said that in all our operations it is important to be first in the field. Initiative in the methods of attack on the aerodromes should be freely surrendered to Wing and Squadron Commanders, and suggestions of Flight Commanders and pilots should be considered. The importance of machines leaving the ground before the enemy makes his attacks is again insisted on. In addition to increasing the difficulties of the German it minimises the possible damage to machines.

(h) I shall now deal with passive means of defence such as AA guns and balloon barrages.

The main effects of the former are:

(i) Fast aircraft have to be used by day and so only small bomb loads can be carried,

(ii) Aircraft are forced up higher, say 15 000 feet, during the last war.

(iii) The aeroplane personnel is somewhat harassed and so accurate aiming is more difficult.

The effect of balloon aprons is chiefly moral, but there are records of a few aircraft being brought down, viz, a Handley Page at Bruges, an FE of the Independent Force near Treves in 1918, a French aeroplane at Differdange in 1916 and a German aeroplane near Longueville. The FE had been damaged previously.

19. Bombing Operations

(a) There is a general tendency to overestimate the radius of action of aeroplanes, and it is wrong to base calculations on the performances obtained on experimental tests unless the correct allowances are made. Apart from wind, deductions must be made for the time taken to get into formation, to reach the necessary height, and for the reduction of speed when, say, six aircraft are flying together. Then allowances must be made for time spent over the target and for possible fighting during the journey, added to which it must be remembered that it is putting a very hard strain on pilots to expect them to arrive back with only five minutes more petrol left in their tanks. [See Figure 2.6]

As an instance of this, raids from Boisdinghen to Gontrode by DH4s used to take $2^{x}k$ to 3 hours from start to finish although the distance between the two places is only 65 miles. Raids on Mannheim by DHls took 4 hours, although the distance is only 120 miles. Pilots must be taught the value and objects of long distance bombing and must realise the military importance of a target as apart from its apparent material value. They do not always appreciate that one bomb on a railway may at certain periods be of more value than twenty in the middle of a town.

Aircraft used for long distance bombing must be suitable for the purpose, otherwise the morale of pilots will drop.

(b) There is frequently much discussion as to the relative efficiency of day and night bombing.

FIGURE 2.6

Service Radius of Action.
(Furthest point to which a formation can operate from its aerodrome under service conditions).

D.H.9a. with Napier Lion engine. Petrol capacity 107 gallons.
Theoretical duration and radius of action reduced by 27 per cent. at 10.000 feet and by 30 per cent. at 15.000 feet.
Based on experiments carried out at the R.A.E. to ascertain the petrol consumption at different heights and air speeds.

Height.	10.000 feet.				15.000 feet.					
Airspeed m.p.h.	90.		120.		90.		100.		110.	
Endurance, hours.	4·8		3·25		4·5		4·0		3·7	
Direction of wind.	In direction of course.	At right angles to course.	In direction of course.	At right angles to course.	In direction of course.	At right angles to course.	In direction of course.	At right angles to course.	In direction of course.	At right angles to course.
Wind velocity 0.	215	215	195	195	210	210	205	205	205	205
Wind velocity 25 m.p.h.	200	205	185	190	190	195	190	195	190	195
Wind velocity 50 m.p.h.	150	180	160	180	140	170	150	175	160	175
Wind velocity 75 m.p.h.	65	120	120	150	65	115	90	135	110	145

Bombing by day can be more intense because aeroplanes can operate in formations of 20 aircraft or more and it is also more certain. On the other hand it usually suffers more casualties. By night aeroplanes can miss their objective, be mis-led by dummy lights and are more dependent upon weather. To be really effective, bombing must be continued both by day and by night. Assuming formation flying by night to be practicable, it has the advantage of rendering the work of sound location very difficult, because the ends of the base may range on different aircraft. On the other hand if aircraft come singly the effect is spread over a longer period and so more disturbance is caused to rest and work.

(c) The following figures of losses over the enemy's lines for the Independent Force may be of interest:

Day bombers	DH4	1 Aircraft in 3 raids
	DH9	1 Aircraft in 2.3 raids.
	DH9a	1 Aircraft in .5 raids.
Average by day		1 Aircraft in 2.4 raids.
Night bombers	FE2b	1 Aircraft in 6 raids.
Handley Page		1 Aircraft in 9 raids.
Average by night		1 Aircraft in 8 raids.
Total Average		1 Aircraft in 3.7 raids.

In No 99 Squadron, the only one for which full figures are available, all the losses over the enemy lines were caused by hostile aircraft, none by AA guns.

The above figures take no account of aircraft that were damaged but managed to recross the lines.

20. Effect of Bombing

(a) From the experiences of the War of 1914-1918 certain general principles may be deduced:

(i) The further the objective from the battle area, the greater the moral effect of bombing,

(ii) Once an industrial population has been well bombed, the anxiety as to whether an attack is likely to take place will by itself prove demoralising,

(iii) In order to get full effect, bombing must be continuous, but this may be difficult owing to:

(1) The fact that the enemy will concentrate means of defence at the objective.

(2) To get adequate result from bombing in the case of disciplined troops, a certain proportion of casualties must be produced, otherwise the moral effect will drop . . .

The original essay now embarks on a long description, covering several of Wrigley's closely written pages, of the effects of bombardment as reported by various observers. These include such widely differing sources as German prisoners, a British Air Ministry paper, and English shipbuilding and munitions factories. The purpose is to provide an aggregate of evidence as to the effectiveness of sustained bombing, a purpose which is well accomplished. Wrigley is careful to give examples drawn from both sides of the English Channel. As much of the material repeats that which appears in Documents 4 and 13, it has been excluded here.

PART III. ACTION

21. Examples of the Application of the Principles of War to Air Operations

Let us now consider some instances of the application of the principles of war to air operations.

(a) The Objective. As has already been indicated it may be possible for an air force to attack its ultimate objective ie, the will power of the enemy nation, before destroying the hostile air force. But as in the analogy of a navy attempting to control sea communications, an air force will often be unable to carry out its ultimate object efficiently unless it has put the enemy air force out of action. It has been pointed out that the Independent Force carried out a series of attacks on the enemy aerodromes before proceeding to the Rhine towns.

As in the case of a navy or an army, resolution in adhering to the main objective is of primary importance and it is well known how the present CAS was undeterred in the pursuit of his object by the heavy losses incurred, eg, when No 99 Squadron on 31st July, 1918, lost 7 out of 9 aircraft in an attempted raid on Maintz or when No 104 Squadron lost 7 out of 12 on 22nd August, 1918, in a raid on Mannheim.

6. The effects of 'Archie'. Anti-aircraft shrapnel bursting near an AFC RE8 near Hazebrouck, 17 April 1918. AWM.

(b) Offensive Action. The necessity for this was made evident at Verdun in 1916 and the results of it clearly shown on the Somme later on in the same year.

The examples for the next principle, the important matter of surprise, are fascinating windows into some of the tactics and procedures developed during the Great War.

(c) Surprise. This may be brought about by air forces in various ways:

(i) By new types of aircraft. The Bristol Fighter was a complete surprise for those of the Huns who mistook it for a BE. New types should be kept away from the enemy till a decisive time arrives for their use. This again is merely an application of the principles of concentration only applied to time instead of place.

(ii) By new equipment, eg, the Le Prieur rocket for the attack of kite balloons, first used on the Somme on 25th June, 1916.

(iii) By new tactics. This may be brought about by new types of aircraft or new fittings. The Fokker Triplane made use of its power of a very steep climb in its fighting tactics. The Nieuport gun mounting on the top plane enabled fire to be brought to bear from almost directly underneath a hostile aeroplane. Captain Ball had a proposal for mounting a downward firing gun on an SE5 so as to introduce a new method of fighting. At one time kite balloons were successfully brought down by threatening them from above, and having an aeroplane flying low to attack them from underneath whilst they were being hauled down.

(iv) By new methods. Group Captain Holt made use of a new method in concentrating several squadrons over some point 20 miles or so on the enemy's side of the lines, and then making a sweep back with the whole force together. Group Captain Ludlow Hewitt introduced a new method in the 10th Brigade in the summer of 1918, using a special formation for the object of attacking some definite enemy establishment, such as an aerodrome or railway station. The formation was rather like a curtain being drawn across the enemy's country with its lower edge forward and practically sweeping the ground. The lower edge of the curtain was composed of small units of Camels working either singly or in threes. These were very low down and directed most of the attention to enemy anti-aircraft defence as much as possible. Immediately above them came the heavy bombers, which flew and bombed at a height of 1000 to 3000 feet. Above them again the diving scouts, namely SE5s to come down quickly to the assistance of the bombers, if necessary. Above them again usually more SE5s and the top of the curtain was composed of Bristol Fighters in two layers.

Each layer flew behind the layer immediately below it in order to protect it from attack from above and behind, and the Bristol Fighters on top provided their own stern defence.

(d) Concentration. The battle of Cambrai is an example of this.

The 3rd Brigade was reinforced by three squadrons before the battle and were assisted during the battle by the Army Wing of the 1st Brigade and squadrons of the 9th (GHQ) Wing. By this means the Royal Flying Corps were able to concentrate 432 aircraft against the German 246 in the Cambrai area, although on the whole front the British were inferior in numbers . . .

The second example of concentration also demonstrates the value of both deception and imagination. There was, and still is, a temptation not to attribute this latter quality to an enemy, particularly this one: but it was obviously and most effectively present on this occasion.

The Germans for their March offensive in 1918, concentrated over 100 squadrons in the area east of St Quentin. They also introduced the factor of surprise on this occasion. Many squadrons were withdrawn from the armies that were not to take part in the attack, but the squadrons that remained did an increased amount of flying and of wireless telegraphy so as to maintain the previous sum total of activity, and spread out so as to leave no aerodrome unoccupied. In addition reserve aeroplanes were brought up to the front. Air units massed for the attack were kept concealed, no hangars or tents were erected and the personnel had to become acquainted with their new front by making use of the aeroplanes of units already on the spot.

(e) Economy of Force.

(i) During the war of 1914-1918, the policy of the Government was to win victory by means of fighting on the ground, hence all other requirements had to be subordinate to the needs of the army.

Thus no squadrons were to be employed for separate work, ie, long distance bombing of Germany until sufficient had been sent out for the army to ensure:

Maintenance of air superiority.

Adequate reconnaissance, including observation of artillery fire.

Direct assistance by bombing and attacks by machine gun fire.

But once these requirements were met additional squadrons as and when available were not to be employed on army work but to be used to attack Germany by other methods. To quote from a paper written at the time:

> Once our air force is strong enough to hold and beat the German air force, the extra effort on the battle front of still further bombing and fighting the Germans in France would not turn defeat into victory. Increasing the strength of an arm beyond what is necessary to ensure the superiority of that particular arm generally means that the extra forces are not used to the best effect, but only to reduce the effort to be made by those already employed. Any machines available over and above the number required to defeat the German air force on the battle front would be better employed in attacking Germany.

> It would have been a waste of available energy to allot more squadrons for work with the army than it could usefully employ, and the surplus was therefore used to carry out other operations calculated to lower the enemy's resisting power . . .

Earlier, the author had identified the dependence of air power on its bases. This element of security is highlighted under the next heading. Since then it has assumed an even greater importance not fully indicated by the brevity of these paragraphs. The first sentence appears to contradict Wrigley's earlier statements as to the purpose of air strategy, namely, to help enforce the national will. In this context he clearly is alluding to the primacy of control of the air in what we now call the three campaigns, namely, control of the air, air bombardment and support for combat forces.

(f) Security. The main object of the offensive policy adopted by the Royal Flying Corps and the Royal Air Force on the Western Front was to defeat the enemy air force and thus by preventing him carrying out reconnaissance, artillery observation and bombing, to obtain security for the army, and for our own artillery and other aircraft.

As has already been mentioned, there was a tendency to site the aircraft depots too far forward and to neglect the possibility of aircraft bombing in their lay-out, in fact a neglect of the principle of security.

(g) Mobility. By October, 1918, it became evident that there was every probability of the Germans on the Western Front being completely defeated. If they could be heavily bombed whilst retiring through the bottleneck in the neighbourhood of Liege, there was a good chance of converting their retreat into a rout and completing the work done by the army. At the same time the air menace to England had largely decreased. It had become therefore of more importance to attack the German army than to protect the home country against the moral effect of hostile bombing.

It was therefore proposed to move the following home defence squadrons from England to France as soon as the Germans had retired to the line Ghent-Mons-Maubeuge-Avesnes-Hirson-Rethel:

7 Camel squadrons.
3 Bristol Fighter squadrons.
1 BE 12 squadron.

All arrangements were made to bring these 11 squadrons over in three consecutive days. As the stages of the journey were within easy flying range, the movement could be effected and the squadrons be in action in their new front, quicker than any other form of reinforcement.

Another instance of mobility would be the allotment of alternative objectives to long distance bombing squadrons so that if unable to get home on one, they could attack another. A rigid form of air fighting tactics precludes the full use of mobility,

(h) Co-operation. The use of aeroplanes to drown the noise of tanks moving up for the attack of 8th August, 1918, is an instance. So also is the

work of the Independent Force at the time of the American attack on the St Mihiel salient in September, 1918. The attack commenced on 12th September and lasted till the 15th, and the Independent Force co-operated by bombing railway junctions near Metz, thus delaying the movement of German reinforcements to the threatened spot.

The principal efforts were directed against Ehrang, Metz, Sablons at the south end of Metz, and Courcelles, and a total of 35 tons of bombs was dropped in the operations. It is known that traffic was delayed on several lines for periods of 15 to 24 hours and at one time 94 locomotives were imprisoned in an engine shed through the destruction of a turn-table. Other instances of the application of these eight principles have been suggested earlier.

22. The Changes Effected by Aircraft on Operations of War

(a) As an instance of the changes effected by air power on problems of war, let us consider the recent operations at the Dardanelles . . .

It may be assumed that it was necessary to garrison Constantinople, consequently the line of communication by sea to that place had to be maintained and this necessitated holding the Asiatic shore or at any rate maintaining a footing there. This was effected by holding an area round Chanak . . .

Imagine the case where we had no aircraft.

The Turks could have accumulated guns and ammunition, unknown to us, on the line Edremid-Panderm; they could have used lorries along the northern coast road by night, because the fire from our ships' guns could not have been observed with sufficient accuracy to break down bridges on that road or to prevent their repair. The Turks could also have improved the mountain paths and then have dribbled ammunition over them and so have gradually built up stocks on the line Bairamich-Bigha, also unknown to us, and finally have advanced to the attack of our trench line with adequate artillery support.

Now take the actual situation where we had practically unchallenged air superiority. Reconnaissance would have indicated the points on the line Edremid-Panderma at which the Turks were accumulating stocks of munitions, and would thus have disclosed the probable lines along which they proposed to move their supplies forward. Aeroplane observation for ships' guns could have ensured destruction of the bridges on the northern coast road and have rendered their repair most unlikely. It is doubtful if any supplies could have been moved along this road.

Any activity on the mountain paths could have been observed and, if not actually stopped, could have been so delayed, that the dribbling across of ammunition would have been a matter of several months, not of a few weeks. In fact the existence of air power completely changed the whole situation.

(b) As another instance, in this case a hypothetical one, imagine a situation in the Middle East, as in 1916-17 . . . The enemy operating in Iraq and Palestine would depend for their lines of communication almost

entirely on the railway from Afium Kara Hissar to Aleppo and thence to Nisibin and Deraa.

Squadrons of Vickers Vimys or even DH9 as stationed in Cyprus would seriously hamper, if not completely stop, movement along this one line, and so long as we kept command of the sea, the bases and lines of communication of these squadrons would be reasonably secure.

23. Analogies between Air Operations and Military Operations of the Past

Many analogies between air operations and well known military operations suggest themselves.

(a) For instance, take the campaign of Maregno in 1801. Napoleon surprised Melas by advancing from an unexpected direction, ie, over the St Bernard Pass. Similarly Group Captain Holt's manoeuvre of sweeping back towards our lines, surprised the German aircraft by arriving from an unexpected direction.

This exploit was referred to above in the discussion on the principle of surprise.

(b) In 1805 Napoleon surrounded the Austrians under Mack at Ulm, though owing to the necessity for stopping Mack's line of retreat towards the south of the Tyrol, Napoleon weakened his force north of the River Danube and gave Mack an opportunity for escaping in that direction, as part of his army in fact did. In September, 1918, Allenby blocked the line of retreat of the Turks towards the north with his cavalry, but left one line open, ie towards the east over the River Jordan at Jisr Ed Damie. But the attempt of the Turks to escape by this line was effectually frustrated by aeroplanes.

(c) In 1813 Wellington forced Joseph to evacuate a strong series of positions along the road Burgos-Bayonne by threatening the French lines of communication from the north and eventually brought him to battle at Vittoria.

Similarly aircraft may by continuous bombing so delay the supply of food and ammunition to an army, as to make it unable to fight a sustained action in a forward position.

24. The Choice of Objectives and the Selection of Bombing Targets

(a) The general principle in selecting objectives is to concentrate on the point that is of the main importance at the time.

A constant source of argument is what the objective of an air force should be at the beginning of a war. Can we go direct for the final object, ie, lowering the morale of the enemy nation to such a point that he will sue for peace, if the enemy air force is left intact and free to act? Can we keep on attacking the enemy's centres of government, population and industry continuously and in force, until we have attained an adequate measure of air superiority?

On the one hand it must be remembered that aeroplanes designed purely for fighting will always be superior in air combat to aeroplanes

designed chiefly for bombing; also that aeroplanes working in their own country can carry less petrol and can therefore have a better performance than similar types which have to fly a long distance before reaching their objective.

The defending side may therefore be constantly bringing down bombing aircraft and so lower the morale of their opponents that they will be forced to stop their bombing of national objectives and concentrate against the enemy air force.

On the other hand consider the difficulties in the way of getting air superiority. We cannot compel the enemy to fight anything in the nature of a decisive battle in the air. His aircraft may remain on the ground until such time as ours are forced to return for want of petrol. Air fighting in fact only takes place by mutual consent, as in the case of land battles of the XVIII Century. If, as is probable, he has camouflaged and dispersed his aerodromes they form very difficult bombing targets. Destruction of his means of production is, as has already been pointed out, a slow business. The matter is not one about which it is possible to be dogmatic, but the following appear to be the principles to follow:

(i) When the main effort of the nation is being directed to winning the war by air action, aircraft should attack their ultimate objective, ie, the enemy's morale, and only be diverted to the task of gaining air superiority should it be impossible to reach their ultimate objective, owing to the amount of air opposition encountered.

(ii) When the main effort of a nation is being directed to winning the war by naval or military action, gaining air superiority will be an essential preliminary and must therefore form the first object of an air force . . .

(b) When selecting bombing targets we must consider what are the enemy's most vulnerable spots. Towards the end of the last war rolling stock, especially locomotives, were very short in Germany and was of more importance than munitions. Engine sheds and repair shops were therefore very suitable objectives. Incidentally this shortage made it impossible for Germany to move her factories further to the interior, since they had to keep near the source of supply of raw material.

Another feature of importance was the Briey area as Germany obtained 80 per cent of her iron ore from there and half of it was smelted on the spot.

Attempts were made to isolate this area by bombing the railway junctions north and south of Treves, viz., Conz and Ehrang, these with Thionville, Metz and Saarbrucken being the focal points.

(c) During the fighting in March, 1918, it was a matter of urgent necessity to check the German advance. Orders were therefore issued from Royal Flying Corps HQ for all available aircraft to concentrate on direct assistance to troops on the ground. Fighting squadrons, for instance, devoted their energies principally to machine gunning and bombing

German infantry, and stopped seeking for combat with hostile aeroplanes.

In this connection the following table giving the number of rounds fired at ground targets on successive days and the weight of bombs dropped is of interest. The great increase in the former indicates how efforts were diverted from fighting in the air to fighting on the ground, in order to cope with the sudden emergency . . . [The] weather was bad for flying on the first two days.

Date	*Fired at ground targets*	*Bombs Dropped*
March 21st	28 000 rounds	15% tons
March 22nd	41 000 rounds	21 tons
March 23rd	44 000 rounds	33 tons
March 24th	82 000 rounds	36/2 tons
March 25th	92 000 rounds	33 tons
March 26th	228 000 rounds	29 tons
March 27th	313 000 rounds	50 tons
March 28th	242 000 rounds	40 tons

(e) Our bombing of Germany by the Independent Force was not carried out as a reprisal, but as a definite operation of war.

The foregoing statement must be regarded as questionable: see Documents 11, 12 and 13.

The objects were:

(i) The attack of industrial, railway, and military centres,

(ii) To force the enemy to withdraw squadrons from the military front,

(iii) To cause alarm and discontent amongst the civil population.

It may be noted that the advantages lay with Germany as she could reach French towns much more easily than we could German; the French also were opposed to bombing towns in Alsace and Lorraine [the occupied areas of France].

Up to this point is seems that the idea of bombing cities was accepted unthinkingly by the members of the armed forces. Here it is quite evident that this was not the case. The understated style barely disguises a strongly felt aversion to the strategy.

(f) The policy to be followed in future as regards bombing of open towns, is happily not one that has to be decided by the fighting services. The Royal Air Force will merely have to carry out the orders of the government on the subject. However, one may be permitted to wonder whether there may not be something higher than winning a war.

Is not a nation that conquers through the sacrifice of its national honour, ruining the future generation more certainly than by incurring

any defeat however disastrous the results of this may appear at the time?

In this connection the two following quotations may be of interest. First, one from a soldier, Sir Douglas Haig, on 1st November, 1916.

> I have no reason to suppose that the bombing of open towns merely for the purpose of terrorising the civil population is a method of warfare that would be approved by HM Government, nor would I recommend its adoption.

The second, from a civilian, is dated from the Foreign Office, 10th September, 1918. (No. 153287/WG)

> The Under Secretary of State for Foreign Affairs presents his compliments to the Secretary, Air Ministry, and is directed by Mr Balfour, Secretary of State, for the information of the Air Council, that HM's Minister at the Hague has reported that according to various sources the despondency in Germany is at the present moment intense; and that this would be greatly increased by air raids on German towns and that the moment would appear to demand the exercise of this method of warfare to its utmost extent.

In any case one may spare a little sympathy for the statesmen on whose shoulders the decision will rest. Is he to permit the use of some germ that will end the war by causing half the enemy nation to suffer a lingering death in agony, or to see his own country becoming exhausted by losing the flower of its manhood and by the moral effect of high explosive bombs on centres of population?

The foregoing was, of course, part of the very argument which raged when the first atomic bombs were dropped on Hiroshima and Nagasaki in August 1945.

In any case we must be prepared for our possible enemies taking advantage of bombing open towns in order to gain their national object,

(g) When the Royal Air Force is working under one of the other services, it is for the staff of that service to select the objectives for bombing. They will naturally consult the senior Air Force officer, but they will be in the best position to judge the relative importance of possible targets and must take the responsibility for the decision. There is usually a tendency to attack too many targets. This merely leads to dissemination of force and waste of available energy. Great results can only be obtained by sustained and concentrated effort.

From principles and strategy, the author now delves into tactics. Some aspects have been omitted as of academic interest only. What clearly is not purely academic is that air interdiction of land transport systems is by no means an easy task. This was rediscovered in several wars in the years to follow, notably those in Korea and Vietnam. Successful interdiction depends to a large extent on the position on the ground: for example, the enemy's supply needs, and the position of friendly troops. Simply focusing on a target and ignoring those kinds of factors can lead to the wasteful use of air resources.

(h) When attacking railways, junctions offer tempting targets. They are, however, not always the best. The main object being to delay movement along the railway, the enemy's facilities for repair must be taken into account. It is frequently the case that at important junctions, repair gangs and machinery are available on the spot, hence any damage can be made good quickly. The permanent way of a railway is not an easy thing to injure, even with 230 lb bombs. Rails are easily replaced, earthworks can hardly be damaged at all and unless a bridge can be broken, the delay caused by bombing seldom exceeds 12 hours. Even then so long as the raids succeed each other at short intervals, it should be possible to block one railway completely, but this means concentration of four or more squadrons on the one objective.

On the Western Front in the War of 1914-1918, we aimed at the following programme:

To damage a train in a cutting.

To set it on fire.

To prevent repair gangs reaching the spot.

This was never fully attained, but it is probably a very effective method of stopping traffic, especially if a persistent gas were used to stop repair . . .

This last rather casual remark is more significant than it may seem. **First, it** shows how chemical weapons were regarded fairly much as a normal part of the arsenal. Fortunately, international conscience has sharpened to the extent that there has been some progress towards banning these weapons. Second, some theorists—notably Giulio Douhet—based their predictions about the effectiveness of air power on the use of gas, a highly effective 'area' weapon. That was done in recognition of the (often extreme) inaccuracy of conventional high-explosive bombs. In the event, gas bombs were not used by strategic bombers, and the predictions made by Douhet and others were seen as exaggerated. In turn, that perceived exaggeration has been something of a cross for air power to bear.

(i) As regards roads, here again the best place to stop traffic is a cutting where it is difficult to clear away a wrecked vehicle. As in the case of railways, the best point to attack is a matter requiring much study and probably reconnaissance.

(j) Harbours or docks will often form bombing objectives. It has been calculated that the vulnerable parts of a port area form about 20 per cent of the total, these parts including ships, railway lines and cranes.

Usually the work of unloading at a dock is only carried out by day, hence night bombing will not cause much actual interruption. In some cases it may be possible to cause the enemy ships to miss a whole tide by aircraft bombing and thus to cause far more delay than that actually due to the bombs themselves.

(k) The possibility of landing demolition parties by aircraft must not be forgotten. It has already been referred to in paragraph 11(b).

25. **The** Use of Reserves in **Land,** Sea **and Air Warfare**

(a) There must of course be reserves to replace wastage in squadrons but the question of the tactical use of reserves in air operations is one that frequently comes up for discussion . . .

An interesting but peripheral treatment of the land and sea environments which follows has been **deleted.**

(d) What is the position as regards air operations?

Air actions are very rapid and their position even more uncertain than in the case of sea battles, hence there is just as little chance of reserves from a distance coming up in time to be of use as in the case of sea warfare.

On the other hand, fatigue of personnel is of more importance than in the case of sea battles, though of less importance than in the case of land battles.

The possibility of surprise is easier than at sea owing to the ability of aircraft to move in three dimensions, hence there is a necessity for guarding against unforeseen emergencies, though not to the same extent as on land.

Air operations appear then to occupy a position midway between sea and land operations in this case and it seems allowable to have a reserve, firstly to guard against surprise, ie, to keep the ring, and secondly to seize a sudden opportunity.

During the progress of an air fight it may be desirable to keep a reserve at higher altitudes to meet emergencies; or a reserve may be used to take advantage of the breaking up of a hostile formation by an assaulting flight.

But the reserve must be on the spot and any general reserve back in a carrier or on the ground would appear to be wrong, except possibly that in the case of co-operation with an army a few aeroplanes may be kept on an aerodrome ready to take advantage of fleeting opportunity for the attack of ground targets.

26. **Air** Forces Used as Detachments

(a) A detachment may be said to be useful and justified when it succeeds in retaining away from the decisive point a relatively larger force of the enemy. Several lessons regarding detachments as applied to air forces occurred during the War of **1914-1918.**

(b) **In** November, 1916, one German aeroplane flew over Cairo. As a result four of our aeroplanes were withdrawn from the front for several weeks to defend that city.

(c) The effect of the German air raids on England. On 13th June, **1917,** there was a daylight raid of four Gothas over London. Only one of them was brought down and they caused casualties to the extent of 130 killed and 246 injured. In consequence of this raid, No 66 Squadron (Sopwith Scouts) was, on 20th June, 1917, moved from Aire to Calais,

where it came under the orders of the Home Defence Group. If a formation of German bombers was reported over England, the squadron was to patrol between Long Sand Lightship and Kentish Knock Lightship in order to intercept them.

In addition No 56 Squadron (SE5s) was ordered to England where it arrived on 23rd June, 1917. The only raid while these squadrons were detached from the BEF was a small one on Harwich on 4th July, 1917. On 5th July, 1917, both squadrons returned to the BEF. On 7th July, 1917, there was a big daylight raid on London which had a serious effect on the public.

The War Cabinet through the CIGS ordered two squadrons to be sent to England and proposed that a raid on Mannheim should be carried out. It will be remembered that this was just before the Third Battle of Ypres began.

The following was the reply from Sir Douglas Haig to the War Office:

> Two good fighting squadrons will proceed to England tomorrow as ordered. Request following facts may be laid before War Cabinet at once in connection with this decision. Fight for air supremacy preparatory to forthcoming operations was definitely commenced by us this morning. Both enemy and ourselves have concentrated fighting machines for this struggle in the air which will undoubtedly be the most severe we have yet had. Success in this struggle is essential to success of our operations. Withdrawal of these two squadrons will certainly delay favourable decision in the air and render our victory more difficult and more costly in aeroplanes and pilots. If raid on Mannheim is undertaken in addition our plans will have to be reconsidered entirely and the operation may have to be abandoned.

As a result the raid on Mannheim was cancelled and the number of squadrons to be sent to England was reduced to one and No 46 Squadron (Sopwith Scouts) arrived at Sutton's Farm on 10th July, 1917.

German raids which only got as far as the coast were carried out on 22nd July, 12th August and 22nd August, and on 30th August No 46 Squadron returned to France. There were 11 service squadrons in the Home Defence Wing at the time.

On 1st October, 1917, the following telegram from the CIGS in England was received by GHQ in France:

> Continuous aircraft raids on England are causing interruption in munition work and having some effect on general public. Cabinet desire immediate action against those German objectives which can be reached from Nancy.

The following extracts give the views expressed by the GOC, Royal Flying Corps, on this telegram:

> The most important points to my mind are that the weather may break, the moon is going, and we are being rushed into doing it with short range machines which will not have the desired effect on Prussian towns, and at the same time we are depleting our forces on the battle front.
>
> I cannot imagine that this will stop the Germans bombing London or that the enemy would take away his bombing machines to stop ours.

The only advantage I can see is that it may make the same unrest in Germany as it has apparently done in England.

The next day, 2nd October, 1917, the GOC, Royal Flying Corps, flew to England and as the result of his interview with the War Cabinet it was agreed that steps should be taken to bomb German towns.

Orders were telephoned over in the evening for Nos 55 and 100 Squadrons to move to Ochey and four Handley Pages were to follow from England.

No 100 Squadron (FE2bs) were withdrawn October 3rd and arrived at Ochey October 5th. Their first raid was carried out on the night of October 24/25th on the railway between Falkenberg and Saarbrucken.

No 55 Squadron started to move on October 11th, arrived at Ochey on October 13th, and carried out its first raid on October 17th on a factory near Saarbrucken. Towards the end of the war we had 15 Home Defence Squadrons, ie, 270 aircraft in addition to 13 000 men employed with AA guns and searchlights.

The Germans had 7 flights, ie, 50 aircraft employed on the bombing of England, but they were occasionally used for other work.

The largest number employed by the Germans on any one raid was 34 aircraft on the night of 19/20th May, 1918.

(d) In 1918 the French squadrons, total 600 aircraft, between Chalons and Pierrefonds were responsible for defensive patrols to protect Paris in addition to their other duties. The long range gun on 23rd March, 1918, was first reported as an aeroplane bomb raid, and caused a large number of these aircraft to be diverted from their proper work.

(e) It is possible that our War Cabinet may have been right in insisting on the supreme importance of taking steps to allay the effect of German raids on the British public, and in the summer of 1917 there were certainly no aircraft in Home Defence Squadrons capable of getting to the height flown by the Gothas. But the point to note is not that one view or the other is wrong but that the moral effect of aircraft attack against the enemy's vulnerable points places a weapon of great efficacy in the hands of a commander for inducing the enemy to detach forces from the decisive point.

Will not the Abraham Lincoln of the future be still more determined to take forces for direct defence if his capital may be attacked that very night, instead of being safe for at least 10 days as was the case with Stonewall Jackson's threats to Washington in 1862.

27. The Future

When attempting to forecast the future it is always advisable to search the records of the past.

In our case it is not without value to examine the pre-war ideas on aviation. In those days ideas had to be based on first principles since there was no experience on which to form conclusions, and in many ways first principles are the nearest guide to the future. Again the War of 1914-1918 is so close that

not only may we draw false deductions owing to incomplete data, but we are also liable to have our vision narrowed to the particular form that the war took.

Remember Foch's remarks that no two wars have ever been on the same lines or ever will be.

For instance, in the French aeroplane trials of 1911 and in ours of 1912, one of the conditions was that the aeroplanes should be easily transportable by road or rail. In the case of one aeroplane, a period of only 14'A minutes was taken from the time it was out of its packing case till it was in the air. The matter seems to be having insufficient attention today.

All that will be said on the future here is that air power will always be very dependent upon technical development and it is therefore essential for all staff officers to keep thoroughly abreast of aeronautical and general scientific progress. Aeroplanes will become less fragile and be capable of remaining in the open for long periods. Engines will be less liable to failure and will require less frequent overhaul.

Forced induction will add some 10 000 feet to the possible ceiling of aeroplanes, though whether there is much practical advantage in this remains to be proved. Forced induction will, however, be valuable by increasing the rate of climb and the speed at altitudes above 10 000 feet.

The use of a cheap, heavy fuel for aircraft engines is in sight and this ought to enable civil aviation to be a profitable business.

Such possibilities as re-fuelling one aircraft from another in the air should not be rejected as impracticable without a trial.

Every technical development introduces fresh possibilities which are often not very obvious. The Royal Air Force must be in a position to make full use of all of them; to place it there will require much investigation, much clear thinking, much foresight on the part of all concerned.

FIGURE 2.7

Bibliography.

1. Books.

(a) Lanchester – "Aircraft in Warfare."
Written at the end of 1915 by an author of much originality and foresight. Many of his suggestions are of value today, especially :–
Chapters V and VI on the N square law, being deductions as to the effect of numerical superiority.
Chapters XIII and XV on air superiority.
Chapters XVIII and XIX on the employment of aircraft affecting the morale of an enemy nation.

(b) Serrigny – "Reflexions Sur L'Art de la Guerre."
A small book containing valuable ideas on war of the future, including the part that will be played by aircraft.

(c) Colonel Simon — "Air Defence." (Encyclopedia Brittannica, Vol. 30).

Principles of air defence from the ground with historical examples. Protection and camouflage. Forms of attack. Instruments available for air defence and the methods of using them.

(d) General Ashmore. — "Air Raids." (Encyclopedia Brittannica, Vol. 30).

A historical summary of the German airship and aeroplane raids on ENGLAND, with some notes on the defensive measures adopted.

(e) Major General Brancker. — "Air Power & Sea Power." (Brassey's Naval Annual, 1921/1922, p. 103).

A survey of the function of aircraft in co-operation with a fleet. Potentialities of aircraft for the attack and defence of merchant shipping. Possible results of air power in a future war.

(f) Buller. — "The Reformation of War", Chapter VII.

Emphasises the advantages of gas as a weapon for aircraft and the effect of such a combination against armies, navies and civil population.

2. Magazine Articles.

(a) Aeronautical Journal, December, 1918, page 391.
"Fighting in the Air." — Major Cochrane Patrick.

A lecture given by a well-known fighting pilot. Describes the development of air fighting during the war, with special reference to the problem of deflection when aiming.

(b) Aeronautical Journal, February, 1922, page 46.
"The Development of the Fighting Aeroplane." — Green.

A lecture given by a designer of many years experience. Deals with the design of fighting aeroplanes in the past and suggestions for future development.

(c) Army Quarterly, July, 1922, page 248.
"Some Speculations on Aerial Strategy." — General Bird.

A short article giving reasons for making the attainment of air superiority the first object of an air force.

(d) Army Quarterly, October, 1922, page 38.
"The Influence of Aircraft on Problems of Imperial Defence." — Squadron Leader Walker.

Comparison of air with naval and military strategy. The necessity for air bases and mobility. The primary object must be destruction of the enemy air forces. Problems of building up an efficient air force. Aircraft for maintaining internal security.

(e) Edinburgh Review, October, 1922.
"Air Defence." — General Sykes.

The functions of aircraft in another war both in co-operation with the Navy and Army, and acting separately. The new phase and sphere in war introduced by the development of air power. The need for offensive action and concentration of effort. The importance of a large air striking force. Value of civil aviation to an air force. Need for a Minister of Defence. Criticisms, mostly unfair, on the policy of the Air Ministry.

(f) Journal of the Royal United Service Institution, May, 1920, page 310.
"The Use of Aircraft in Small Wars." — Air Commodore Borton.

A short lecture on methods of employing aeroplanes in this connection.

(g) Journal of the Royal United Service Institution, May, 1921, page 205.
"The Use of the Air Force for Replacing Military Garrisons." – Group Captain Chamier.

The value of aeroplanes for controlling a semi-civilized country with special reference to IRAQ. An extract from this lecture is quoted with disapproval by Buller in "The Fiends of the Air." (See below).

(h) Journal of the Royal United Service Institution, November, 1921, page 641.
"Strategy and Air Strategy." – Group Captain Chamier.

An excellent article on the basic principles of air operations, with comparisons between these and operations on sea and land.

(i) Journal of the Royal United Service Institution, May, 1922, page 274.
"The Influence in the Future of Aircraft upon Problems of Imperial Defence." – Flight Lieutenant Mackay.

R.N.S.I. Prize Essay, 1921. A long and comprehensive essay dealing with the subject under the following headings:–

Finance. Influence of aircraft on war, peace strategy, home defence, overseas defence, co-operation with the navy and army. Small wars.

(j) Journal of the Royal United Service Institution, November, 1922, page 622.
"The Probable Influence of Air Reconnaissance on Strategy and Tactics" – Lt. Jr. Mackay

Gordon Sheppard Memorial Prize Essay for 1921. Deals with both the naval and military aspect. Methods of obtaining information in the past. The value of aircraft for reconnaissance. Instances from 1914, not always accurate. Historical examples to show the effect that air reconnaissance would have had in past wars.

(k) Journal of the Royal United Service Institution, May, 1923, page 291.
"Thoughts on Our Requirements in Relation to an Air Force. – General Bird.

Draws comparisons between the relations of a navy with the mercantile marine and those of an air force with civil aviation. Effect of air development on the defence of GREAT BRITAIN.

(l) Naval Review, May, 1922, page 220.
"The Influence in the Future of Aircraft upon Problems of Imperial Defence."

R.N.S.I. Essay, 1921, 3rd Prize. Destruction of the enemy's armed forces is the first requirement for winning a war. Difficulty of striking direct at the will power of the enemy nation by evading his fighting forces. Need for one system of Imperial strategy for the purpose of co-ordinating the operations of the three services. The value of air power in Imperial Defence and suggestions for development of air power in the Dominions.

(m) Naval Review, February, 1923, page 81.
"The Fiends of the Air." – Colonel Buller.

The author deals with the subject from a philosophic standpoint and somewhat after the manner of his "Reformation of War." He discusses the nature of war, the basic characteristics of aircraft and their potentialities and limitations. Suggests suitable methods of operating for aircraft acting separately, in co-operation with the Navy and the Army, and in small wars. Lays stress on the value of civil aviation.

(n) Nineteenth Century, September, 1922, page 349.
"Air Power and the Empire." – Squadron Leader Walser.
The functions of the air force in the defence of the British Empire. How the Air Force can assist the Navy. The importance of air bases and air routes.
(o) Nineteenth Century, April, 1923, page 598.
"Air Power." – Squadron Leader Walser.
Probable course of a big war in the future with special reference to the effect of air forces. Value of information in air operations. Co-operation of an air force with an army. Possibility that bombing squadrons may replace long range artillery.
(p) Quarterly Review, October, 1921, Article 4.
"The Air Raids on LONDON." – Edwards.
An historical account of the German airship and aeroplane raids.
(q) Revue Militaire Francais, January, 1921, page 46.
"Considerations Sur Notre Aviation Militaire." – Commandant Menard.
The author commanded a group of fighting squadrons in the Division Aerienne. He is opposed to bombing by day and considers that bombing should only be carried out at night. He considers that during the War of 1914-1918, the French had to use such a large proportion of their available fighting squadrons for the purpose of enabling their day bombing squadrons to operate, that they had insufficient for other purposes.
(r) Revue Militaire Francais, May, 1923, page 235.
"Le Bombardement de Jour." – Commandant Morlais.
The author commanded a group of day bombing squadrons in the Division Aerienne. He opposes the views expressed in Menard's article above, quotes cases of successful day bombing attacks, and points out the difficulties in the way of successful bombing at night. He discusses various disadvantages of the single-seater fighter

3. Pamphlets Issued by the Air Ministry.
C.D. 8. Issued June, 1920. The policy which should govern the distribution of Air Forces and some consideration as to how they should be employed. Includes some notes on the immobility of air units when they have to be packed up for sea transport and on the evils of disseminating an air force.
C.D. 18. Issued March, 1921. The future of the Air Force in national and imperial defence. Discusses the role of the Air Force in defence at sea and defence on land, and the danger of air invasion.
C.D. 19. Issued July, 1921. Air defence and suggested lines of development for Dominion air forces.
C.D. 21. Issued July, 1921. The power of the air force and the application of this power to hold and police MESOPOTAMIA.

4. Parliamentary Debates.

Commons, 14th March, 1923.

Sir S. Hoare's statement on introducing the Air Estimates and the subsequent debate.

Commons, 21st March, 1923.

Further debate on the Air Estimates.

Lords, 21st March, 1923.

Lord Birkenhead's notes on the relative strengths of British and French air forces. Statement of Duke of Sutherland giving statistics for French air forces.

5. Newspaper Articles.

Brigadier General Groves in the "Times".

Many articles of which the following contain most of what the author has to say:—

1922. March 21st, 22nd and 24th. April 24th. July 1st.
1923. May 3rd.

The articles are written mainly with the object of showing that the most effective method of obtaining a large air force in war is the development of civil aviation in peace. The author criticises Air Ministry policy freely and often unfairly and he is tinged with animus against individuals on the Air Council. He constantly brings forward identical arguments in successive articles.

DOCUMENT 7.

Precis of a Lecture on the Development of Co-operation with the Army During the War of 1914-1918

Army cooperation was the first role of air power. As Wrigley points out, for many years there was no thought of aircraft taking a separate role. This document provides an excellent abbreviated history of this subject. The dryness of the text is fully compensated by the interesting tale he unfolds as the techniques and guidelines for artillery spotting, reconnaissance and close air support are gradually pieced together.

It is noteworthy that, while ostensibly discussing joint operations, Wrigley cannot avoid describing the development of air superiority, a campaign which is, of course, conducted primarily by an air force. As we have noted elsewhere, the campaign for the control of the air emerged during this period as the prime campaign, in that air superiority was already becoming the prerequisite for most other activities by all forces.

The notion of joint operations represented by the army cooperation flying of the Great War remains topical today. Doctrine in most armed forces assumes that operations will normally be of a joint nature—that is, that two or more services will be operating closely together, under one set of objectives and usually under one joint force commander. Such doctrine recognises that there is a degree of overlap in what each service can do, as well as great opportunities for support. To act completely independently is to waste effort.

The opportunities for cooperation between land and sea forces is fairly limited, as they often work in quite different and mutually exclusive environments. At first glance, examples such as the island-hopping campaign in the Pacific during World War II might seem to disprove this rule. That campaign relied on sea-borne transportation of army divisions: many of the initial island assaults were conducted by the United States Marines and the United States Navy who exemplify joint land and sea forces.

However, in the context of Wrigley's foray into joint operations, some valuable points emerge from that aspect of the Pacific war. First, there were really two great campaigns: one an air-land campaign under General MacArthur; and the other a maritime (air-sea) campaign under Admiral Halsev. Later in the war, the air bombardment of Japan emerged as a separate campaign, independently directed by General H.H. 'Hap' Arnold. The Joint Chiefs of Staff never placed the land-oriented and the sea-oriented operations together under one commander, so they were conducted under separate obj lives until the one-theatre aim ol the defeat ol the Japanese was accomplished. Perhaps the size of those campaigns was such that unified command was not

needed, overall coordination being provided in Washington. Within the maritime campaign, delivery and sustainment of land forces was to a large extent by sea but the degree of truly joint action was relatively limited.

Second, in some ways these campaigns were primarily air. In the opening months during 1942, air power was used very much in support of the surface forces. However, before much longer and certainly by 1944, the surface forces were often wielded in such a way as to further the air campaign, primarily to gain control of the air so that the sea could then be controlled and land could be occupied.

The main point is that joint action in smaller nations is sometimes but not very often navy/army; it is far more often navy/air or army/air. The era of joint operations arrived with the era of air power. Until then, strategists were almost entirely categorised as either maritime or continental. The historical pattern is still prevalent today, where operations are seen to be dominated either by the cold and wet environment, or the hard and dry, with air being an ephemeral and elusive contributor. There is a tendency to draw a line at the beach, the low water mark, the brown water line or some other arbitrary base line and discuss the contribution of air power accordingly.

This is natural enough for the human race, for whom escape from the inevitable pull of gravity is temporary, costly and sometimes uncomfortable. But it obscures a clear and unbiased view of air power. That view too often is predicated upon which side of the line and on which of the two surfaces the observer naturally or professionally prefers to operate.

So air power as it evolved stepped directly into a position of tension, of controversy and of competition. Its domain was tied neither to the land nor to the sea. It could range at will in order to support the surface campaigns or to conduct its own activities, still in pursuit of national goals but separately and almost independently. By virtue of a different viewpoint, it grew quickly to its own *modus operandi.* It possessed new capabilities and brought new possibilities yet was an orphan of the established families.

Little of this tension can be perceived directly from this lecture precis. Nevertheless, the competition for resources is evident, and Wrigley's quotations from the Smuts Report and other sources show that he is keen to record the basis of the independent air force (see also Part Three). In these notes, however, he is content to trace history and to offer some advice on how to achieve good cooperation. It is very good advice, one might even say down to earth.

The Smuts Report (see also Document 11) was not the only authoritative source Wrigley was able to draw on in compiling these notes. He benefited from a lecture on 'Army Cooperation' given at the RAF Staff College in October 1927 by Wing Commander T.L. Leigh-Mallory, DSC; while his observations on 'Fighting in the Air' (paragraph 6) were able to incorporate ideas presented at the same venue in February 1928 by Air Marshal Sir John Salmond, KCB, CMG, CVO, DSO, Air Vice-Marshal Sir J.M. Steel, KBE, CB, CMG, and Air Vice-Marshal Sir R. Brooke-Popham, KCB, CMG, DSO, AFC.

1. The **Situation in August, 1914**

On mobilisation the Royal Flying Corps had been in existence for 2 years and 3 months. It is interesting to remember that there was one Royal Flying Corps with a naval and a military wing, but the former was in process of splitting off and becoming the Royal Naval Air Service.

The Military Wing consisted of four aeroplane squadrons each of 12 aircraft, and their stations were:

No 2 Squadron	Montrose
Nos 3 and 4 Squadron	Netheravon
No 5 Squadron	Gosport
Headquarters	Farnborough

There was also the nucleus of a repair and stores depot at Farnborough.

Engines were unreliable and aircraft were slow, about 60 miles per hour. Pilots were, with some reason, afraid of their aircraft getting out of control in gusty winds or a hot sun, and but little progress could be made against strong head winds.

Training with the Army was carried out spasmodically, the general idea being that Army units should spare but little time from the serious business of life for the purpose of working with aircraft, whilst the frequency with which the latter broke down rendered systematic co-operation difficult.

In 1912 aeroplanes took part in the cavalry manoeuvres which preceded the army ones, but owing to a series of fatal accidents were unable to do much. During the Army manoeuvres of that year, we were more successful, the distance reconnaissance on the first day being remarkably good on one side.

In the 1913 manoeuvres one side was represented by a skeleton and this afforded but little opportunity to air reconnaissance. The good results of the 1912 manoeuvres were therefore somewhat obscured.

As regards observation for artillery fire, a good deal of work had been carried out on Salisbury Plain in 1912, 1913 and 1914, thanks largely to the efforts of some officers of the School of Gunnery. The chief difficulties were, firstly, lack of ammunition for practices other than the standard ones of the practice camp, and secondly, want of funds to buy apparatus with which to try out new ideas. As early as 1912 it was realised that the secret of successful co-operation lay in the development of W/T for aircraft, and this was put very definitely in a report made to the War Office in the autumn of 1912. Unfortunately all the W/T experiments in aircraft were carried out at Farnborough and on Salisbury Plain W/T aeroplanes were never available. Therefore the work of artillery observation had to be carried on with Very lights and by the end of 1913 a definite code and procedure had been evolved which was embodied in the Royal Flying Corps Training Manual issued just before the war.

The development of air photography was also handicapped by want of funds. All the money available was spent at Farnborough, but in some other squadrons officers were sufficiently enthusiastic to purchase experimental cameras out of their own pockets and so a good deal of work was done in an amateur way. For instance, No 3 Squadron made a complete photographic reconnaissance of

the Isle of Wight and Portsmouth one day from 5000 feet, and even developed negatives in the air.

Most people realised that air fighting would take place, but not enough clear thinking was given to what this would entail. It was not till 1913 that the first shot was fired, with much alarm and trepidation, from a service aeroplane; but during the following winter a flight was sent to Shorncliffe and a series of tests was carried out on the Hythe ranges to decide upon the best type of machine gun for use in the air. As a result the Lewis gun was selected and efforts were made to design special fighting aircraft. But there the matter stopped. Experiments with gun mountings were discouraged. A proposal from a civilian to use an interrupter gear for firing through the airscrew was laughed to scorn by the pilots of those days, and no one attempted to think out air tactics.

In one respect we were well situated, namely, in the way of observers. Six Staff College officers were attached for a four weeks' course and proved invaluable in the early stages of the war.

2. The Opening Stages of the War

In August 1914 nearly every serviceable war aircraft and trained pilot in the Military Wing went overseas. There was no aircraft industry even in embryo and we were entirely dependent upon France for our engines. Sir David Henderson, who commanded the Royal Flying Corps in France, decided that it was above all necessary to husband the scanty resources available, and with this object in view kept all four squadrons under his own orders for the first few weeks. He may have been right, but it was one of the reasons that led to the Royal Flying Corps being employed solely for GHQ reconnaissance up to 6th September, and doing no work for corps or divisions.

It was interesting to see the change in the attitude of the GHQ Staff towards air reconnaissance during the first fortnight.

The Intelligence Branch attached great importance to it from the first, but the Operations Branch during the first week seemed to be rather doubtful whether air observers could get information of any value and whether the reports that were sent in were to be trusted. It was not till the end of August that the Operations Branch really seemed to believe in air reconnaissance, ie, after they had had some practical experience of it. It seems a pity that more opportunities for acquiring this experience had not been given in peace.

From the Battle of the Marne onwards decentralisation of the Royal Flying Corps was carried out and eventually, on 29th November 1914, wings were formed and one allotted to each of the two armies. Wings expanded into brigades, each with a corps wing and an army wing, in January 1916.

There are a few obvious points with regard to air reconnaissance that are worth remembering for mobile warfare:

(a) The difficulty of distinguishing friend from foe. On 31st August 1914, part of Manoury's army was reported as enemy. GHQ, however, knew it was not, so no harm was done . . .

(b) Columns marching through the same town may be confused . . .

(c) Occasional difficulty of distinguishing arms composing a column . . .

(d) The impossibility of identifying units, hence the need for daily reconnaissance . . .

(e) Ground and air reconnaissance are supplementary.

The chief point in issuing orders for air reconnaissance is to give definite questions for the observers to answer.

3. The Development of Artillery Work

At the Battle of the Aisne two aeroplanes fitted with W/T were available and these did useful work for the artillery using the simple signals, short or over, right or left. The rest of the aircraft used Very lights and the procedure evolved at the practice camp on Salisbury Plain. W/T apparatus was very hard to get but, relying mainly on French sources, it was possible to equip about 10 aircraft by December 1914. A special wireless squadron was formed on 8th December 1914 and one flight allotted to each wing.

In January 1915 a big advance was made by the introduction of the clock code. By this time the use of Very lights was practically obsolete, but the signalling lamp was used to supplement W/T.

Many difficulties were experienced in the operation of W/T for artillery work. The chief method tried, to get over them, was increasing the power of the transmitting set in the aircraft. This really made matters worse by increasing the possibility of jamming. It was not until we got wireless engineers in the Royal Flying Corps, in place of enthusiastic amateurs, that it was realised we were working on the wrong end, and that improvement had to be sought in developing the efficiency of the receiving sets. When this was done progress was rapid, and incidentally the weight of the apparatus carried by the aeroplane was reduced from 75 lbs eventually to 17 lbs.

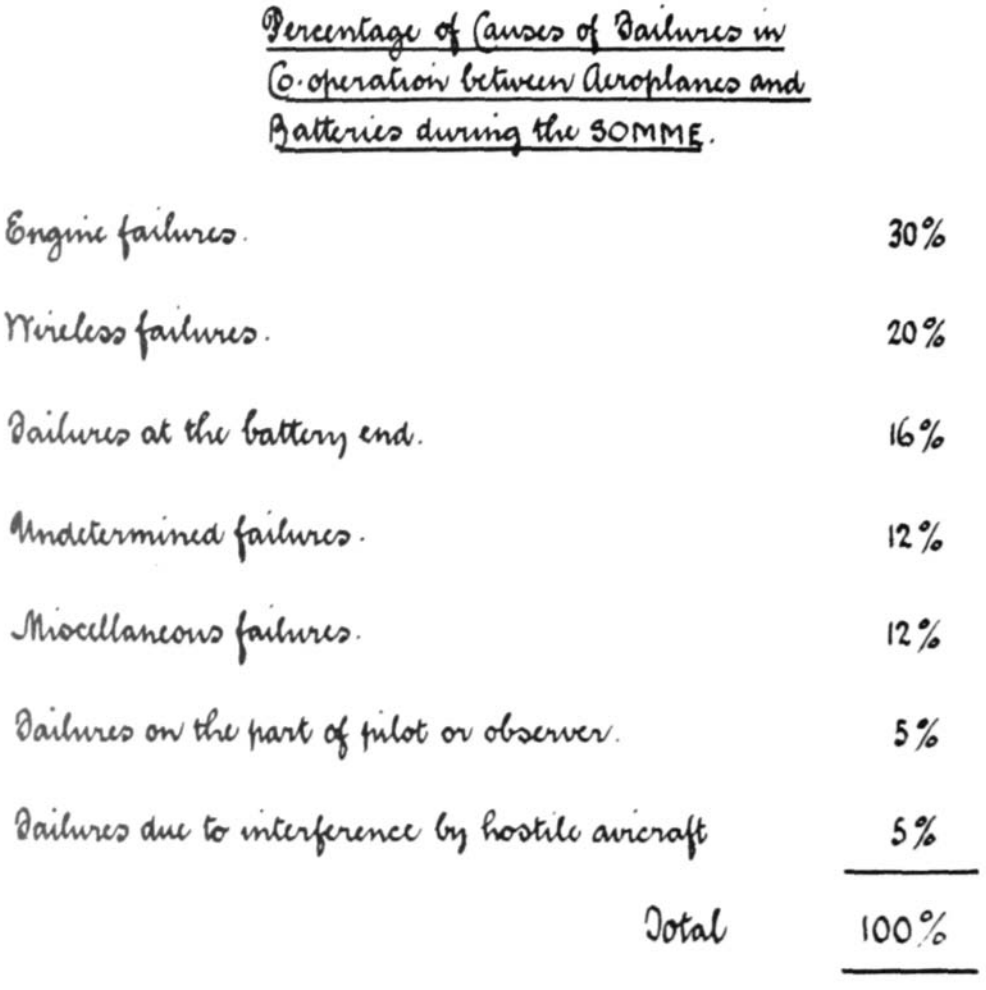
At Neuve Chapelle (10th March 1915) we had only a total of 8 aircraft equipped with W/T working with the First Army. At Festubert (9th May 1915) all the aircraft used for artillery observation had W/T and by the Battle of Loos (25th September 1915) air observation for artillery was fully organised. Each of the squadrons working with the attacking Corps (I and IV) had two flights for counter battery work and one for trench bombardment. It was found possible to keep three W/T aircraft per squadron in the air without jamming and the wireless proved very reliable.

As Figure 2.8 illustrates, engine reliability remained a greater problem than W/T.

From the Battle of Loos to the end of the war great improvements were made in the execution of the policy, details of procedure were perfected and a few special call[s] introduced, but there was no general change in method.

It is very important to have close touch between the flying personnel and the gunners and constant interchange of visits. Batteries must look after the W/T operators attached to them.

FIGURE 2.8



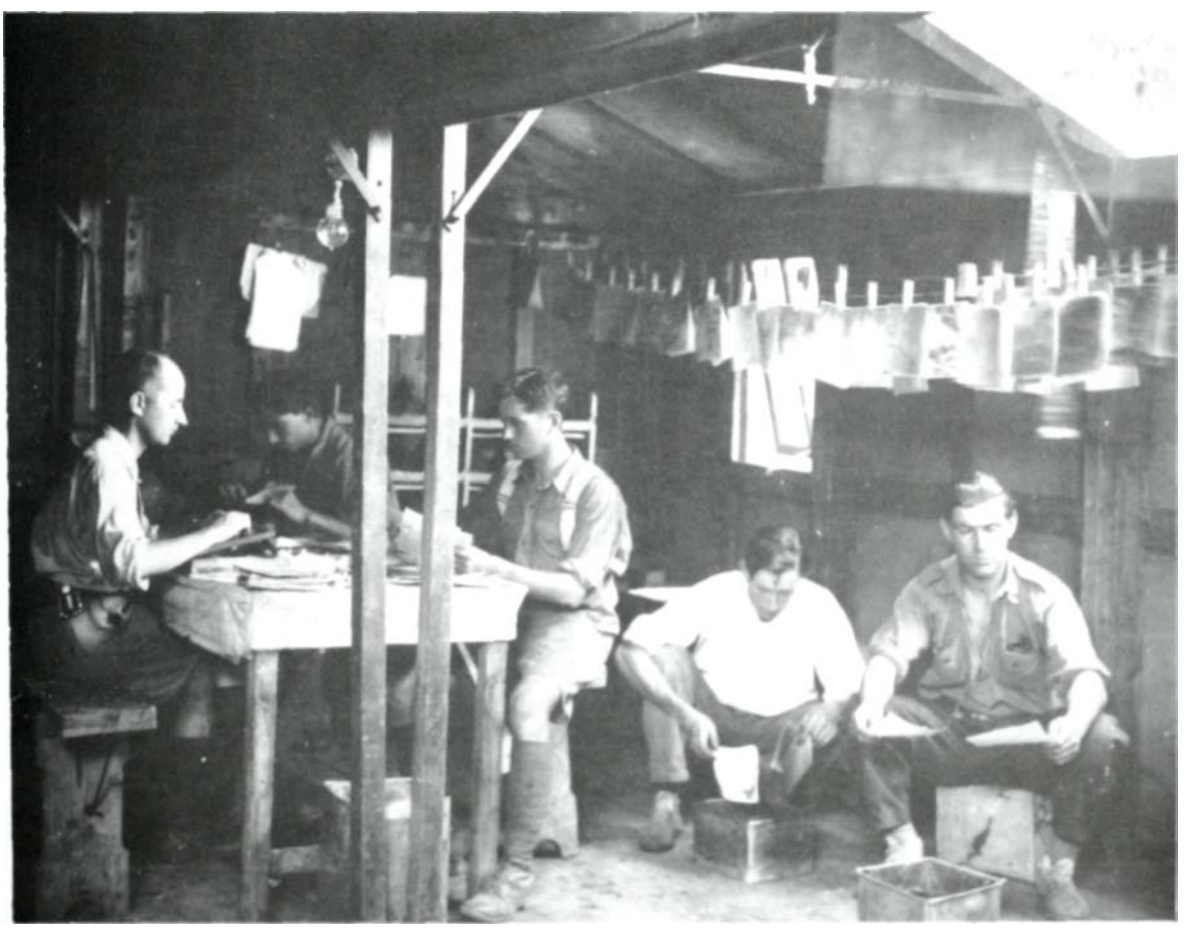
4. Development of Photography

Wrigley's notebooks are full of fascinating windows into the reality of air warfare. In this paragraph, we are reminded of the importance of a role which is still vital today, although the sensors are now far more elaborate than hand-held, then fixed, optical cameras. Given the equipment in 1918, 1000 photographs per day on average was an impressive rate of effort.

These days, the intelligence system too has developed to the extent that the delivery of photographs 'to companies and platoons immediately before an attack' seems a very strange idea. Now, photographs are initially analysed for quick intelligence reports before being given thorough and expert combing by trained interpreters far from the sounds of battle. Results are reported to the headquarters in the field or incorporated into intelligence bulletins for dissemination by message, sometimes by more immediate electronic means to interested parties.

This sophistication brings with it greater vulnerability to interference, be it from astute enemy action, mechanical faults or just the unexpected break in some small link of the chain—any of the manifestations of Clausewitz's 'friction' of war. It is not impossible to foresee that in such situations some innovative planner may come up with the novel idea of dropping prints to those who need the information in a hurry.

As regards photography, the results of the experiments carried out before the war had resulted in certain conclusions being reached on the design of a special aeroplane camera. Some were actually being constructed when war broke out and were received in France before the end of 1914. A few of existing types of cameras had also been taken out. One or two photographs were taken of the Aisne, but as they were not received with much enthusiasm at GHQ, the conclusion was reached that air photography wasn't wanted. Soon after the arrival on the Ypres front, Royal Flying Corps HQ were hauled over the coals by GHQ for taking no steps with regard to photography whilst the French were producing very useful photographs. As the result of this it was decided to form a special photographic section with two civilian experts in charge to investigate the whole problem from a scientific point of view, instead of in the amateurish fashion in which it had been done hitherto. Rapid progress was made in camera



7. Men of the Photographic Section oi the AFC trimming and drying prints. AWM.

design, personnel from the staff of illustrated papers showed how to produce prints in quantity at short notice, and in June 1915 the more or less accidental discovery was made that better photographs could be taken by fixing the camera to the aeroplane than by holding it in the hand.

From that time onwards improvements were merely in matters of detail, making cameras more foolproof and perfecting methods of mounting them, whilst the utilisation of the Army Printing Section enabled prints to be produced in quantity. Air photography became a big business. In 1918 photographs taken averaged about 1000 per day and the number of prints made about 6000. The record number of photographs taken in one day was just over 4000.

It is unnecessary to emphasise the value of up-to-date photographs issued to companies and platoons immediately before an attack.

Their use to find rear lines of defence is also obvious. Daily photographs of a railway station enables an intelligence staff to judge trend of traffic. At the end of May 1918, a photograph of a German practice trench enabled the objective of a future attack to be predicted accurately.

One point that is important for all officers to bear in mind is the necessity for practice in reading air photographs. This seems to me just as important as reading maps.

5. Close Tactical Reconnaissance

The germs of the idea of close tactical reconnaissance, or contact patrol as it was called during the war, are found at Neuve Chapelle (10th March 1915), when one officer made two reconnaissances from a low height and tried to ascertain the exact situation immediately in front of our attacking troops. The idea was carried further at Festubert (9th May 1915), when three aeroplanes were fitted with wireless and detailed for the work. One of these was always to be in the air and the observer was to report as soon as the infantry, who were to carry white strips 7 feet by 2 feet, had reached certain points marked on a map. The wireless worked well, forty-two messages being sent down and nearly all received correctly. Few of them, however, were of any real value. The white strips were either difficult to see or were forgotten and the observer had great difficulty in distinguishing friend from foe. In consequence this form of co-operation fell into disrepute. It was however resurrected at the Somme and largely owing to the fact that opportunities had been afforded for training, the results were fair. Aircraft were sent out either at specified times to find the front line, or to specified places to see if our infantry were there. Aircraft were specially marked and messages dropped at report centres.

At Messines in 1917, a useful method for communication was introduced, namely, the issue to each observer of blocks containing quadruplicate copies of a map (1/10 000 scale) with carbon interleaved. The observer marked the position of the troops and dropped one copy at each Divisional HQ, one at Corps Report Centre, and retained the fourth.

In 1917 and 1918 every aircraft that carried out low flying attacks on ground targets was also ordered to bring back information about the enemy. Messages were dropped at the report centres and though some were not of

much value, in one case a series of a dozen or so enabled an Intelligence Officer to get a very shrewd idea of where a counter attack was impending.

The problem of distinguishing signs for our own troops was never completely solved and it is a question for consideration whether development was really made along wrong lines, ie, we started from the basis of what the aeroplanes could see instead of what the infantry could use. Red flares were fairly successful on the Somme but often failed at Third Ypres owing to the wet.

It is of course obvious that the aeroplane observer must find it very hard to distinguish friend from foe when everyone is uniformly covered with mud. It is also difficult to tell living from dead in shell holes . . .

6. Fighting in the Air

Fighting in the air must be counted as part of the co-operation with the army during 1914-1918, because it was carried out mainly with the object of rendering reconnaissance and observation possible.

In August 1914, we held the idea that a fighting aeroplane must be a two-seater because one brain would never be able to control an aeroplane as well as shoot a gun. Further, since the idea of firing through the airscrew had been rejected, the two-seater pusher was looked upon as the only possible type of fighter, whilst speed was not regarded as of much importance.

Every aeroplane was supposed to take up some form of firearm, either a rifle or a revolver, but mainly for defensive purposes.

Whilst on the Aisne the first fighters were received, one flight of 4 two-seater pushers armed with machine guns. Actually they were the slowest aircraft we had. It was intended to develop this flight into a fighting squadron.

We had a few fast single-seaters in those days, but they had not been regarded before the war as being fighting aircraft. They were called scouts and were to be used solely for reconnaissance on days when the wind was so strong that the other types of aircraft could make but little headway.

The need for high performance in a fighter was realised in the first two weeks of the war, but it was not till February 1916 that we received our first high performance fighter squadron.

At first the ideas of fighting were based on a defensive attitude, ie, of flying over the areas to be defended, and waiting for the enemy to come. The flight of fighter aircraft were for instance used in this manner for the purpose of protecting a detrainment at Hazebrouck when the Army was moving from the Aisne to the Ypres area. It was soon found that the aircraft of this flight were too slow to be any good for fighting, and so the scouts were armed in various ways and used as fighters.

At the same time there was a reaction from the idea of the specialised fighting squadron and the armed scouts were divided up amongst the existing squadrons. At first these scouts were used offensively, but not used on any definite system. They merely attacked any enemy aircraft they happened to meet.

On 17th April 1915, before the attack on Hill 60, a more systematic but at the same time more defensive plan was carried out, the object being to prevent German aeroplanes observing the move of the 5th Division to the salient. At

Festubert this idea was extended and defensive patrols carried out for 4 days before the battle. This was an attempt in fact to form a sort of aeroplane barrage.

The next step was made by the Germans who introduced the specialised fighter, the Fokker, in quantity [see Document 15). This seriously interfered with the work of our artillery aircraft, with the result that they had to work in pairs for self-defence, or else be escorted by one or more of our fighting scouts, this being in fact the genesis of formation flying. This put us definitely on the defensive.

At Loos a step forward was made in the shape of patrols over a definite line on the enemy's side, to hold back his fighters and so leave an area free in which our artillery aircraft could work. Tactically this was offensive in so far as the patrols were to attack any enemy aeroplane they saw, but in conception it was defensive, the underlying idea still being that of forming a barrage.

The next phase occurred in the winter of 1915-1916 in the shape of two men talking over their ideas together. They were General Trenchard and Commandant Du Peuty. They came to the conclusion that the mere attack of one aeroplane on another was not enough, but that a completely offensive attitude must be adopted with the definite object of gaining superiority in the air.

This policy necessitated having regular fighting squadrons in place of attaching a few fighters to every squadron.

The full offensive policy was first put into execution by the French under Du Peuty at Verdun with complete success. So long as the French remained on the offensive, their own observation aeroplanes were able to work fully, whilst the enemy's reconnaissance was practically stopped.

The Germans were not long in recognising the value of offensive in the air. Von Hoeppner, who became GOC German Air Force at the end of 1916, in referring to the idea of a defensive barrage, says:

> It is not possible to keep down the enemy by this means. The rapidity with which the enemy aeroplanes can get away, their ability quickly to change their attitude, the difficulty of recognising an enemy in the air from a distance, all combined to prove that this kind of aerial line patrol merely meant an unlimited waste of strength, and spoilt the chances of our own reconnaissances.

With the idea of carrying out this offensive, they began to concentrate their fighting aircraft, which up to the Spring of 1916 had been divided amongst squadrons, and by the end of August 1916 seven so called pursuit flights, of 14 aircraft each, had been formed.

The offensive policy was put into execution by us at the Somme, at first with complete success, though later, when the Germans adopted the same policy, the superiority was less marked. The following are extracts from a paper, by General von Below, called 'Experience of the German First Army in the Somme Battle':

> The beginning and the first few weeks of the Somme battle were marked by a complete inferiority of our own air forces. The enemy aeroplanes enjoyed complete freedom in carrying out direct reconnaissances. With the aid of aeroplane observation, the hostile artillery neutralised our guns and was able to range with the most extreme accuracy on the trenches occupied by our infantry. By means of bombing

and machine gun attacks from a low height against infantry, battery positions and marching columns, the enemy's aircraft inspired our troops with a feeling of defencelessness against the enemy's mastery of the air.

There were certainly other causes that contributed to our air superiority in the early stages of the Somme, in addition to methods of operation. We were superior as regards numbers and the performance of aeroplanes, but the definite offensive attitude was the main factor.

During the winter of 1916-1917 several changes occurred in the German organisation. Their air service was made a separate corps with its own commander, more fighting squadrons were formed, better types of aeroplanes brought into the service, and a definite offensive policy decided upon.

The results of this were made evident at Arras with practically the same types of aircraft as at the Somme. They were unable to gain any measure of air superiority.

At the Somme our air offensive was started at the same time as the artillery bombardment. At Arras it commenced on Z-5 day. At Third Ypres it commenced on 8th July, ie, over 3 weeks before the army attacked. We then see the idea of an air offensive as a definite preliminary to a ground offensive fully established by the middle of 1917.

A new development occurred in June 1918 when the first night fighting squadron arrived. These were single-seater fighters (Camels) and were remarkably successful, bringing down a total of 26 German night bombers with the loss of only one aircraft and that by accident. This result, however, must be considered as having been brought about mainly by surprise, the Germans not having expected to be attacked in the air by night and their aircraft being slow and an easy prey.

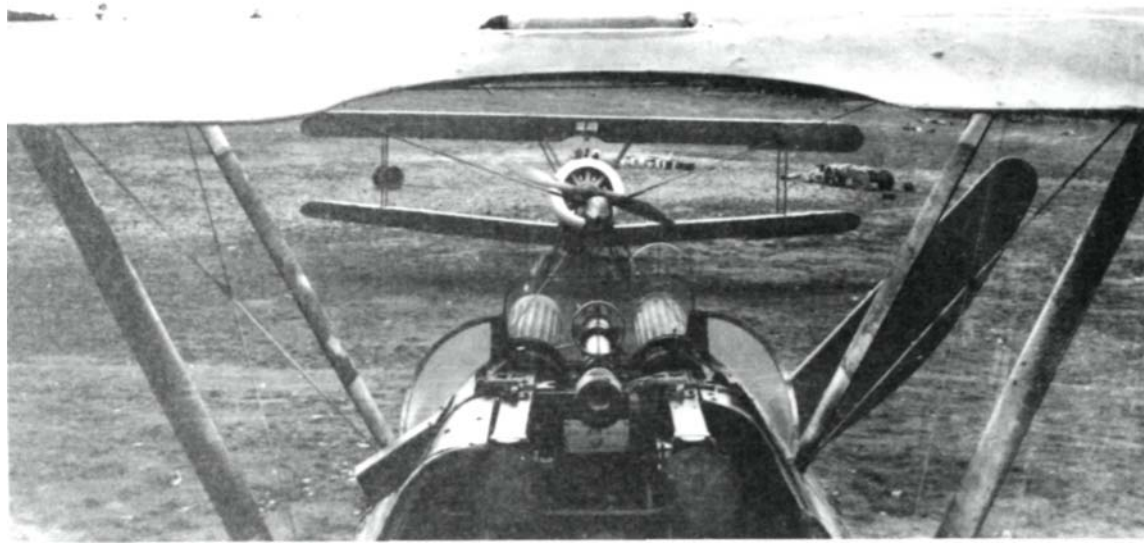
Nevertheless, the loss rate of pilots was very high, averaging 8 per cent per squadron every month, as shown in Figure 2.9.

7. The Development of Bombing

Before mobilization no one in the Royal Flying Corps had given any thought to the possibility of aeroplanes dropping bombs.

It was by pure accident that any were taken out to France. Three days after mobilization one squadron was sent to Eastchurch to co-operate with the Royal Naval Air Service in the defence of London. The CO of this squadron found that the Royal Naval Air Service had some 20 lb. Hales bombs and were proposing to make use of Mills grenades to bring down hostile aeroplanes. Some of both were taken out and the idea was tried of attaching a linen tail to the Mills grenade and throwing them out of aeroplanes. Naturally this was very inefficient, though it was reported that an ammunition wagon was on one occasion blown up by this means.

However new bombs were quickly sent out and at Neuve Chapelle a definite attempt was made to stop movements of German reinforcements by bombing roads and railways. This bombing had very little effect, partly because no bomb sight was yet available, and partly because the weight of bombs dropped was very small.



8. The pilot's view from a Sopwith Camel fighting scout machine. AWM.

At Festubert more bombing was done, but again without any concentration of effort, each aeroplane being given a separate target. At Loos a very complete scheme was drawn up for damaging the German railways, combining the efforts of the Royal Naval Air Service from Dunkirk, the Royal Flying Corps, the French air service, and agents. This was more successful. Six trains were hit and at any rate some delay caused. But there was still no idea of intense bombing, the total dropped from September 23rd-28th being only 5Vi tons.

At the Somme the same principle was adopted ie, using bombing aeroplanes to hinder movements by rail to the front being attacked, and different lines were allotted to brigades for this purpose. Trains in movement were to be the first objective and, if none [was] seen, the bombs were to be dropped on certain important stations, namely, Cambrai, Busigny and St Quentin. From 1st July to 17th November, 1916, 298 tons of bombs were dropped . . .

The first request for specialised bombing squadrons was put forward from France in August 1915 and the first such squadron arrived in February 1916.

Although spasmodic night bombing had been carried out on occasions, it was not till March 1917 that the first night bombing squadron arrived in France. It was equipped with obsolete two-seater pushers and was so successful that others were quickly formed. At the armistice we had six squadrons of this type and 3 Handley Page squadrons, exclusive of the Independent Force.

The size of bombs used increased up to 1650 lbs. The average tonnage per squadron per month dropped from June to October 1918 was 8.5 tons.

8. Low Flying Attacks on Ground Targets

This section relates to the role known today as close air support. Again, names have changed but many of the considerations appeared from these earliest times: in the following discussion, for example, we note the problem of the loss of highly trained crews in ground attacks; and the dilemma of priorities—whether to task the available aircraft to regain control of the air or to support hard-pressed land forces.

Attack by aircraft to assist infantry in the assault was suggested early in 1915. Low flying attacks on the enemy troops were carried out on the Somme and made much progress in 1917. At Arras on two occasions aeroplanes co-operated in this manner in an infantry attack, being given definite objectives. At Third Ypres low flying aeroplanes were generally given a roving commission to attack any suitable targets they saw, and, at any rate in the early stages, no definite scheme of co-operation was drawn up.

In 1918 from March 23rd to 28th the Royal Air Force practically suspended the struggle for air superiority and all the fighters were concentrated on delaying the advance of the enemy's infantry and guns.

In the 8 days March 21st to 28th the Royal Air Force fired over a million rounds at ground targets and dropped over 2 50 tons of bombs mostly from a low height.

Such a course is possible in emergencies and the Air Force must be prepared to do it, but it cannot be continued for more than a few days without heavy losses from enemy aircraft amongst our artillery reconnaissance aeroplanes, with consequent interruption of that work. On 8th August, 1918, all the fighting aircraft of the Fifth Brigade, which was cooperating with the Fourth Army, were concentrated against ground targets, viz, hostile troops, transport, gun teams, ammunition wagons and anti-tank guns. Three single-seater fighter squadrons were allotted to each of the Australian and Canadian Corps fronts, aircraft being sent out in pairs every half hour.

The GHQ fighter squadrons were originally to have taken over the responsibility for air fighting on the Fourth Army front, but were directed at the last moment to low attacks on the bridges over the Somme at Peronne and St Christ.

On the morning of the 8th the weather was foggy and but little loss was suffered from hostile aircraft, but it cleared in the afternoon and many of our artillery and bombing aircraft were brought down by German fighters.

On 10th August some squadrons were consequently brought back to air fighting. It must be remembered that unless the element of surprise is present, the losses in aeroplanes from low flying will always be heavy owing to fire, chiefly machine-gun fire, from the ground. On 8th August we lost a total of 160 aircraft, a large proportion being from low flying, and the point that arises is whether compensating advantage is gained. In the case of squadrons allotted to an army this is for the Commander-in-Chief to decide, but the staff must remember that if skilled fighting pilots are lost in low flying attacks, air superiority may be gained by the opposing side and all form of co-operative work will consequently suffer.

Generally it may be said that low flying attacks against front line trenches do not achieve any sufficient degree of success to compensate for the losses in aircraft and personnel.

When the enemy are retreating low flying attacks are fully worth while, at any rate when the country is difficult to move across, eg, the Turkish retreat in 1918 in Palestine and the Bulgarian retreat in Macedonia.

Attack on a hostile salient favours surprise by low flying aircraft. Low flying aircraft should not be employed near the front line unless pilots know the

FIGURE 2.9

Casualties to Pilots of Single-Seater Fighter Squadrons.

Western Front, January - September, 1918.

Month	Number of Squadrons.		Killed.		Killed by accident.		Died of wounds.		Died of injuries.		Wounded.		Wounded accidentally		Missing.		Other causes.		Total wastage.		Average wastage per Squadron per month.	
	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5.	Camel	S.E.5	Camel
Jan.	8	10	2	1	2	2	-	-	-	-	1	2	3	3	5	13	15	23	28	44	3·6	4·4
Feb.	8	10	-	1	2	3	-	1	-	1	4	3	3	1	8	8	17	22	34	40	4·3	4·0
Mar.	10	10	3	5	-	-	-	3	-	-	13	24	-	-	29	45	-	-	45	77	4·5	7·7
Apl.	12	15	2	9	-	-	-	3	-	-	18	27	-	-	13	49	-	-	33	88	2·7	5·8
May	12	13	1	2	3	7	-	-	-	1	5	3	13	9	25	46	48	46	95	114	7·9	8·7
June	14	17	2	2	4	5	1	-	-	1	6	8	9	4	23	38	36	48	81	106	5·7	6·2
July	14	16	3	4	4	6	1	-	2	3	10	9	5	3	22	54	59	64	106	143	7·5	8·9
Aug.	14	16	2	4	5	7	-	2	1	1	17	30	5	3	36	68	55	59	121	174	8·6	10·8
Sept.	14	15	3	4	2	4	1	2	-	1	18	12	4	7	53	67	45	47	126	144	9·0	9·6
Mean monthly averages per Squadron (approximately)																					6.	8.

Mean wastage in pilots, per month, for Single-Seater Fighter Squadrons (S.E.5 & Camel) – 7. This figure includes not only battle casualties, but wastage due to transfers, postings to Home Establishment, sick, etc.

ground well and are thoroughly acquainted with the general situation, owing to danger of them attacking their own troops.

It might be of interest to note that on the morning of 8th August, all aeroplanes had to follow the road Villers Bretonneux-Brie in order to find their way, and the congestion was so great that traffic regulations had to be issued to avoid collisions.

The best defence against low flying aeroplanes is machine-gun fire. At Third Ypres the Germans at first used their low flying aeroplanes against our front line, but as soon as the infantry began to use machine-guns against them, they avoided the front line and went further on to the artillery.

9. Co-operation with Tanks

Co-operation with tanks really made little progress until No 8 Squadron was definitely allotted to work with them. During the summer of 1918 a fair amount of training was carried out between the tanks and No 8 Squadron. For 8th August 1918 aeroplanes were used chiefly for:

(a) Drowning the noise of tanks assembling.

(b) Close reconnaissance, reports being written and dropped at Brigade or Battalion Headquarters.

A modern equivalent to this first role mentioned is hard to find. The cartoonist might be attracted to the idea of a Number 111 (Tank Noise Drowning) Squadron, perhaps operating F-lll aircraft as very effective converters of aviation fuel into decibels. In more serious vein, however, note the underlying realisation that deception is a matter of vital importance if any sort of surprise is to be achieved.

The 8th August showed that the chief enemy tanks had to fear was the anti-tank gun. It was therefore decided to concentrate the efforts of the tank co-operation squadron chiefly against these guns, and an additional squadron, No 73 single-seater fighters, was allotted for this duty. Special maps were prepared by the Tank Corps showing all likely spots on the front of attack where anti-tank guns were likely to be found and these proved most valuable to the aircraft crews, half the places so marked proving to be active.

On 23rd August 1918 several German anti-tank guns were silenced by aircraft, the two squadrons dropping a total of 22 5 bombs and firing 31 000 rounds at them. More tactical reconnaissance was also carried out, the chief difficulty being means of communication. It was found that the further to the front the messages were dropped the better, those battalions that had their own dropping stations getting good information, those that relied on brigade dropping stations getting very little. The W/T tank should solve the communication problem.

Additional methods of co-operation were also used in 1918, namely, dropping ammunition and sometimes food. On 8th August, 1918, fifty five boxes of ammunition were delivered to the Fourth Army by air, mostly by one squadron

specially detailed for the purpose. On 2nd October, 1918, eighty British and Belgian aeroplanes dropped 15 000 rations (about 13 tons) on Belgian troops in four hours.

10. Training of Personnel

I shall now refer to a few points with regard to training in England.

If we regard this as training in secure home areas away from the direct conflict, then Wrigley's advice is again widely applicable.

In August 1914, as already mentioned, every trained pilot and every aeroplane fit for war went to France. The problem of training new pilots both for replacement of casualties and for the formation of new squadrons was therefore extremely difficult, and we very soon had to send back officers for instructional work. Keeping a balance between the demands for training at home and the requirements of the squadrons at the front was a difficulty throughout the war.

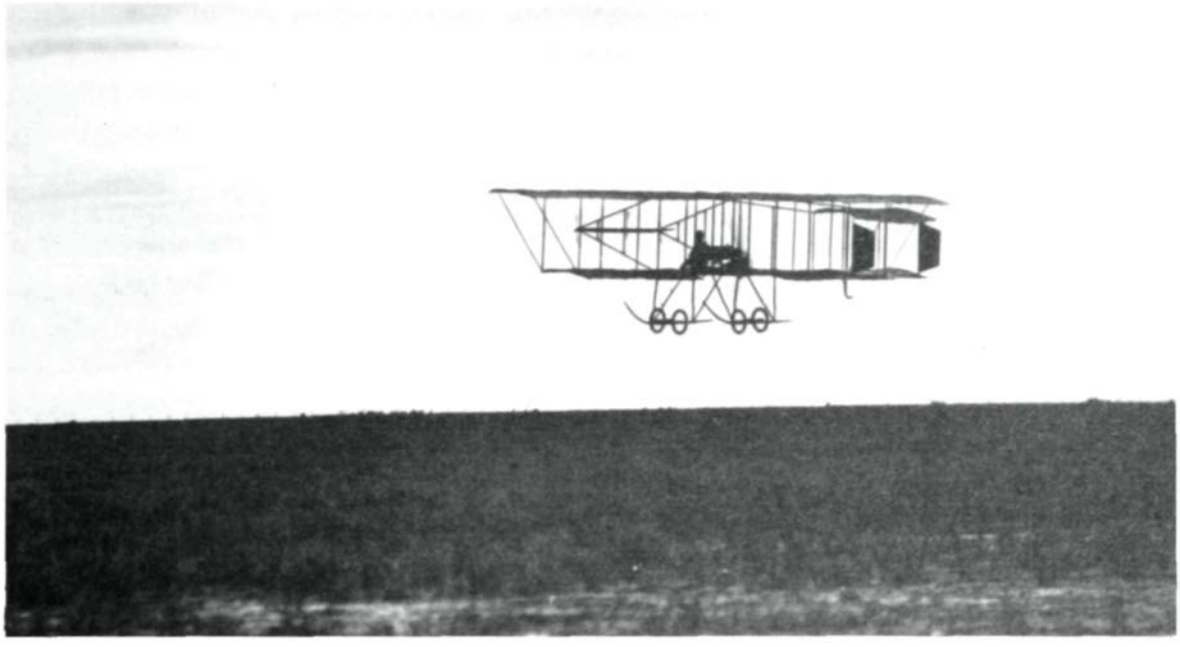
Another problem was this; ought we to keep pilots in England until they were fully trained, or should we send them out partially trained in order to keep existing squadrons up to establishment. The former method meant that casualties in the squadrons at the front could not always be made good, with the consequent loss of efficiency and morale, the latter that the new pilots suffered heavy casualties in air fighting and also brought about losses amongst the older pilots owing to their inability to keep formation.

The main principle that we tried to adhere to throughout was to avoid forming new squadrons until the supply both of personnel and material was sufficient to ensure replacement of casualties in existing squadrons, but abnormally heavy losses in France or a spell of bad weather in England sometimes upset all calculations.

Use was made of civilian training establishments and flying schools were started in France, in Canada and in Egypt. By the Armistice there were 199 training squadrons and inclusive of cadets a total of 30 000 pupils under instruction.

Establishing flying training schools in secure overseas locations can be seen as the precursor to the famous Empire Air Training Scheme which Australia supported strongly during World War II.

The chief development in training occurred in 1916. Up till then the principle adopted had been to get the pupil to fly by himself as early as possible; he would first be taught how to fly straight and then be sent up by himself to do a few straight flights. Then he would be taught simple turns, and so forth. The new system aimed at giving the pupil complete confidence in the air before he was allowed to take solo charge of an aircraft. With this object the instructor would put the pupil through many kinds of manoeuvre, and make him repeat them on the dual control, before he was allowed to make a landing or take up an aircraft by himself.



9. This striking silhouette of a Bristol Boxkite at the Central Flying School, Point Cook, in 1915, beautifully illustrates the 'string and wire' construction of the early training machines. AWM.

11. Supply of Material

And now a few words about technical development.

When the Royal Flying Corps crossed to France in August 1914 every engine and half the aeroplanes were of French manufacture. There was no aircraft industry in England. It all had to be created during the war. At the Armistice all our aeroplanes were of British make and all except about 15% of the engines. The output of aeroplanes was at the rate of nearly 120 a day and of engines about 100 a day.

In the supply of material, as in the case of pilots, we had to keep a balance; in the former case between the need for immediate output and the desirability of thorough tests of a new design before putting it into production.

Our demands from France for better aeroplanes and for increased numbers were high. People in England declared they were unreasonable. At the same time, if production of a new type was unduly hastened, the aircraft proved unreliable. A good instance of this occurred at the end of the war when, happily, the effects were not felt. A new type of engine was designed, put through a few tests and appeared to meet all requirements so perfectly that orders were placed for 11 000 of them. However it was found that after a few hours running in the air, the engine began to break down and in spite of every effort extending for 2 years after the Armistice we finally condemned this type altogether as being unsuitable for service use.

On the other hand the result of testing out new aeroplanes and engines thoroughly before going to production was that they were out of date and outclassed by the time we got the first squadron overseas.

Another difficulty was with regard to modification to design. In France we would continually be finding some essential or desirable alteration to aeroplanes

or engines. But if this was introduced during the process of manufacture, much delay in output would be caused, because the factories concerned, being laid out on a production basis, could not make any change rapidly. We got over this to some extent by making modifications at our own depots in England or in France.

Then in common with many other branches we were continually up against the brick wall of absolute shortage. In the early stages of the war we imagined that all that was necessary in order to obtain material, was to give orders, pay liberally, and to keep on pressing the manufacturers. It took some time to realise that this was not the case and what it all entailed. On one occasion Royal Flying Corps Headquarters in France postponed the re-equipment of a squadron with new aircraft on hearing that a ship with special Swedish iron for making ball bearings had been sunk in the North Sea.

Another point to notice is the development of specialisation. In August 1914 there was practically only one type of aeroplane which was supposed to be capable of fulfilling all duties. Then fighting aircraft were specialised and later on fighting squadrons. After that came the specialised bombing squadrons, then the night bomber and finally the aircraft for observation of long range artillery fire and the armoured aircraft for low flying. There was a tendency to over specialisation towards the end of the war.

12. General Retrospect

Besides giving an abbreviated history of flying developments, this section contains more advice which could usefully appear in the modern text book. Wrigley urges attention to joint training, technical development and the use of civilian resources.

However, he reminds us of the important human element in all this. He would have us test our attitudes of mind: the limits we may have put upon our capabilities and flexibility; the need for foresight and imagination, that quality in a commander which is easily said and hard achieved, in-sight—Clausewitz's *coup d'oeuil,* Sun Tzu's *ch'i* energy. Finally, he says, 'there is a need for some sort of thinking department'. Wrigley's examples are of a technical and tactical nature, but the principle applies even more urgently at the strategic level in the formulation of national security policies.

There are, I think certain lessons one can draw from all the above. First, the need for imagination in foreseeing the possible application of new developments to war. Some five years before the war, a very senior officer said that he could conceive of no conditions under which aeroplanes could be of any use in war. In 1910 the officer responsible at that time for the progress of military aviation in Great Brita in said that it was ridiculous to suppose any one would ever be able to observe troops from aeroplanes, because his whole energy would be devoted to holding on with both hands and that he would be gripping so tight that he would squeeze sap out of the struts. This latter officer might have foreseen that aeroplanes would not always be of the box kite variety where one sat on a sort of horizontal ladder with nothing below except the ground.

Another lesson is the need for training together. This was important when we were two branches of the same service. It is still more so now we are separate services. Of course this is a platitude, but is so self evident that people are inclined to forget its importance. The failure of close tactical reconnaissance at Festubert was due to lack of training and put back progress for 12 months. Contrast this with the successful co-operation between aeroplanes and tanks in August 1918, due to the training that had been carried out in the previous few weeks.

Then there is the need for ensuring that technical developments in the services are not pursued for their own sake only, but are put to practical application. Before the war W/T in aircraft had really made great progress and two aeroplanes had communicated with each other by morse code over distances of 5 miles. This was certainly a great achievement but there was no object in it at that time. On the other hand, if we could have had those two aeroplanes on Salisbury Plain for a couple of months to do artillery work, we might have gone to the war with the clock code and with a dozen W/T aeroplanes instead of two.

Another point is the need for the services keeping in touch with developments in civil life and not being ashamed to seek for civilian help. Up till the end of 1914 we had been dealing with W/T and photography from the point of view of the enthusiastic amateur, and it was not until we called in civilian aid that the subsequent developments became possible. Again, had pilots of the Royal Flying Corps not laughed a civilian's suggestion to scorn, we might have had an interrupter gear for firing through the airscrew before the enemy instead of after him.

Above all there is the fact that progress depends as much upon attitude of mind as upon technical developments. In October 1914 we were flying in weather which in the previous July would have been regarded as certain to lead to a fatal accident. Up till 1916 if a pilot got into a spin, a fatal accident was regarded as a certainty. Then one day some one decided to try out a theory on the subject and found that getting out of a spin was really quite simple. A few weeks later it became a recognised manoeuvre and was taught to pilots in their early training.

Night flying in scouts was discovered to be possible, really by accident, in September 1917, simultaneously in France and England. Then we had set too low a limit to human endeavour. It was soon found in war that a pilot could do far more than had ever been thought possible in peace, eg, control an aeroplane and use a machine gun.

Finally there is the need for some sort of thinking department. Often and often throughout the war when some development occurred, we wondered why we hadn't thought of it before, and nearly always came to the conclusion that there was no real reason. It was only lack of foresight. This applied particularly to air fighting.

As early as 1911 many had said that aeroplanes would fight in the air, but no one carried that idea to its logical conclusion and thought how one would fight and how the design of aircraft must be modified in consequence. The result was that most of our aircraft were not only unsuitable for fighting but impossible to fight in, for instance the BE of which we had 7 squadrons at

Arras. The fact is that those who ought to have been thinking these things out were too deeply immersed in daily work, too occupied with coaxing aeroplanes into the air and teaching pilots to bring them down again without breaking their necks.

A statistical 'General Retrospect' is given by Figure 2.10.

Some Miscellaneous Statistics for the Western Front, 1914 - 1918.

1. Hours Flown.

Average per aeroplane per month for 1917. 30·8 hours.

2. Bombs Dropped.

1917. Average per squadron per month. 1·24 tons.

1918. June to October inclusive —

Average per squadron per month (FLANDERS Front)

Cooper.	3·75 tons.
Heavier types	4·75 tons.
Total all types.	8·5 tons.

Average per squadron per month Independent Force.

D.H.9 Squadron.	9·3 tons.
Handley Page Squadron.	25·7 tons.

3. Expenditure of Special Aircraft Ammunition.

Average per squadron per month on FLANDERS Front in 1917.

Sparklet.	Buckingham.	Ordinary.	Links.
11.000	1.200	22.000	16.000

4. Aeroplane Wastage.

During the year ending October, 1917, the total wastage in squadrons was 3177 aircraft, or 56·7 per cent. per month.

This takes no account of aeroplanes that were overhauled in Depots, but represents the number that had to be replaced in squadrons. During the same 12 months, the depots repaired approximately 1100 aeroplanes, leaving 2.077 to be supplied from ENGLAND or from French manufacturers.

Wastage in Squadrons in 1918.

(See next page).

Month.	Bad aerodromes.	Errors of pilots.	Enemy action.	Missing.	Time expired.	Forced landings due to engine failure and similar causes.	Total.
March.	42	151	160	151	17	318	839
April.	35	140	154	84	28	258	699
May.	38	248	110	124	46	208	774
June.	38	244	107	114	46	214	763
July.	39	259	86	126	79	196	785
August.	20	212	212	203	77	241	965
September.	18	163	190	244	63	226	904
October.	42	192	159	150	58	234	835
Totals.	272	1609	1178	1196	414	1895	6564

It will be noticed that wastage due to enemy action and missing only accounts for 2374 of the total, or 36 per cent.

The following is an analysis of the causes of casualties from enemy action.–

Month.	Machine gun fire from ground.	A.A. Fire.	Enemy aircraft.
July, 1918.	15	18	51
August, 1918.	34	23	76

The above does not include all casualties from enemy action but only those for which information is available

5. 1917.

Detail.	Jan.	Feb.	Mar.	Apl.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Enemy aircraft brought down on enemy's side.	18	16	29	91	110	121	116	128	132	101	42	40	944
Enemy aircraft brought down on our side.	10	3	5	11	6	9	6	7	7	7	7	17	95
Enemy aircraft brought down by A.A., m.g. fire and infantry.				6	13	8	5	2	13	7	8	12	74
Enemy aircraft driven down out of control.	18	25	48	174	114	99	120	103	122	60	37	28	948
Our aircraft missing	14	19	52	152	88	80	90	105	124	109	71	30	934
Enemy balloons brought down.			1	18	14	2	5	3	2	1	2	1	49
Bombs dropped. (tons)	10	12¾	6	62¾	55	48¾	66½	79	125	113¼	58½	64½	699
Time flown, hours.	10.424	12.156	14.728	29.613	39.423	35.328	32.906	31.794	38.424	30.605	17.717	17.942	311.061
Enemy batteries successfully engaged for destruction.							1940	1860	1372	1189	291	360	7012
Pits destroyed.							345	364	138	114	33	23	1017
Photographs taken	5352	5837	5822	11.682	11.795	11.893	13.165	11.102	15.837	11.224	5000	9993	118.702

Detail.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Number of R.F.C. squadrons in the Field.	40	41	45	46	46	46	46	46	49	53	51	52	
Number of R.F.C. aircraft in the Field.	720	738	810	828	828	828	828	828	882	954	918	936	

6. Table Showing Casualties to Pilots on the Western Front, 1917.

Casualties include dead, wounded and sick, but not transfers to Home Establishment on promotion or on account of length of service in FRANCE

Type of Aircraft.	July.				August.				September.			
	46 Squadrons. 828 Aircraft				46 Squadrons. 828 Aircraft				49 Squadrons. 882 Aircraft.			
	No. of Sqdns.	No. of Aircraft	Casualties to pilots		No. of Sqdns.	No. of Aircraft	Casualties to pilots.		No. of Sqdns.	No. of Aircraft	Casualties to pilots.	
			No.	%			No.	%			No.	%
Sopwith Scout.	3	54	9	16·7	2	36	9	25	3	54	16	29·6
Sopwith Camel.	1	18	12	66·7	2	36	18	50	2	36	32	88·9
D.H.2.	3	54	15	27·8	3	54	12	22·2	3	54	16	29·6
S.E.5.	1	18	7	38·9	2	36	8	22·2	3	54	17	31·5
Nieuport Scout.	4	72	27	37·5	3	54	18	33·3	3	54	20	37
S.P.A.D.	2	36	11	30·6	2	36	19	52·8	2	36	17	47·2
B.E.	2	36			1	18						
R.E.	14	252	45	17·9	15	270	38	14·1	16	288	40	13·9
A.W.	3	54			3	54	3	5·5	4	72	4	5·5
Morane.	1	18			1	18			1	18	3	16·7
Sopwith Two-seater.	2	36	9	25	1	18	6	33·3	1	18	5	27·8
Bristol Fighter.	3	54	7	13	3	54	18	33·3	4	72	25	34·7
F.E.2b.	1	18	2	11·1	2	36	2	5·5	2	36	9	25
F.E.2d.	1	18	5	27·8	1	18	4	22·2				
D.H.4.	4	72	23	31·9	4	72	19	26·4	4	72	9	12·5
Martinsyde.	1	18	7	38·9	1	18	6	33·3	1	18	4	22·2

Totals, 1st January to 31st December, 1917.

Type of Aircraft.	Average number of aircraft per month.	Number of months aircraft were used.	Percentage of Casualties to Pilots for whole period.
Sopwith Scout.	40½	12	19·7
Sopwith Camel.	60	6	42·2
D.H. 2.	42	6	13·9
D.H. 5.	54	7	20·9
S.E. 5.	46	9	22·2
Nieuport Scout.	55½	12	32·7
S.P.A.D.	30	12	33·9
F.E. 8.	24	6	15·3
B.E.	166½	8	12·8
R.E. 8.	186	12	13·2
A.W.	48	12	5·4
Morane.	18	9	8·6
Sopwith Two-seater.	43	9	20·4
Bristol Fighter.	52	9	23·1
F.E. 2 b.	63	12	14·3
F.E. 2 d.	32	8	32·5
D.H. 4.	61	10	18·9
Martinsyde.	18	10	16·7
		General Percentage.	18·4.

DOCUMENT 8.

Precis of Lectures on Air Warfare

This document, unlike most of the others so far, is really a set of notes, summarising a wide range of air warfare matters. Considering its condensed style, the original document of some 80 numbered paragraphs encompasses a great amount of detailed discussion. It cannot be read as an essay but is a rich source of aphorisms and wisdom, almost like a book of proverbs.

To some extent it repeats the contents of other documents, and has therefore been slightly abbreviated. However, the main theme here now moves from strategy to operational guidance and tactics. The references to air power principles and strategy are used to set the scene for detailed advice on such matters as formation flying, close air support, selection of targets and many other issues which can only be ignored at the risk of 'spoiling the ship for a hap'orth of tar'.

As was the case with Wrigley's notes on 'The Nature of War', he would have made use here of a series of lectures given by Air Commodore Ludlow-Hewitt, the Commandant of the RAF Staff College. In this instance, nine lectures on 'Air Warfare' were presented by Ludlow-Hewitt in February 1928. It is probable that Wrigley also incorporated some of the observations on air defence made by Air Marshals Salmond, Steel and Brooke-Popham which were cited in the editorial introduction to Document 7.

The structure of headings is logical but sometimes a little confusing. There are seven parts, I to VII. The first five have several groups of paragraphs, lettered consecutively from A to L.

I. **AIR** POWER

A. THE AIR FORCE AND ITS STRATEGY

1. Introduction

Misconceptions about air strategy.

In view of the controversial phase through which the subject of air strategy is at present passing, every officer should reason out his ideas on the subject from first principles and not accept other people's views without critical examination . . .

2. Air Power

The principal instruments of air power are aeroplanes and bombs. The gun is equally necessary and is subsidiary to the bomb. The bomb is the offensive weapon and the gun the defensive.

Air strategy is mainly concerned with the operation of bombers and fighters.

Today, the utility of other roles such as air transport, surveillance and electronic warfare have changed this balance. The next statement, however, has lost none of its power, although it is often a point of strong contention. One modern 'heresy' is to draw a line at the coast and attach air concepts narrowly to one side or the other. The control of air space is a national issue, and must be an integral part of national security planning.

From a strategical point of view the air is all one and should be so regarded.

3. The Use of the Term 'Independent' as applied to an Air Force or Its Operations.

Neither the Air Force nor its operations are independent.
The nation fights as a whole and depends for success upon the co-ordinated and unified action of its parts.
The more the three services can be trained and used as one weapon the better.

B. THE SPECIAL CHARACTERISTICS OF AIR WARFARE

4. Principles of War

Air strategy is governed by the principles of war just like any other kind of strategy, but the application of the principles to air warfare cannot be the same as in land warfare because the conditions are so different.

5. Conditions Peculiar to Air Warfare

Air operations are influenced by certain special conditions which are different from those found in the operations of the other services.

The most important of these are:

(a) The great air spaces.
(b) The third dimension.
(c) The high speed of aircraft.
(d) The short endurance of aircraft. (Therefore all opportunities are fleeting.)

6. Military Characteristics of Aircraft

The principal military conditions resulting from these factors are:

(a) The difficulty of interception.
(b) The ease of evasion.
(c) The lack of stopping power of aircraft.
(d) The power of penetration of aircraft.

C. ECONOMY OF FORCE

7. The Offensive and Defensive

The offensive and the defensive enter into every strategical problem. There can be no offensive except from a strong defensive, ie, secure bases.
The easier evasion is in war the more difficult becomes the problem of security, and the more apparent and important becomes the defensive side of strategy.

8. The Allocation of Force between the Offensive and the Defensive

The offensive wins wars; neglect of the defensive may lose them.

The offensive implies concentration; the defensive necessitates dispersion.

The weakness of the defensive in air warfare combined with the lack of cover provided by the offensive will give rise to strong demands for more protection.

Demands for more protection are antagonistic to concentration for the offensive.

The people of a nation generally demand immediate security everywhere, requiring strong local protection and dispersion of force.

In air warfare this means reinforcing and increasing the number of fighters at the expense of the bombers, hence, a definite weakening of the striking force.

If unchecked this tendency leads to the abandonment of the offensive and reliance upon passive defence.

Hence, the allocation of force between the offensive and the defensive for home defence and for operations in connection with land or sea warfare is a problem requiring very thorough consideration.

Defensive measures must be kept to the lowest limit possible.

9. Principle of Economy of Force

The importance of the principle of economy of force and the special need to study its application in air warfare.

II. AIR TACTICS

D. THE NATURAL FACTORS IN AIR TACTICS

By 'natural', Wrigley means physical considerations such as the range and speed of the aircraft of the day. These have developed so far as to make most of this part of historical interest only. However, it does provide a picture of conditions and the aircraft of the time.

10. Introductory Remarks

Application of principles of war to air tactics.

No rigid rules in tactics. Tactics must always be largely governed by the individuality of the leader.

The development of tactics in peace time necessarily theoretical.

Importance of keeping tactical development in line with technical progress and not allow it to lag behind.

Tendency to attach too much importance to past war experience.

11. The Influence of Altitude on Air Tactics

Similarity of altitude to the weather gage in naval tactics in the days of the sailing ship.

Superior altitude confers the initiative and superior mobility. Can choose to attack when and where one likes.

The single-seater aircraft diving to attack from a superior altitude has also the

advantages that:

(a) He is protected, to some extent, by his engine.

(b) The conditions favour accurate shooting. The value of the altitude factor tends to make pilots fly higher and higher. It was on this account that aircraft during the war flew at great altitudes, and not because they were driven up by anti-aircraft fire.

Influence of the advantage of altitude upon the design of fighting aircraft.

12. Single-Seater Fighters

Advantage of single-seater fighter mainly dependent upon superior rate of climb. This advantage likely to be permanent, and renders them particularly suitable where rapid interception is required.

Other characteristics of single-seater fighters:

(a) Superior manoeuvrability.

(b) Superior speed.

(c) Radius of action sacrificed to performance.

(d) No rear guns and, therefore, no rear guard.

(e) Difficulty of concentrating fire with fixed guns.

Results of these characteristics:

(a) and (b) confer tactical initiative.

(c) confines action to short radius.

(d) renders single-seaters unsuitable for unsupported long distance work over enemy territory.

(e) puts them at a disadvantage in attack upon good bombing formations.

13. General Inference

High speed, manoeuvrability and superior climb of single-seater fighters renders them particularly suitable for air defence work.

Their lack of defensive fighting power and radius of action renders them unsuitable for distant offensive action.

Single-seater fighters are, therefore, strategically defensive and tactically offensive.

14. Two-Seater Fighters

Their longer endurance and additional guns render them particularly suitable for long range fighting.

In combat with single-seater fighters their inferior performance confines them mainly to a tactical defensive. Against bombing formations and other aircraft of inferior performance, two-seaters can develop a more powerful concentration of fire than single seaters.

Their inferior rate of climb renders them less suitable for air defence.

15. Bombing Aircraft

Bombing aircraft being of inferior performance have normally to employ defensive tactical methods. Therefore, their task being to attack the enemy by air bombardment they are strategically offensive but tactically defensive.

E. THE PRINCIPLE OF CONCENTRATION

16. Concentration of Fire on Weapon Concentration

Methods of obtaining concentration of fire:

(a) Superior number of guns.
(b) Greater rapidity of fire from guns.
(c) Greater projectile effect.
(d) Superior direction of fire, ie, accuracy and control.

17. Comparison of Big Guns and Small Guns

.5 machine gun compared with the .303 and the projected .28 gun.

(a) Advantages of the .5
  (i) Heavier and more destructive bullet,
  (ii) More accurate at long range.
(b) Advantages of a small calibre machine gun.
  (i) Greater rapidity of fire,
  (ii) More guns and ammunition can be carried
  (iii) A handier weapon for the gunner.

18. Other Factors in Weapon Concentration

(a) Training.

Importance of speed and efficiency in the correction of defects and stoppages.

Accuracy.

Quick handling of gun.

(b) Command.

Direction and control of fire in the air.

(c) Design.

The elimination of blind spots.

All round concentration.

The broadside in aircraft.

The fighting value of the big aeroplane.

19. Tactical Concentration

Aircraft of inferior performance should not attempt to get results by employing methods unsuitable to their special characteristics. The strength of the heavier types of aircraft lies in their gun power from a steady platform, not in high speed and manoeuvre.

Multiple seater aircraft develop their greatest defensive power when flying in close formation. The objective of such formation is to obtain:

(a) Tactical concentration.
(b) Fire control.
(c) Mutual support.

20. Single-Seater Formations

The rigid single-seater formation is unsuitable for:

(a) Offensive purposes.
(b) Developing concentration of fire.

The rigid formation was developed for defensive purposes and for fighting enemy single-seaters over enemy territory. It is not required against defensive formations.

The advantage of single-seaters and other fighting aircraft lies in their superior mobility and freedom of movement. These special qualities must be fully exploited to get the best weapon concentration.

Single-seater formations should therefore be as elastic as possible.

F. TACTICAL SECURITY

21. Some Factors of Tactical Security in the Air

(a) Mobility.
(b) Evasion.
(c) Tactical dispositions.
(d) Protection (Armour).
(e) Alertness.

22. Mobility, Evasion and Armour as Methods of Security

Evasion as a means of security. The use of great altitudes, high speed and clouds.

Advantages and disadvantages of evasion.

Bad moral effect of the continual practice of evasion.

Ultimate need to prove and establish superiority by actual fighting.

Use of evasion by fast bombers, lightly loaded and lightly armed in small formations.

Evasion and armament are antagonistic to methods of evasion.

The use of armour as a means of security.

23. The Formation as a Means of Security

The value of formations as a means of security depends upon:

(a) Efficient command and direction.
(b) Drill and discipline.
(c) Individual efficiency of personnel.
(d) Good tactical instructions.
(e) Suitable methods of communication.

24. The Formation Leader

Position of the formation leader in the formation. Qualities required of the leader.

25. Drill and Discipline

Cohesion and elasticity under all circumstances.

Mutual support demands high discipline and self-control.

26. Individual Efficiency of Personnel

Good gunnery, air pilotage and navigation.

27. Tactical Instructions and Signals in the **Air**

Signals in the air should be as few and as simple as possible.

Tactical instructions are those given before leaving the ground and should be full and clear so as to reduce signals in the air to the minimum.

Crews must be thoroughly familiar with tactical instructions. They may deal with:

Lookout responsibility.

Tactical manoeuvres.

Distances to be kept.

Direction of fire.

Action on reaching objective.

Action in case of a straggler.

Action in case of engine trouble or partial disablement of one aircraft.

Other special circumstances likely to arrive.

28. Communication in the **Air**

Is R/T [radio telephony] suitable for the special conditions required in air fighting? Advantages and disadvantages of R/T.

Alternative possibilities. The use of Morse or lights.

Need for good communications to permit of direction of fire in the air.

Importance of good direction of fire.

29. Size and Nature of Formations

The size of the unit or sub-formation.

Principle that sub-formation should be of the minimum size but large enough to take care of itself when isolated.

Larger formations may be composed of several sub-formations.

Need to avoid any rigidity as regards numbers.

Owing to inevitable losses involved in air fighting formations must not depend upon precise uniformity of arrangement.

Small formations for evasion; large formations for fighting.

Bombing formations are entirely defensive in character; their strength depends on maintaining a steady speed and a steady platform for their guns. High speed and manoeuvre not necessary to the fighting power of the bombing formation.

30. Reserves and Supports

The use of a reserve or support at high altitude either for security or as a reserve for offensive fighting.

G. TACTICAL METHODS AND MOVEMENTS

31. The Principle of Surprise

Use of surprise in air fighting during War 1914-1918.

A formation not necessarily difficult to surprise because:

(a) Organisation of all round lookout is difficult.

(b) Difficulty of communication.

(c) Small crews fully occupied in fighting in one direction can be surprised from another.

32. Methods of Surprise

The following are some of the factors which may be used to facilitate surprise:

(a) Speed of attack and slow manipulation of guns in defence.

(b) Small size of aircraft and speed of approach.

(c) Blind spots of defending aircraft.

(d) Number of lines of approach in three dimensions.

(e) The sun, clouds and visibility conditions generally.

(f) Divided tactics.

33. Divided Tactics in Attack

Straightforward frontal attack inadequate.

Superior mobility and freedom of manoeuvre of attacking aircraft must be exploited.

For single-seater fighters, elastic formations necessary for offensive purposes to permit of the utmost development of co-ordinated individual action combined with full exploitation of superior speed and manoeuvrability.

All tactics must be as simple as possible, but will require a high standard of drill and training.

34. Methods of Attack—Single-Seater Fighters

(a) Close attack.

The methods of concentration of fire by single-seaters.

Converging attack.

Number of individual attacks which can be made on a single formation.

Attack that part of the hostile formation where mutual support is the most difficult to effect, eg, in the case of formations at different altitudes attack the higher.

Take advantage of the weaknesses of the enemy formation and of his aircraft.

Feint attacks and decisive attacks.

Flank attacks. Value of deflection fire.

Attacks from ahead; advantages and disadvantages.

Attacks on the leader.

Continuity of attack.

(b) Long range attack.

By accurate shooting from long range without deflection.

Use of long range attack in the air.

Possible advantages as regards concentration of fire.

Moral effect of this form of attack.

35. Methods of Attack—Two-Seater Fighters

Their superior speed enables them to take up the best position to concentrate their back guns on the enemy formation . . .

H. MORALE

37. Morale

The material factor tends to predominate in peace time, the moral factor in war time.

Unreality in peace time exercises.

Moral effect of superior equipment.

38. Surprise

Speed as against hanging about.

Effect of hesitation in air fighting.

Advantage of thoroughly practising drill movements.

39. The Offensive Spirit

III. THE DEVELOPMENT OF AIR STRATEGY

I. THE EVOLUTION OF THE OFFENSIVE PATROL

40. Aircraft in 1914

Regarded as of value for reconnaissance only.

Aircraft not armed nor fitted to carry bombs.

At first no air fighting, but this began to develop after the stabilisation of the line at the beginning of trench warfare.

In the Spring of 1915 a demand arose for the protection of army co-operation aircraft.

41. Escorts

The first attempt to provide protection for co-operating aircraft took the form of the direct escort.

Disadvantages of the escort in air warfare:

(a) Dispersion of force.
(b) Weakness of detachments.
(c) Surrender of the initiative.
(d) Susceptibility to surprise.

42. Defensive Patrols

Escorts were replaced in May 1915 by defensive patrols.

Disadvantages of the defensive patrol in its use as a covering force:

(a) Dispersion of force.
(b) Role purely defensive, therefore surrendered initiative.

(c) Easy to evade.
(d) Restricted freedom of action unsuitable to air fighting.

43. Offensive Patrols

Failure of escorts and defensive patrols led to the realization of the weakness of any fixed defensive system of protection in the air.

The importance of the initiative and freedom of action in air fighting was seen. Hence, development of the offensive patrol system.

Object—to seek out and destroy the enemy's aircraft.

Patrols given a free hand to find and fight the enemy.

The patrols were designed to intercept the enemy before he reached the lines.

Logical development of offensive patrols is close blockade of enemy aerodromes, if practicable . . .

J. THE SUCCESS OF THE OFFENSIVE PATROL AND AFTER

45. The Offensive Patrol System in 1916-1917

Success at Verdun and on the Somme.

Its superiority to the German and French barrage system.

The use of the latter by the Germans and French.

46. Advantages and Disadvantages of the Offensive Patrol System

(a) Advantages.
  (i) Good for morale.
  (ii) Kept the enemy fighting aircraft busy well away from the lines,
  (iii) Practically prevented enemy army co-operation aircraft from working effectively.

(b) Disadvantages.
  (i) Expensive in casualties,
  (ii) Dispersion of effort over a great area.
  (iii) The weak patrols easily overwhelmed by larger concentrations of enemy fighters.

The offensive patrol system was, in fact, ineffective when met by large concentrations of German aircraft.

47. Concentrations of Fighting Aircraft

(a) Concentration in time.
(b) Concentration in space.
(c) Concentration in time and space.

Difficulty of dealing with enemy concentrations.

Techniques for dispersion and concentration are illustrated by Figures 2.11 to 2.14.

FIGURE 2.11

DISPERSION ON BOTH SIDES.

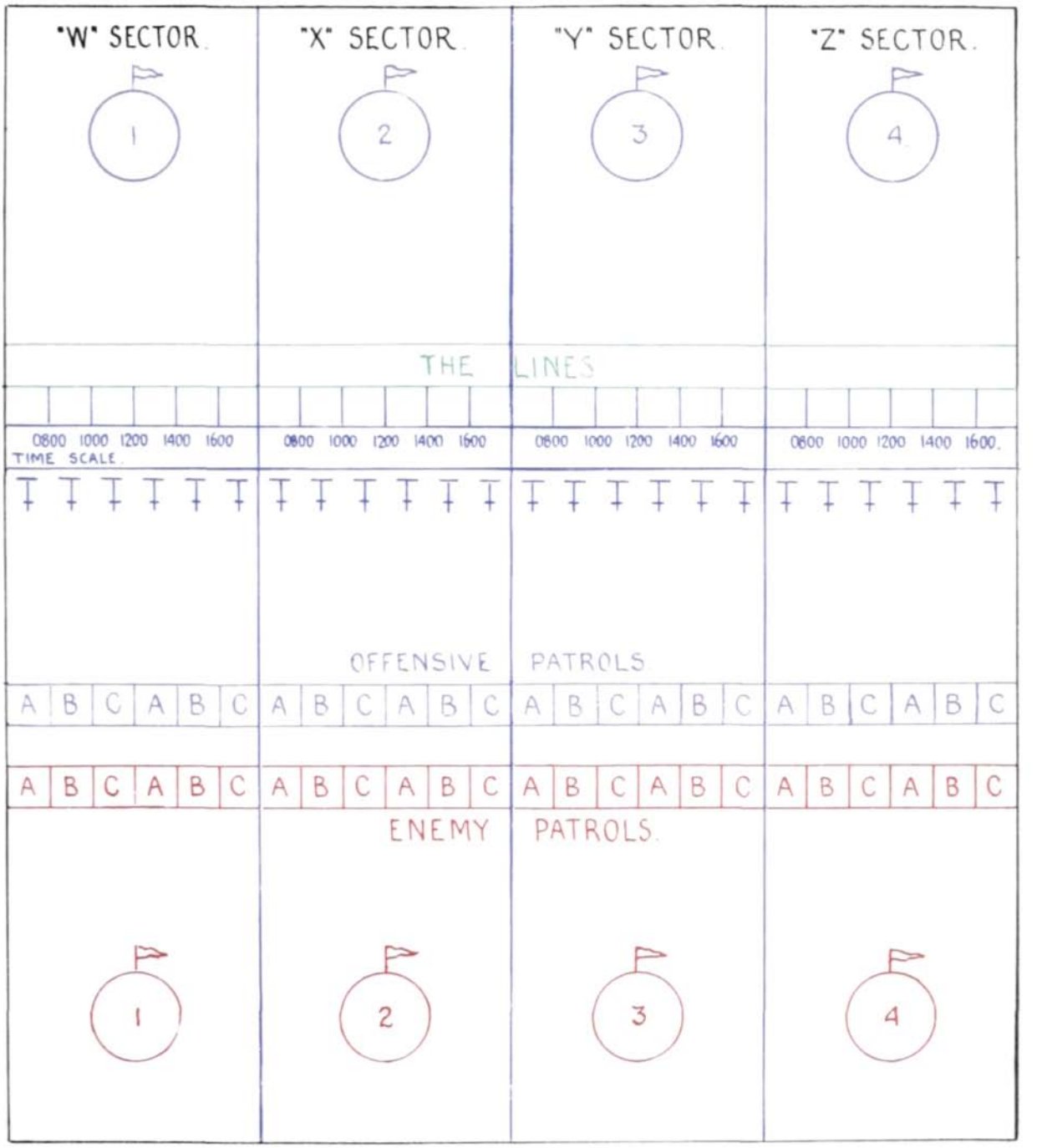
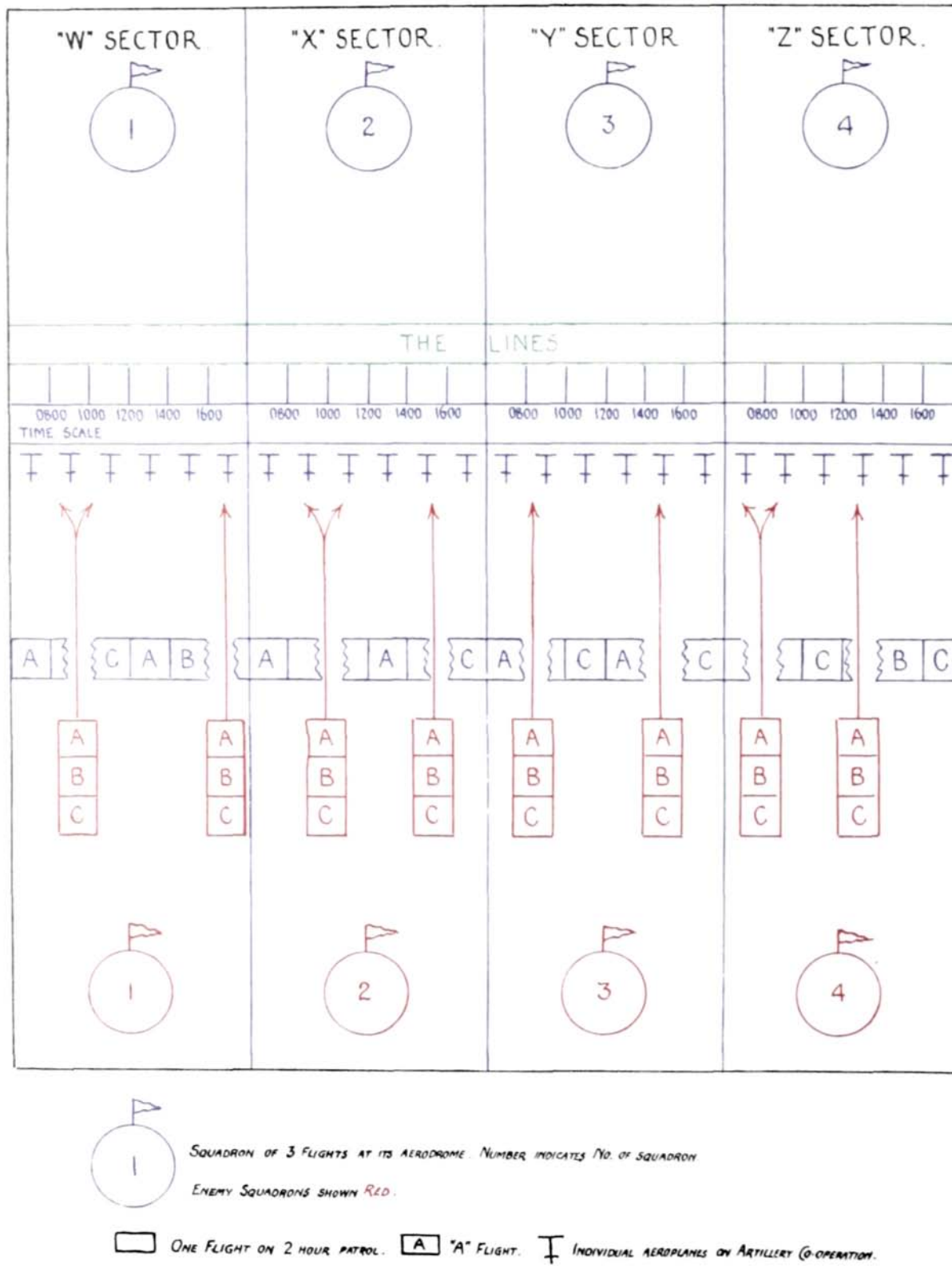


FIGURE 2.12

CONCENTRATION IN TIME.



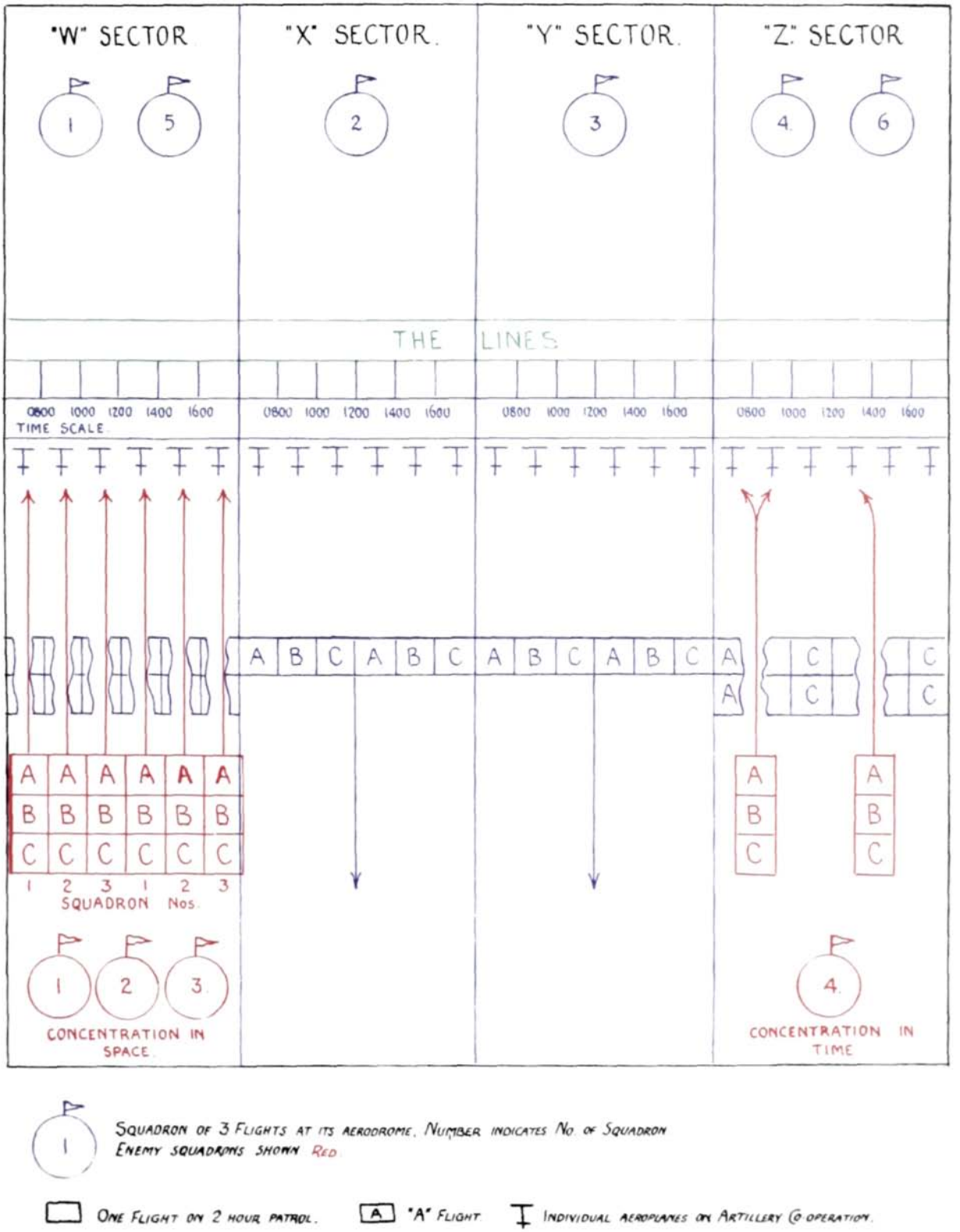
1 — Squadron of 3 Flights at its aerodrome. Number indicates No. of squadron.

Enemy Squadrons shown Red.

One Flight on 2 hour patrol. [A] "A" Flight. Individual aeroplanes on Artillery Co-operation.

FIGURE 2.13

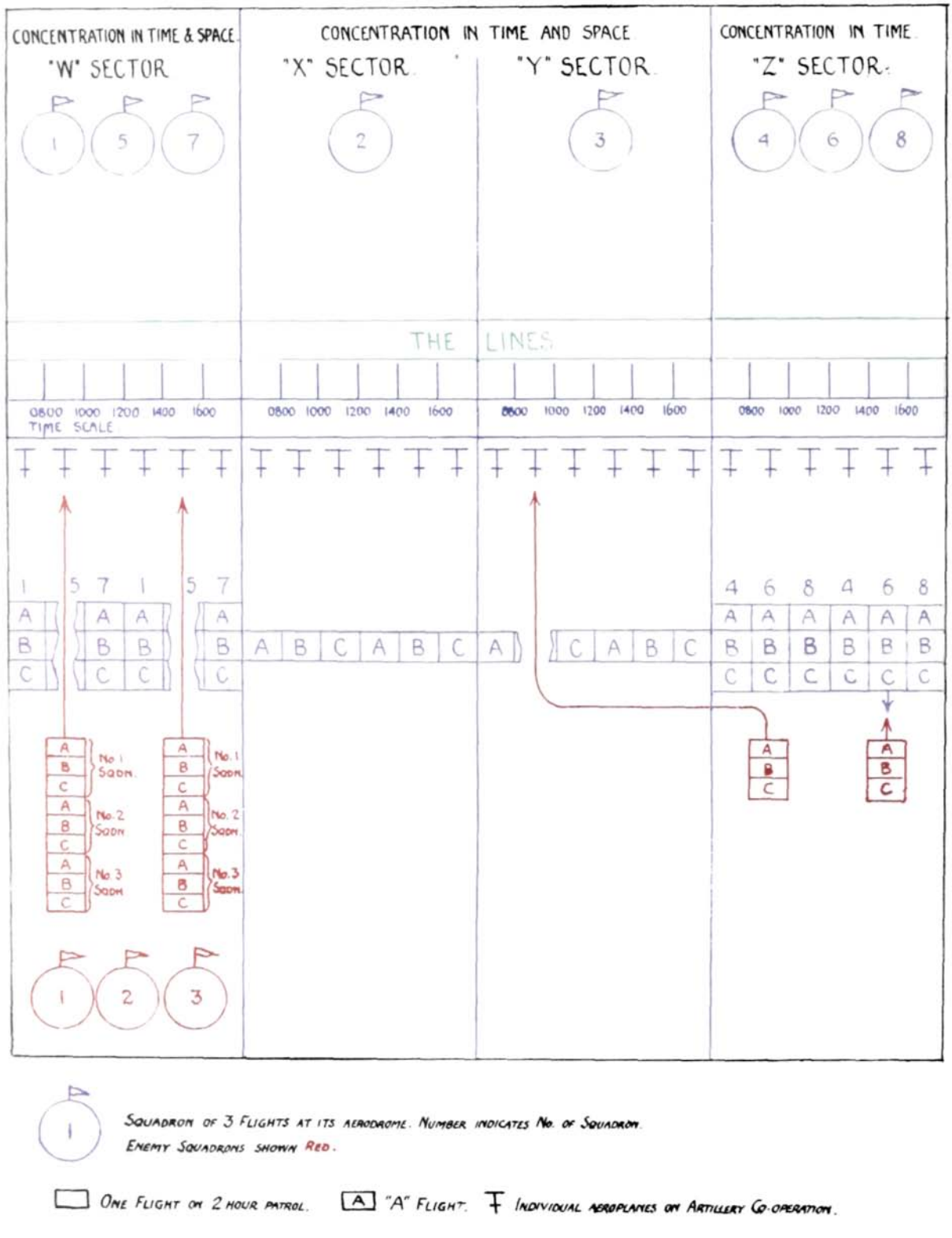
DISPERSION



1 — Squadron of 3 Flights at its aerodrome. Number indicates No. of Squadron. Enemy squadrons shown Red.

One Flight on 2 hour patrol. A — "A" Flight. Individual aeroplanes on Artillery Co-operation.

FIGURE 2.14



1 Squadron of 3 Flights at its aerodrome. Number indicates No. of Squadron. Enemy Squadrons shown Red.

One Flight on 2 hour patrol. [A] "A" Flight. Individual aeroplanes on Artillery Co-operation.

48. The Problem of Bringing Enemy Fighting Aircraft to Action in the Air

Inability of fighting aircraft alone to bring the enemy to battle.

Analogy in naval warfare.

Unless the navy can threaten something vital to the enemy's security it has no means of compelling the enemy fleet to come out and fight.

The army the sword of the navy.

In air warfare, air bombardment can be used to force the enemy aircraft to fight in defence of vulnerable points.

49. The Use of Air Bombardment as a Means of Weakening the Enemy Concentrations on the Lines

Air bombardment used to divert enemy aircraft to the defence of vulnerable points. Examples during the War 1914-1918.

IV. THE AIR BATTLE

K. INTERCEPTION AND BOMBING RANGE

50. Interception

(a) Interception from the ground.

Dependent upon obtaining sufficient notice of enemy approach.

Notice required varies with height of enemy and strength and direction of wind.

(b) Static interception by defensive patrols.

A bad and wasteful system entailing dispersion.

Static interception often necessary and justifiable.

Objectives to be defended should be limited in number and size and of great importance, such as a port, an anchorage, and an aircraft carrier.

51. Air Defence (By interception from the ground)

The position of observation posts and fighter aerodromes.

Co-operation of searchlights, wireless and anti-aircraft guns.

52. Range of Bombers

'Bombing range' regarded as the distance from the fuelling base to the objective.

'Tactical range'—distance from enemy lines, frontier or coast line to the objective.

'Radius of action'—the greatest distance to which an aeroplane can fly in a straight line under given conditions while retaining enough fuel to return to its starting point.

'Close range zone'—depth of penetration over enemy territory without interception from the ground.

'Effective Zone'—depth into enemy territory to which sustained bombardment can be carried.

Limitations—Fuel, ammunition and morale.

'Long Range zone'—Occasional raids only.

53. Vulnerability of Objectives

Depending partly upon the zone in which they lie.

Vulnerability of ports, dockyards, naval bases, and ships in harbour . . . [and] of aerodromes.

54. Results of the Fighting between the Air Defence and the Bombing Offensive

No pitched battle.

Continual small engagements resulting in small losses.

The result mainly shown in effect upon morale which will be shown in increase or decrease in the tactical range of the bombers.

55. The Results of Superiority in the Air Fighting

(a) Tactical range of enemy bombers will be reduced.

(b) Tactical range of our bombers will be increased.

(c) Enemy will tend to depend more and more upon evasion, hence attacks will be delivered from greater altitudes.

(d) Enemy will tend to turn back if faced by a strong defence or, alternatively, drop his bomb load to increase his defensive power.

(e) Enemy will tend to increase his fighters both for air defence and to escort his bombers.

L. THE CONDUCT OF AIR BOMBARDMENT

56. The Ideal

To develop as heavy and accurate bombardment as possible. Hence:

(a) Devote utmost resources to provision of bombers as against fighters.

(b) Use heavy bombers.

(c) Carrying capacity to be entirely devoted to bombs.

(d) Fly at most accurate aiming altitude in the most effective strength and frequency to the most decisive point. The principle—Concentrate utmost force into the bombing offensive.

57. Modification Which May Be Imposed by Enemy Air Defence

(a) Carrying capacity partly devoted to guns and ammunition, hence the reduction of bombing loads.

(b) Escorts to protect bombers. This means building more fighters and less bombers.

(c) Practice evasion. This means flying at greater altitudes, using lighter aircraft, smaller bomb loads and less radius of action.

58. Escorts to Bomber Formations

(a) Single-seater fighters—Can they keep with bombers?

(b) Two-seater fighters—Inferior performance to enemy single-seater fighters, hence confined mainly to defensive action, are they much better off than the bombers themselves?

Doubtful economy. Probably better to have another formation of bombers than a formation of two-seater fighters.

59. Evasion

Means weaker attack, but is better than nothing.

Particularly suitable for sustained attack in small force.

Also has the advantage at first in reaching objective with fewer casualties and therefore more bombs. If not intercepted bombs may be dropped with greater care.

The disadvantages are mainly moral—fear of interception may mean scamping the job, also:

(a) Bombing from extreme altitudes less accurate.

(b) High attacks less moral effect than low attacks.

(c) Tactical range practically limited to distance at which interception probable.

(d) Radius of action of high flying aircraft less.

Importance of bad weather flying as a means of employing evasion with all the advantages of low attack.

Evasion should be regarded as a means of surprising the enemy, not simply as a method of avoiding him.

60. Attacks at Fighting Altitude

The reference here is to lower altitudes, compared with high altitude flight discussed in the previous paragraph.

Advantages

(a) More accurate fire.

(b) Improvement of our own air morale.

(c) Destruction of enemy's air morale.

(d) Greater moral and material effect from the air bombardment.

(e) If successful, penetration to greater distances.

Disadvantages

(a) At first until superiority is established, more expensive, more casualties, thus reducing weight of bomb attack delivered at objective.

(b) Hard fighting may interfere with accurate bombing.

If the fighting offensive fails we can then adopt evasion.

61. Methods of Attack

(a) Mass attack for destructive material effect.

(b) Sustained bombardment for moral effect and interruption of enemy activities.

(c) Isolated long range attacks for surprise and moral effect.

V. THE OBJECTIVE IN AIR WARFARE

62. The Objective in General Terms

The general object in war is to defeat the enemy.

Air power should, therefore, be applied so as to contribute in the most direct and effective manner to the defeat of the enemy. The problem is to determine in what way air bombardment can be used most effectively.

63. The Nation in Modern War

National resistance [is] no longer confined to first line armaments.

The fighting forces draw their vitality and powers of resistance from the nation itself. Hence, war is made against the nation and not only against its military forces.

Air power is therefore likely to be used in whatever may be regarded as the most effective way of bringing the enemy to terms.

64. The First Object in Land Warfare

The destruction of all the enemy armed forces.

This is a practicable and necessary step towards the higher object—the occupation of the enemy country and the control of the enemy administration.

65. The First Object in Naval Warfare

The destruction or neutralisation of all the enemy naval forces. This is a necessary step towards the ultimate object of the navy—namely the control of sea communications.

66. The First Object in Air Warfare

In general terms the object in air warfare is to apply air bombardment wherever it will have the most direct and decisive effect. In order to do this must we first destroy the enemy air forces?

In other words is our first object the destruction of the enemy air forces?

67. The Destruction of the Enemy Air Forces

The possibility of destroying the enemy air forces.

Relatively small combatant personnel in the air force (6000 at end of 1918).

Casualties though high in proportion to combatant air personnel are low in relation to national man-power.

High rate of production of aircraft (100 per day at end of 1918).

With good organisation replacement of maximum casualties in personnel and in aircraft should present no great difficulty, except in the early stages of the war before output and production have got going.

Decisive results, therefore, probable only in the early stages of the war.

Destruction of the enemy air forces can only be accepted as practicable in certain favourable conditions:

(a) During the first six months of a first class war.

(b) In war against undeveloped countries who cannot organise production to replace casualties.

(c) In distant or isolated theatres of war where reinforcements or replacements of casualties are limited.

Even where possible, the destruction of the enemy air forces may be neither the most effective nor the most practicable object to which air power may be applied.

The object in air warfare cannot therefore be selected in any dogmatic manner, but will depend upon the situation. The principle to be followed in the selection of the air objectives for the bombers is that air bombardment should be used to contribute to the success of the national war plan in the most direct and decisive manner.

68. Air Superiority

If we cannot destroy the enemy air forces, should our object be to gain air superiority before applying air power in a more direct manner?

Air superiority must be fought for and fighting involves the use of air bombardment.

The principle governing the use of air bombardment has already been decided.

The outcome of the struggle to reach the objectives for air bombardment will settle the question of air superiority one way or the other.

69. Summary

The object in air warfare cannot be defined in the precise terms applied to the object of the other two services.

In air bombardment the object is to develop the most effective attacks against the most decisive points in the enemy's national and military organisation.

The selection of the actual objectives for attack must depend upon the situation.

The principle to be followed in the selection of these objectives is that air bombardment should be used so as to contribute in the most direct, decisive and effective manner to the defeat of the enemy.

VI. AIR POWER IN SUPPORT OF OPERATIONS ON LAND AND SEA

72. A Naval and Air War

Perhaps an economical plan for an island Power.

Air support of a naval campaign.

Naval and air blockade. Navy stops supplies. Air Force destroys supplies and internal supply organisation.

The possibility of a decision by these means.

A slow process.

Economy of force—avoiding diversions.

73. The Quick Decision on Land

Air power in support of military operations on land designed to bring about a quick decision.

Selection of objectives for immediate effect.

Three periods:

(a) The mobilization period.

(i) Delay and interference with enemy's mobilization,

(ii) Air superiority.

(b) The passage of an expeditionary force.

(i) Temporary air superiority by the attack of enemy aerodromes,

(ii) Defensive patrols.

(c) The armies in the field.

(i) The attack of military objectives for immediate effect.

(ii) The protection of the army co-operation aircraft.

(iii) Direct intervention in the land battle by low flying attacks. This action only in a decisive crisis. Do not use air bombardment against targets which can best be reached by other means, eg, guns, etc.

74. Air Command and Organisation

Command—depends upon the situation. Unified command generally essential.

Organisation of air force supporting military operations.

Dispersion of force probably unavoidable.

Organisation must be flexible to permit of maximum power of concentration both of bombers and fighters under centralised direction.

VII. DIRECT ACTION

75. Air Bombardment as a Demoralising Factor in War

Application where the demoralising effect will have the quickest and most decisive results.

Attempt to terrorise a nation by bombarding the civil population.

Dissipation of force.

Apply the principle of concentration by finding out where the demoralisation caused by air bombardment will have the greatest effect.

76. The Selection of Objectives for Air Bombardment

The organisation of a modern industrial nation and its vulnerable points. The effect of air bombardment upon production, distribution, transportation and communications.

The effect upon organisers and workmen.

Frequent interruption necessary to get best effect.

Effect of precautionary arrangements.

The German air raids on London and their effect upon industries and communications.

The indirect effect upon the nation as a whole . . .

78. Intelligence Work in Peace Time

A new form of intelligence information required.

Detailed information regarding internal economic organisation.

Enemy psychology.

Military, political and administrative organisation.

Main lines of internal communication. Nature of traffic using these lines.

Centres of production and what they produce.

Key factories.

Ports and their specialisation . . .

DOCUMENT 9.

Future Policy in the Air

'Future Policy in the Air' was issued by General Trenchard, GOC of the RFC in France, in September 1916. It is a classic air power document, presenting the original and definitive statement on the necessity to use the air weapon offensively. 'It is the deliberate opinion', Trenchard emphatically asserts, 'that the aeroplane is an offensive and not a defensive weapon'. Absolute commitment to taking the fight to the enemy is, therefore, essential.

The principle does not end there. Should the enemy counter by taking the offensive himself, then we must go even further and 'increase the offensive'.

Right or wrong, this is an uncompromising piece of work.

Since the beginning of the recent operations the fighting in the air has taken place over the enemy's line, and visits of hostile aeroplanes over our lines have been rare. It is to be hoped that this state of things may continue, but as one can never be certain of anything in war, it is perhaps an opportune moment to consider what policy should be adopted were this state of affairs to change, and were the enemy to become more enterprising and more aggressive.

It is sometimes argued that our aeroplanes should be able to prevent hostile aeroplanes from crossing the line, and this idea leads to a demand for defensive measures and a defensive policy. Now is the time to consider whether such a policy would be possible, desirable and successful.

It is the deliberate opinion of all those most competent to judge that this is not the case, and that an aeroplane is an offensive and not a defensive weapon. Owing to the unlimited space in the air, the difficulty one machine has in

seeing another, the accidents of wind and cloud, it is impossible for aeroplanes, however skilful and vigilant their pilots, however powerful their engines, however mobile their machines, and however numerous their formations, to prevent hostile craft from crossing the line if they have the initiative and determination to do so.

The aeroplane is not a defence against the aeroplane but it is the opinion of those most competent to judge that the aeroplane, as a weapon of attack, cannot be too highly estimated.

A single instance of this fact is offered to us by the operations which took place in the air at Verdun.

When the operations at Verdun began, the French had few machines on the spot. A rapid concentration was made, and a vigorous offensive policy was adopted. The result was that superiority in the air was obtained immediately, and the machines detailed for artillery cooperation and photography were enabled to carry out their work unmolested, but as new units were put into the line which had less experience of working with aeroplanes a demand arose in some quarters for machines of protection and these demands were for a time complied with. The result was that the enemy took the offensive, and the French machines were unable to prevent the hostile raids which the enemy, no longer being attacked, was now able to make. The mistake was at once realised and promptly rectified. A policy of general offensive was once more resumed, and the enemy at once ceased to make hostile raids, all his time being taken up in fighting the machines which were attacking him. Superiority in the air was thus once more regained.

On the British front, during the operations which began with the battle of the Somme, we know that, although the enemy had concentrated the greater part of his available forces in the air on this front, the work actually accomplished by their aeroplanes stands, compared with the work done by us in the proportion of 4 to 100. From the accounts of prisoners, we gather that the enemy's aeroplanes have received orders not to cross the lines over the French or British fronts unless the day is cloudy and a surprise attack can be made, presumably in order to avoid unnecessary casualties. On the other hand, British aviation has been guided by a policy of relentless and incessant offensive. Our machines have continually attacked the enemy on his side of the line, bombed his aerodromes, besides carrying out attacks on places of importance far behind the lines. It would seem probable that this has had the effect so far on the enemy of compelling him to keep back or to detail portions of his forces in the air for defensive purposes.

When Lille station was attacked from the air for the first time no hostile aeroplanes were encountered. The second time this place was attacked our machines encountered a squadron of Fokkers which were there for defensive purposes. This is only one instance among many.

The question which arises is this: [sjupposing the enemy under the influence of some drastic reformer or some energetic leader, were now to change his policy and follow the example of the English and French, and were to cease using his aeroplanes as a weapon of defence and start a vigorous offensive and attack as many places as far behind our lines as he could, what would be the sound policy to follow in such a case? Should we abandon our offensive, bring

back our squadrons behind the line to defend places like Boulogne, St Omer, Amiens and Abbeville, and protect our artillery and photographic machines with defensive escorts, or should we continue our offensive more vigorously than before? Up to now the work done by the Germans compared with that done by our aeroplanes stands, as we have seen, in the proportion of 4 to 100, but let us suppose that the enemy initiated a partial offensive in the air, and that his work increased, compared with ours, to a proportion of 30 or 50 to 100, it is then quite certain that a demand for protective measures would arise for protective squadrons and machines for defensive patrols.

One of the causes of such demands is the moral effect produced by a hostile aeroplane, which is out of all proportion to the damage which it can inflict.

The mere presence of a hostile machine in the air inspires those on the ground with exaggerated forebodings with regard to what the machine is capable of doing. For instance, at one time on one part of the front whenever a hostile machine, or what was thought to be a hostile machine was reported, whistles were blown and men hid in the trenches. In such cases the machines were at far too great a height to observe the presence of men on the ground at all, and even if the presence of men was observed it would not lead to a catastrophe. Again, a machine which was reported in one place would certainly, since it was flying rapidly, be shortly afterwards observed in another part of the lines and reported again, but the result of these reports was often that for every time the machine was sighted a separate machine was reported, leading at the end of the day to a magnified and exaggerated total.

The sound policy then, which should guide all warfare in the air would seem to be this: to exploit this moral effect of the aeroplane on the enemy, but not to let him exploit it on ourselves. Now this can only be done by attacking and by continuing to attack.

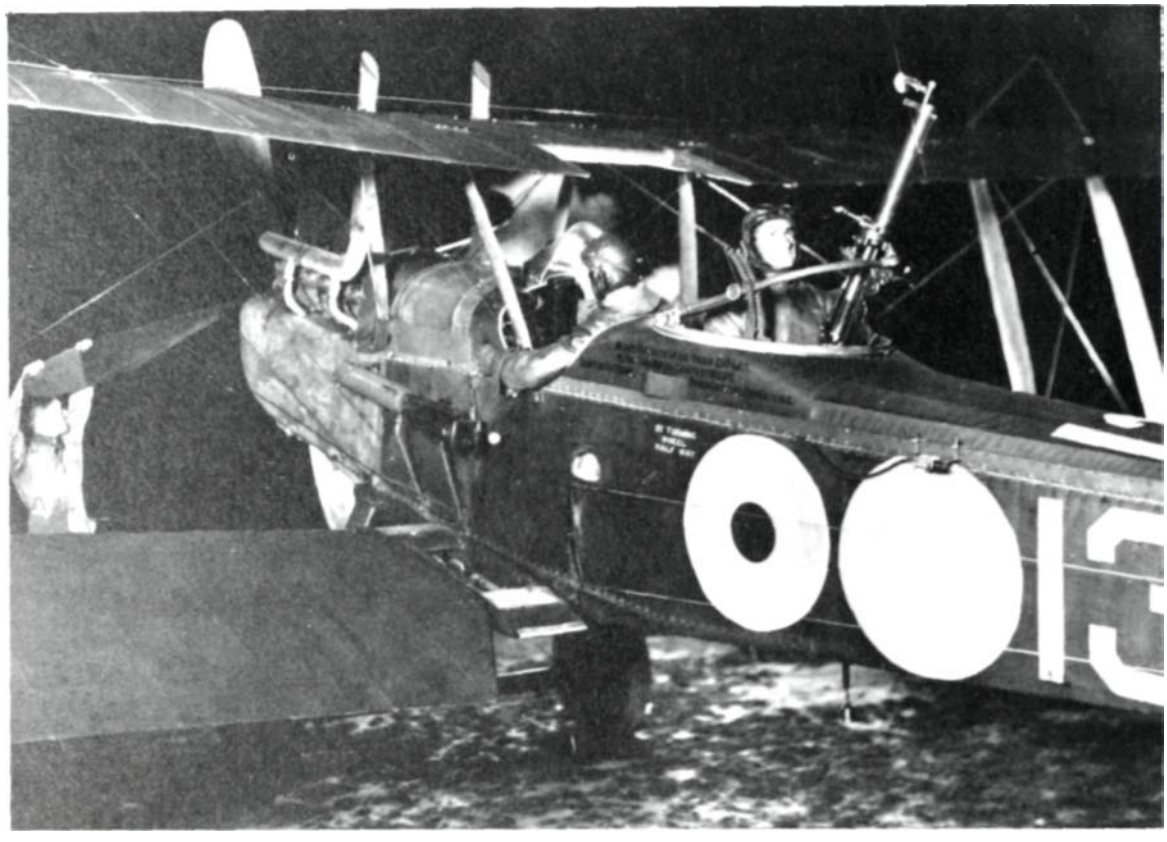
It has been our experience in the past that at a time when the Germans were doing only half the work done by our machines that their mere presence over our lines produced an insistent and continuous demand for protective and defensive measures.

If the Germans were once more to increase the degree of their activity even up to what constitutes half the degree of our activity, it is certain that such demands would be made again.

On the other hand, it is equally certain that, were such measures to be adopted, they would prove ineffectual. As long as a battle is being fought any machine at the front has five times the value that the same machine would have far behind the lines.

If the enemy were aware of the presence of a defensive force in one particular spot he would leave that spot alone and attack another, and we should not have enough machines to protect all the places which could possibly be attacked behind our lines, and at the same time continue the indispensable work on the front.

But supposing we had enough machines both for offensive and defensive purposes. Supposing we had an unlimited number of machines for defensive purposes, it would still be impossible to prevent hostile machines from crossing the line if they were determined to do so, simply because the sky is too large to defend. At sea a number of destroyers will have difficulty in preventing a



10. An RE8 of No. 69 (later No. 3) Squadron AFC starting out for a night bombing operation from Savy, 22 October 1917. AWM.

hostile destroyer, and still less a hostile submarine from breaking the blockade. But in the air the difficulty of defence is still greater, because the area of possible escape is practically unlimited, and because the aeroplane is fighting in three dimensions.

The sound policy would seem to be that if the enemy changes his tactics and pursues a more vigorous offensive, to increase our offensive, to go further afield, and to force the enemy to do what he would gladly have us do now. If, on the other hand, we were to adopt a purely defensive policy, or a partially offensive policy, we should be doing what the French have learnt by experience to be a failure, and what the rank and file of the enemy, by their own accounts, point to as being one of the main causes of their recent reverses.

Moreover, in adopting such a policy it appears probable that the Germans were guided by necessity rather than by choice owing to the many fronts on which they now have to fight, and owing to the quality and the quantity of machines they have to face, on the Western front alone. Nevertheless, one cannot repeat too often that in war nothing is certain, and that the Germans may, either owing to the pressure of public opinion, or the construction of new types of machines, or the rise of a new leader, change their policy at any moment for a more aggressive one.

Advanced Headquarters
Royal Flying Corps
September 22nd, 1916

DOCUMENT 10.

Precis of Lectures on Small Wars

The value of aircraft for policing remote, undeveloped territories was quickly recognised by the British, who used 'Air Control' or the 'Air Method' most effectively throughout the 1920s in the Middle East and on the North West Frontier of India. Under the system, an errant community would be warned by leaflet drop that unless they complied with the occupying power's wishes, the next time aircraft appeared they would be dropping bombs, not paper. Thus, the technique exploited the psychology of aerial bombardment, as well as the inherent speed, flexibility and freedom of movement of aircraft.

Air control amounted to the substitution of air power for land power. It proved to be very successful. The RAF's CAS, Sir Hugh Trenchard, subsequently proposed substitution of air power for land and sea power in a wide variety of other roles. Trenchard's concept of substitution became probably the most contentious issue in British defence circles in the late 1920s.

Wrigley addresses the concept in paragraph 7. He maintains a balanced outlook by immediately listing some of the limitations of the technique. Similar warnings are repeated later in the paper.

Some very dated attitudes of a superior imperial power are evident in this document. They may seem highly inappropriate today, but that should not be allowed to obscure the fact that it remains valid to examine the advantages and disadvantages of using aircraft in iow intensity' conflicts. Comparisons with the Malayan emergency and the Vietnam war might be instructive for the reader who is familiar with those more recent conflicts. Wrigley's exposition provides a balanced view, indicating that the limitations of the air were very well understood in the early days. Unfortunately, some of those lessons had to be forgotten and relearned at great expense.

In addition to the sources cited in the bibliography at the end of this document, Wrigley was able to draw on a lecture on 'Small Wars' given by Wing Commander D.C.S. Evill, DSC, AFC, at Andover in September 1928.

PART 1. GENERAL

1. The Characteristics of Small Wars

Small wars are generally speaking the operations of a regular force against an uncivilised or partly civilised enemy. They are normally fought in undeveloped country and against irregular or comparatively ill-equipped forces.

Such operations for the purposes of discussion may be considered in two groups:

(a) Expeditions against an enemy beyond our frontiers.
(b) Operations to restore order in our own territories.

The same general principles apply in each but there are some limiting factors in operations of the second group which need special consideration, vide Part III (c) below. There is no clear dividing line between these groups and some operations present the peculiarities of both.

2. The Object in Small Wars

The object in all such operations is ultimately the same, ie, to force the enemy to submit to our will. But in pursuit of this object the following factors have to be taken into account:

(a) The difficulty of finding decisive military objectives owing to the loose national and military organisation of the enemy.

(b) The extreme mobility of irregular forces operating in their own country.

(c) The natural difficulties of the theatre of operations.

It therefore generally becomes necessary to adopt the course of, either:

(i) Bringing the enemy's fighting men to decisive action, or

(ii) Inflicting sufficient hardship on the enemy communities to force them to submission.

3. Land Forces in Small Wars

(a) Their disadvantages:
The extreme difficulty of movement, supply and communication in undeveloped country.
The opportunity which land forces offer in difficult country to guerilla opposition, their liability to tactical defeat, and the prospect of loot which this presents to the enemy. All these stimulate sporadic opposition, but the regular force is faced with the greatest difficulty in bringing the enemy to face decisive action.

(b) Their advantages:
The holding power of land forces and their thoroughness in execution. Their opportunity of inflicting casualties against the enemy's fighting men, of establishing a personal ascendancy over them in battle and of exacting just punishment after their defeat.

PART II. THE PROPER ROLE OF THE AIR FORCE IN SMALL WARS

4. Conditions Favourable to the Use of Air Force

Where a people is dependent upon settled activities or where their leaders derive power or wealth from certain fixed services, then air force should be effective and that without many of the disadvantages attendant upon the use of land force.

5. A Difference between Land and Air Strategy

The natural strategy of land forces is to force action upon a concentration of the enemy's fighting men.

The natural strategy of air forces is to inflict sufficient hardship upon the enemy by the interruption of his normal activities to force submission.

Air action has a disruptive as well as a high moral effect which must be appreciated if air force is to be properly employed in conjunction with land force.

6. The Use of Air Force in Conjunction with Land Force

Instances of the dispersive effect of air action employed prior to action by land force:

(a) Somaliland, 1920

(b) Lau Nuers, Patrol 8 in Sudan, 1928
These operations would appear to have been justified only if the land force available was inadequate to engage the enemy concentrations.

(c) Mohmand, June 1927
Here aircraft dispersed a concentration which the land forces present could not immediately deal with, and nipped the possibility of more considerable trouble in the bud.

(d) Garluak Nuers, Patrol 9 in Sudan, 1928
Here our aircraft decisively engaged a concentration which had been forced upon the enemy by our land forces but which the latter could not reach.

7. Air Force Employed without Assistance from Land Forces

Waziristan operations, April 192 5

Here air force alone brought in an unruly enemy inhabiting difficult country and offering few material objectives to attack though dependent upon activities lying within easy reach of air bases.

This capacity has been proved before on the north West Frontier on a small scale, and in Iraq, eg, Beni Huchaim, 1923 . . .

8. The Limitations of Air Force in a Defensive Role

By their speed and range air forces can, under favourable conditions, provide for the security of their own bases. But in face of a well organised offensive, if denied 'room for manoeuvre' or if located in difficult country, land force will generally be required for this. If required to fill a defensive role air forces must be allowed to act offensively against the source of the enemy's strength and must not be restricted to any limited defensive action. Vide Turkish operations on northern frontier of Iraq in 1924.

9. The Role of Air Force

Air Force can be applied effectively wherever an enemy is dependent upon settled activities within range of air bases. It is suitable in application because:

(a) It can be applied quickly so as to nip trouble in the bud.

(b) It offers the enemy no incentive to prolong resistance.

(c) Its presence being largely moral it does not intensify those conditions which give rise to the need for its use.

Where an enemy can avoid its action or when faced by determined aggression owing to its lack of holding powers it requires the assistance of land force. It cannot for these reasons in many circumstances replace land force and

therefore when operations are on a large scale it must nearly always be used in conjunction with land force.

10. The Application of Air Force

Its effect being mainly moral it must always be used with this in view. The speed of the blow after need has arisen has much to do with its effectiveness, and air force must therefore be used under an organisation which permits of rapid action.

Authority conducting operations must be prepared to take full advantage of moral effect produced to secure the enemy's submission. This necessitates good intelligence and close co-operation between the air commander and local authority. Finally, the respective attributes of land and air force must be fully understood and applied in suitable combination to each particular emergency.

PART III. THE CORRECT EMPLOYMENT OF AIR FORCES

(a) THE CONDUCT OF AIR OPERATIONS

11. The Selection of Air Objectives

The selection of objectives is dependent upon:

(a) The object of the operations. This may make it necessary to aim at the infliction of heavy casualties and at ruthless destruction. Or if the object is merely the restoration of order it may be desirable to limit the pressure to the minimum necessary to achieve this result.

(b) A sound knowledge of the enemy's characteristics.

12. Intelligence

An accurate knowledge of the psychology and customs of the enemy, of the influences by which they are swayed, and the sources of their strength is essential to the direction of operations. Hence the need for good political and intelligence services working in close touch with the air forces.

The conditions of undeveloped country make it necessary that air personnel should take every opportunity of correcting maps, preparing plans of likely targets and familiarising themselves with the country.

13. The Initial Stages of Air Operations

Air operations must not be commenced precipitately before the necessity is clear and adequate means are available, but once undertaken must not be relaxed short of success. Some measure of casualties and loss are essential to full moral effect of air operations. The best opportunities for the infliction of these occur in the initial stages and are dependent upon surprise. Surprise must therefore be carefully provided for if the best results are to be obtained. Bombing for material destruction after objectives are deserted must be accurate and effective if moral effect is not to be lost . . .

14. Later Stages of Air Operations

The disappearance of all concentrations of personnel or live stock is a sign that normal activities are being interrupted. Attack should then be moderated in order to avoid waste of effort but pressure should be maintained by persistent

harassing—blockade. Night attack closes up an otherwise considerable gap in the continuity of pressure, and possesses valuable moral effect. Long delay fuses may be employed for this purpose but are less effective. The enemy may endeavour to avoid blockade by moving into neutral territory, but this is seldom successful.

Contrary to Wrigley's last observation, 'moving into neutral territory' worked well for the North Vietnamese when they diverted the Ho Chi Minh trail into Laos during the war against the United States and its allies from 1962 to 1975. Similarly, both the North Korean and North Vietnamese air forces profited from using the sanctuary of Chinese airfields during their respective wars against United Nations and United States forces.

The principle for conduct of air operations is that of an intensive initial attack followed by a vigorous and determined blockade maintained until final success is achieved.

(b) AIRCRAFT IN COOPERATION WITH LAND FORCES

15. Air Operations in Support of Land Operations

This is a form of indirect co-operation by which air forces may help land forces towards their objective, eg, bombing back areas to draw off enemy opposition, support of isolated military posts by air action, air cover for lines of communication.

16. Close Co-operation

Normal principles of army co-operation apply, modified to suit any special conditions. Special features are:

(a) opportunities for use of single-engine bombers and single-seater fighters as well as army co-operation type of aircraft for close support of troops.

(b) Special problems of control and communication.

Aerodromes and landing grounds should be selected by air force personnel in consultation with the military staff and full consideration given to questions of supply and defence.

17. Ancillary Services by Aircraft

These 'ancillary services' would in many areas, such as in remote parts of Australia, form vital elements of land force mobility and sustainment. They cannot be seen as just an afterthought.

(a) Use of aircraft for intercommunication and personal control. Vide examples in Report on Rowanduz Operations, Iraq, 1923, by Sir J. Salmond. (Supplement to London Gazette, 10th June, 1924.)

(b) Troop carrying by aircraft as a rapid means of moving small bodies of troops may be invaluable in undeveloped countries.

(c) Supply by air of military necessities, an emergency service which may be of great value. The use of parachutes enables delicate stores to be delivered with success.

(d) The evacuation of casualties by air. A service which the French have developed in Morocco with great success. We did the same at Rowanduz in 1923. This service if successful is a very great material and moral gain to land forces operating in difficult country.

(c) USE OF AIR FORCES IN SUPPORT OF CIVIL ADMINISTRATION

18. Requirements of a Military Policy

(a) That the native must be conscious of and impressed with our presence, omniscience, and power. Yet his life and property must never be interfered with unless he has consciously misbehaved.

(b) That the native must never be tempted to break out by the sight of some local weakness on our part which he might profitably attack.

(c) That when the native has misbehaved there must descend upon him punishment swift, adequate, and suitable against which he has no chance of retaliation.

19. Showing the Flag

Aircraft can show the flag effectively and economically. But precautions must be taken by the maintenance of an efficient intelligence service and good signal organisation to keep the command in close touch with local situations. Also air power must be wisely employed if the moral effect of air demonstrations is to be maintained . . .

21. Punishment

Air action must not be commenced without a warning to the offenders which makes the situation quite clear and also enables them to remove women and children to places of safety. Air action is not unduly indiscriminate or destructive. Its use is not resented by the tribesmen as unfair or unjust. Its rapidity of action prevents trouble spreading and therefore reduces the instances in which punishment becomes necessary.

(d) THE ORGANISATION OF AIR FORCES IN AN OVERSEAS COMMAND

22. Security

Air forces can be kept concentrated at a very few central bases, operating from advanced landing grounds when necessary. Land forces are necessary for the security of these central bases. The security of their communications is dependent upon the rapidity of air action which enables troubles to be nipped in the bud. Example, Beni Huchaim Operations, Iraq, 1923 . . .

23. Mobility

The next two brief sections capture quite well the philosophy of mobility and deployability which are essential for a small force with a large area of responsibility, such as the RAAF.

Air forces are dependent for their general effectiveness upon mobility. Maximum mobility can only be achieved by developing an organisation of landing

grounds to any of which air units can be moved by air with the necessary personnel and equipment to operate their aircraft until they can be reinforced by other means. And under certain circumstances it will be necessary to maintain these units for considerable periods by air transport from railhead to air base.

24. Organisation

Not only must the landing grounds and the aircraft be available for such operations, but our units, our equipment, and our supply procedure must be so organised that operations may be initiated without time wasted in improvisation, and as far as practicable the normal organisation of our units should be suited to meet such requirements . . .

FIGURE 2.15

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PART THREE

An Independent Air Force

Extracts from a Report by General Smuts on Air Organisation and the Direction of Air Operations

In October 1917 the nucleus of an 'Independent Force' of British air power started operations in France at the direction of Lloyd George's Cabinet. It had been established rapidly and in an atmosphere bordering on panic following raids against London in broad daylight by German Gotha bombers on 13 June and 7 July. The Independent Force's purpose was to retaliate against those raids and take the war to the enemy's homeland.

The Gotha raid on 7 July in particular shocked Britain and probably caused more concern in London than any other event during the war. Apart from the public panic, it was plain that the Home air defences were completely ineffectual. In response to the raids, the Smuts Committee was formed to report on Home Air Defence and the Direction of Aerial Operations. The Committee consisted of just two members: the South African general and statesman Jan Smuts, and the volatile Prime Minister Lloyd George himself. The two-man committee presented the first part of its report on 19 July, and the second part (from which Document 11 is taken) on 17 August.

Differing opinions can be found for the reasons the reports were acted upon so quickly. Clearly the government needed to be seen to be taking action against the Gotha raids. There was also an argument that the existing system for providing air power was wasteful, as the two responsible services, the Royal Flying Corps (that is, the Army) and the Royal Naval Air Service, duplicated and competed with each other. It also seems possible that Lloyd George was desperate to find a way to break free from the 'dead hand' of Haig on the Western Front; thus, the air weapon seemed to offer the chance to resolve the war through bypassing the appalling, moribund mess on the ground in France.

Regardless of those or any other political machinations, the Smuts reports stand scrutiny on their own merits. In view of the overall circumstances of the war, the formation of an independent, long-range striking force was a logical action. As the extract shows, the committee held that view, and accordingly couched its recommendations in the most fulsome and confident terms. In doing so, General Smuts and Lloyd George embraced the same optimistic expectations for air power as did the subsequent essays of theorists like Douhet, Mitchell and Seversky.

With the formation of the Independent Force, imprimatur had been given to the concept of the aircraft as a weapon of strategic importance, and to aerial bombardment as a technique likely to force an enemy into submission without necessarily engaging his armed forces.

If the Independent Force, and then the RAF, had not been established, it is unlikely that the RAAF would have been founded three years later as the world's second independent military air service.

. . . Under the present constitution and powers of the Air Board, the real directors of War Policy are the Navy and the Army, and to the Air Board is really allotted the minor role of fulfilling their requirements according to their ideas of war policy. Essentially the Air Service is as subordinated to Military and Naval direction and conceptions of policy as the artillery is, and, as long as that state of affairs lasts, it is useless for the Air Board to embark on a policy of its own, which it could neither originate nor execute under present conditions.

5. The time is, however, rapidly approaching when that subordination of the Air Board and the Air Service could no longer be justified. Essentially the position of the Air Service is quite different from that of the Artillery arm; to pursue our comparison, artillery could never be used in war except as a weapon in Naval or Military or Air operations. It is a weapon, an instrument ancillary to a Service, but could not be an independent service itself. The Air Service on the contrary can be used as an independent means of air operations. Nobody that witnessed the attack on London on 7th July could have any doubt on that point. Unlike Artillery, an air fleet can conduct extensive operations far from and independently of, both Army and Navy. As far as at present can be foreseen, there is absolutely no limit to the scale of its future independent war use. And the day may not be far off when aerial operations with their devastation of enemy lands and destruction of industrial and populous centres on a vast scale may be come the principal operations of war, to which the older forms of naval and military operations may become secondary and subordinate. The subjection of the Air Board and Air Service could only be justified on the score of their infancy. But that is a disability which time can remove, and in this respect the march of events has been very rapid during the war. In our opinion there is no reason why the Air Board should any longer continue in its present form as practically no more than a conference room between the older Services, and there is every reason why it should be raised to the status of an independent Ministry in control of its own War Service.

6. The urgency of the change will appear from the following facts. Hitherto aircraft production has been insufficient to supply the demands of both Army and Navy, and the chief concern of the Air Board has been to satisfy the necessary requirements of those Services. But that phase is rapidly passing. The programme of aircraft production which the War Cabinet has sanctioned for the following 12 months is far in excess of Army and Navy requirements. Next Spring and Summer the position will be that the Army and Navy will have all the Air Service required in connection with their operations; and over and above that there will be a great surplus available for independent operations. Who is to look after and direct the activity of their surplus? Neither the Army nor the Navy is specially competent to do so; and for that reason the creation of an Air Staff for planning and directing independent air operations will soon be pressing. More than that; the surplus of engines and machines now being

built should have regard to the strategical purposes to which they are going to be put. And settling in advance the types to be built, the operations for which they are intended apart from Naval and Military use should be clearly kept in view. This means that the Air Board has already reached the stage where the settlement of future war policy in the Air war has become necessary. Otherwise engines and machines useless for independent strategical operations may be built. The necessity for an Air Ministry and Air General Staff has therefore become urgent.

7. The magnitude and significance of the transformation now in progress are not easily realized. It requires some imagination to realize that next summer, while our Western front may still be moving forward at a snail's pace in Belgium and France, the Air battle front will be far behind on the Rhine, and that its continuous and intense pressure against the chief industrial centres of the enemy as well as on his lines of communication may form the determining factor in bringing about peace. The enemy is no doubt making vast plans to deal with us in London if we do not succeed in beating him in the air and carrying the war into the heart of his country. The question of machines, aerodromes, routes and distances, as well as nature and scope of operations require[s] careful thinking out in advance, and in proportion to our foresight and preparations will our success be in these new and far-reaching developments. And take again the case of a subsidiary theatre there is no reason why we may not gain such an overpowering air superiority in Palestine as to cut the enemy's limited and precarious railway communication, prevent the massing of superior numbers against our advance, and finally to wrest victory and peace from him. But careful Staff work in advance is here in this *terr[a] incognita* of the Air even more essential than in ordinary Military and Naval operations which follow a routine consecrated by the experience of centuries of warfare on the old lines . . .

We must create the new directing organisation - the new Ministry and Air Staff which could properly handle this new instrument of offence, and equip it with the best brains at our disposal for the purpose. The task of planning the new Air Service organisation and thinking about and preparing for schemes of aerial operations next Summer must tax our experts to the utmost and no time should be lost in setting the new Ministry and Staff going. Unless this is done, we shall not only lose the great advantages which the new form of warfare promises, but we shall end in chaos and confusion, as neither the Army nor Navy nor the Air Board in its present form could possibly cope with the vast developments involved in our new aircraft programme . . .

10. To summarise the above discussion we would make the following recommendations:

(a) That an Air Ministry be instituted as soon as possible, consisting of a Minister with a consultative Board, on the lines of the Army Council or Admiralty Board, on which the several departmental activities of the Ministry will be represented. The Minister to control and administer all matters in connection with aerial warfare of all kinds whatsoever, including lighter-than-air craft as well as heavier-than-air craft.

(b) That under the Air Ministry an Air General Staff [be] instituted on the lines of the Imperial General Staff responsible for the working out of war plans, the direction of operations, the collection of intelligence and training of the Air personnel; that this staff be equipped with the best brains and practical experience available in our present Air Service and that by periodic appointment to the staff of officers with great practical experience from the front due provision be made for the development of the staff in response to the rapid advance of this new service . . .

(g) That the Air General Staff shall from time to time attach to the Army and Navy the Air Units necessary for Naval or Military operations, and such Units shall, during the period of such attachment, be subject for the purpose of operations, to the control of the respective Naval or Military command. Air units not so attached to the Navy and Army shall co-operate under the immediate direction of the Air General Staff.

August, 1917

DOCUMENT 12.

The Air Force in its Role as a Separate Service

Wrigley's paper on the separate functions of an air force is in two parts Paragraphs 1 to 9 discuss the history of 'independent' air operations; while paragraphs 10 to 17 comment on likely developments as seen at the end of World War I. The observations presented in paragraph 15 on the need to develop joint operations and procedures are especially noteworthy, as competition for the control of air assets has been a persistent feature of military aviation.

A. HISTORY

1. Misunderstanding of the term 'Independent'

During the war a somewhat unfortunate term came into use, to indicate the work carried out by the air, apart from co-operation with the Navy and Army, namely 'Independent'.

This expression led to the idea that the Air Force would carry out its operations without any regard to what the Navy and Army were doing or what the policy of the Government was, in fact that, as one well-known officer expressed it, we should arrive from God knows where, drop our bombs God knows where, and go off again God knows where.

Such an idea is of course entirely wrong, but it shows the pitfalls into which an unfortunate nomenclature may lead the unwary and bearing this in mind, the Air Staff decided to use the word separate in place of independent.

2. The Long Distance Raids of 1914

From the very beginning of the war the thoughts of many people had been directed towards bombing Germany and more especially Essen.

Lord Kitchener was very keen on this in November, 1914. We got as far as designing a special bomb to destroy workshops, but the aeroplanes to carry them to Essen never materialized.

The first germ of separate air action started in 1914. On 8th October of that year a pilot and a single-seater aircraft flew from Antwerp to Dusseldorf, 125 miles, and succeeded in destroying a Zeppelin in the shed at the latter place.

This was followed on 21st November by an attack on the Zeppelin works at Friedrickshafen. Three aircraft started from Belfort and succeeded in damaging one Zeppelin and blowing up the hydrogen plant. One of the pilots was brought down wounded.

Both the above attacks were carried out by the Royal Naval Air Service.

3. The Third Wing, Royal Naval Air Service

A few other attacks of a similar spasmodic nature were carried out, but the next definite step forward was not made until 1916. At this time although the War Office was anxious to carry out offensive air operations into Germany, it had insufficient aeroplanes for the requirements of the Army.

The Admiralty however, had a surplus and on 16th April, 1916, they obtained the concurrence of the French to send a Wing to Luxeuil, 30 miles north-west of Belfort, to operate from there against the Rhine towns.

This Wing started work at the end of July and was broken up on 14th April, 1917.

Its formation at that time appears to have been a mistake. It took away aircraft that would have been better employed on the Somme, and owing to shortage of aircraft it could not be kept up to establishment. So |it] only dropped a total of 17'A tons of bombs.

4. Despatch of Royal Flying Corps Squadrons to Nancy

It was not till the formation of the Independent Force that a definite or continuous attempt was made to attack Germany by means of air power.

The first nucleus of the Independent Force was the 41st Wing which was despatched to the neighbourhood of Nancy in October, 1917. The immediate cause of its despatch was the following telegram received by GHQ, France on 1st October, 1917: 'Continuous aircraft raids on England are causing interruption in munition work and having some effect on general public. Cabinet desire immediate action against those German objectives which can be reached from Nancy'.

One day bombing and one night bombing squadron were accordingly moved to an aerodrome near Nancy, and were followed by a Handley Page squadron from England. The first raid was carried out on 17th October.

5. The Formation of the Independent Force

By the end of the year the situation in England as regards the supply of aeroplanes was rapidly changing and it was clear that the time was approaching

when there would be more aeroplanes than were required by the Navy and the Army for co-operation.

It was therefore decided that the scheme of attacking Germany by air could now be put into practice.

It is evident that the idea underlying the despatch of the 41st Wing to Nancy was retaliation, but this was not the policy that led to the formation of the Independent Force. The latter was a definite step towards reducing the resisting power of the German nation and so forcing it to sue for peace.

It was laid down that the objects of the Independent Force were:

(a) To damage industrial, railway and military centres [see Figure 3.1 J.

(b) To force the enemy to withdraw squadrons from the Army front.

(c) To cause alarm and discontent amongst the civil population of Germany.

The Independent Force was definitely formed on 5th June, 1918, and took over all the units in the Nancy area.

The GOC Independent Force was to work directly under the Air Council and to receive orders from the Secretary of State for Air and not from the C in C British Armies in France.

It is probable that had the war lasted a little longer, he would have received his orders from Marshal Foch.

The total weight of bombs dropped by the Independent Force from its formation in June, 1918, to the Armistice was 537 tons of which 160 tons were dropped by day and 377 tons by night.

The total number of squadrons at the Armistice was:

Day bombing	4
Night bombing	5
Fighter	1
	10 or 132 aeroplanes

At the time it was estimated that by the end of May, 1919, the Independent Force [squadrons] would have expanded to:

Day bombing	18
Night bombing	18
Fighter	4
	40

6. The achievement of the Independent Force

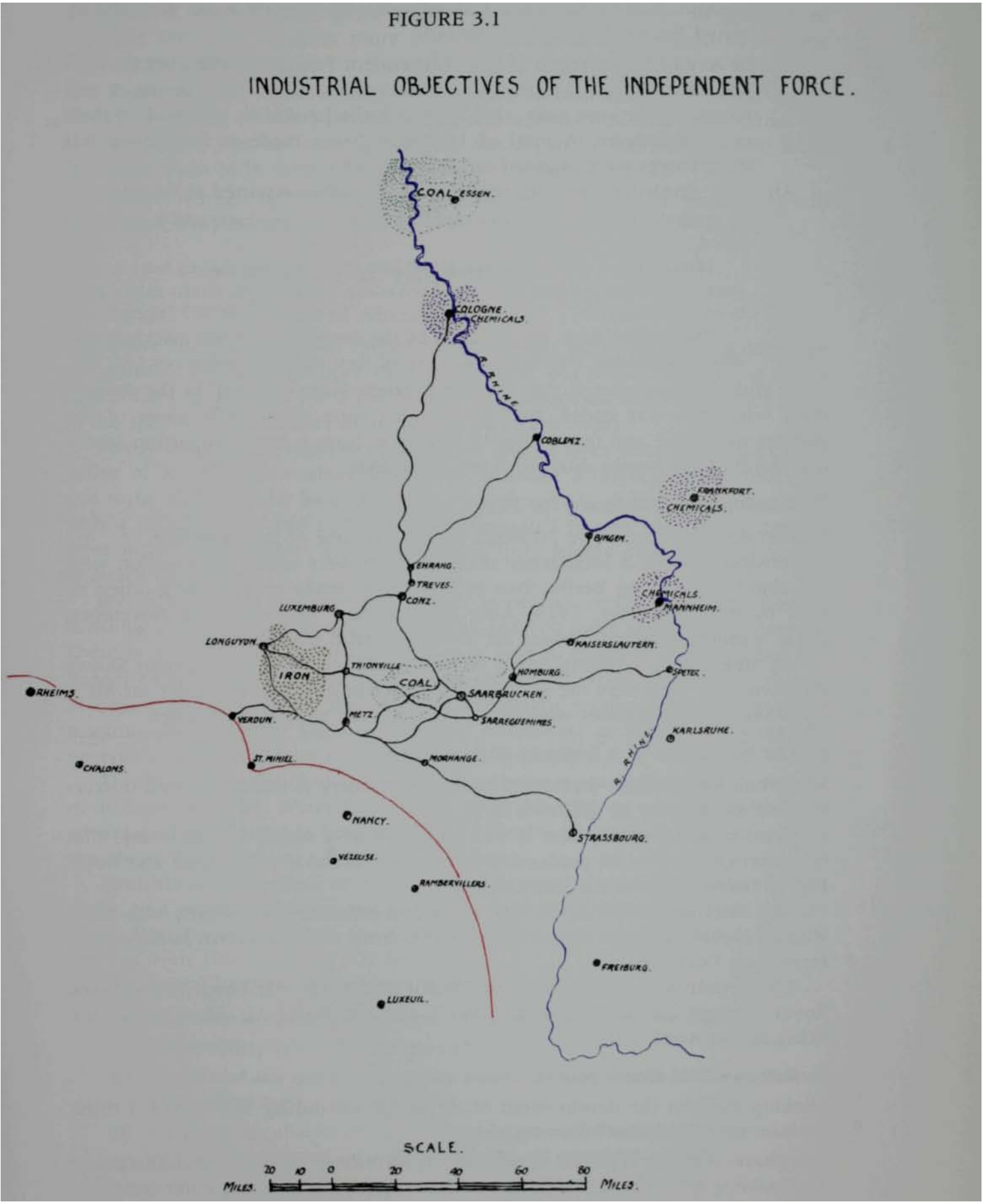
(a) The material damage was not great, in fact somewhat disappointing.

That assessment differs from the impression of 'material damage' created in Document 4, 'Reports on the Attack on Cologne, 18 May 1918'.

(b) The Germans were forced to withdraw squadrons to deal with the new menace. From August, 1918, onwards they kept to oppose the Independent Force:

16 Home Defence Flights—240 aircraft and 5 local protection Flights.

FIGURE 3.1


INDUSTRIAL OBJECTIVES OF THE INDEPENDENT FORCE.
COAL
ESSEN.
COLOGNE.
CHEMICALS
RHINE
COBLENZ.
FRANKFORT.
CHEMICALS.
BINGEN.
EHRANG.
TREVES.
CONZ.
LUXEMBURG.
CHEMICALS.
MANNHEIM.
LONGUYON.
KAISERSLAUTERN.
IRON
THIONVILLE
COAL
HOMBURG.
SPEYER.
RHEIMS.
SAARBRUCKEN.
VERDUN.
METZ.
SARREGUEMINES.
KARLSRUHE.
R. RHINE
CHALONS.
ST. MIHIEL.
MORHANGE.
NANCY.
STRASSBOURG.
VEZELISE.
RAMBERVILLERS.
FREIBURG.
LUXEUIL.
SCALE.
20 40 0 20 40 60 80
MILES.
MILES.

Also 5 ordinary pursuit squadrons—90 aircraft were partially diverted from their ordinary duties.

In August the strength of the Independent Force was 102 aircraft,

(c) The moral effect caused must always be a matter of dispute. I will merely quote one case, that of the Badische Anilin und Soda Fabrik near Mannheim. A total of 18 attacks were made at Mannheim but these works were alarmed on 256 occasions.

After the Armistice the chief engineer of the works reported as follows:

A general state of nervousness commenced and became more and more intensified.

Directors and workmen alike found that the continued alarms were a great strain to the nerves and had raids been more frequent the results might have been disastrous.

The workers were not perturbed by the damage as this was quickly repairable, but constant alarms and raids ruined their nerves, in some cases for life.

It must be remembered that the Independent Force was still in the embryo stage when the war ended, that bomb-sights were then crude, some of the engines unreliable and that owing to defects in fuzes a large proportion (about one third) of the bombs dropped failed to explode.

7. Developments Projected for 1919

Further developments were projected also at the time of the Armistice.

Aeroplanes with a total range of 1100 miles were under construction with the object of bombing Berlin. Two of these were ready and awaiting orders to start by 8th November, 1918. After the Austrian Armistice (3rd November, 1918) a project was put forward for bombing Berlin from Prague.

An inter-allied bombing group was to be formed and two Checko Slovak divisions sent to protect the aerodromes. The whole was to be under an Air C in C. Sites for aerodromes were being reconnoitred by 11th November.

8. The Formation of a Separate Air Ministry

The whole story of the formation of an Air Ministry is interesting and instructive but too lengthy to deal with here.

It must suffice to say that it was the result of a steady evolution and that two attempts to control production for the Royal Naval Air Service and Royal Flying Corps under an Air Board failed.

The chief step towards the formation of a separate Air Ministry was made when General Smuts presented to the War Cabinet what is known as his second report [see Document 11]. . . .

This report was agreed to by the War Cabinet, the Air Force Bill received Royal Consent on 2nd November, 1917, and the Royal Air Force came into being on 1st April, 1918.

9. Retrospect of Development

Looking back on the development of air operations during 1914-1918, I think we can distinguish the following phases:

1st Phase. Aircraft regarded merely as an additional means of reconnaissance for enabling the Army Commander to draw up his plans with greater certainty.

2nd Phase. Aircraft found to be capable of assisting the Army to fight, ie, of enabling the guns to shoot more effectively and to some extent of helping forward the infantry.

3rd Phase. Aircraft found capable of rendering indirect assistance to the operations of an Army by bombing the hostile communications, and further, that for this purpose it was not essential for the aircraft to be located near the army front, nor even to be under the command of the Army C in C.

4th Phase. Aircraft believed capable of assisting the nation to impose its will upon the enemy people by action separate from that of the Navy and Army.

B. THE FUTURE

10. Special Characteristics of Aircraft

The above show the trend of events during the last war, and give a guide as to the probable course of air operations in the next, but before considering this it is necessary to go back for a moment to first principles and to consider some of the special characteristics of aircraft as they exist today.

Firstly there is the rapidity of action of aircraft over distances within their radius of action. This enables aeroplanes to attack a target say 200 miles off and to be back at their base, all within four hours. It also enables aeroplanes with a radius of say 150 miles to be concentrated in one area within two or three hours, or it enables aeroplanes acting from widely dispersed aerodromes to attack one target.

Secondly there is the ease with which aeroplanes can change their targets, attacking a place 100 miles north-east today and 100 miles south-east tomorrow. There is a certain danger in this as it may lead to dispersal of effort, but the danger to be guarded against here is not change of target so much as change of object. For instance, if the object is to prevent reinforcements or supplies reaching the area near Soissons, blocking of railways at Valenciennes may be necessary at first and later of those through Thionville.

Thirdly there is the obvious point that aeroplanes are not stopped by natural or artificial obstacles. Water for instance up to 50 miles or more in width is an advantage to the attacker because of the difficulty the defender has of putting out observation posts or AA guns in that space.

Fourthly their freedom of movement. An army is limited to motion in one plane, to a general direction and for the present at all events to certain definite lines. Aircraft can approach their objective from any direction and at heights varying from 100 feet to 20 000 feet.

The special limitations (on aircraft] are:

(a) Dependence upon weather and difficulty in fog and low cloud.

(b) Vulnerability when on the ground.

(c) Absence of any physical stopping power such as that provided by barbed wire or bayonets.

(d) A further peculiarity of aircraft is the fact that they spend most of their time on the ground, ie, out of the element in which they fight.

11. The Effect of Aircraft Characteristics on Air Operations

Now how does all this affect air operations.

(a) It is almost impossible to defeat an enemy Air Force in the same way that a Navy or an Army can be defeated. We cannot ensure meeting the enemy in the air or bringing him to action. In fact air fights only take place by accident or by mutual consent.

We may fly over the enemy's aerodrome but he may sit on the ground until shortage of petrol forces us to go home.

Suppose then that we bomb him on the ground. We shall probably do him some damage and although we shall lose some aircraft ourselves in the process, we shall gain on the exchange. But granted a decent supply organisation, it is impossible to defeat an enemy Air Force by this means.

Carry the process a step further and attack the enemy's aircraft factories so as to stop the supply at its source. This may be effective in time but is a slow process.

Experience in the last war shows that so long as the enemy system of supply is functioning, all that can be gained is local and temporary air superiority, and that any idea of a permanent defeat of the enemy Air Force is dangerous and misleading.

(b) The attacker has no fixed line of communication between his aerodromes and his objectives. He therefore runs very little risk of being cut off from his base even if the enemy Air Force is unbeaten and free to act.

(c) It is very difficult to stop aeroplanes reaching their objectives. Suppose the defending aeroplanes are kept on the ground waiting for the alarm. By the time they get the warning and up to the height at which the attacker is flying, the bombs will probably have been dropped and the attacker be on his way home.

Limitation of petrol capacity and the uncertainty as to direction and the height will usually prevent a sufficient force being kept in the air to meet any possible attack. AA guns will hamper but not stop aeroplanes.

In an important qualification to his preceding conclusions, Wrigley goes on to acknowledge the vulnerability of those conclusions to technological developments.

I would like to emphasise here that these points apply to aircraft as they exist today and as far ahead as one can see clearly, but there is always the possibility of some new discovery modifying the present characteristics of aircraft in the method of operation.

12. Methods of Bringing Pressure to Bear on an Enemy People

Wars are won by breaking our opponent's will power . . .

But in any national war, in any big war of the future, it is the will power of the enemy people that we have to break, and the energies of all three fighting services are directed towards this as their final object.

The methods of operation whereby they each seek to achieve this object differ.

A Navy brings pressure to bear on an enemy people mainly through the control of sea communications, ie, by cutting off the supply of food and other essentials of life. To do this, it usually has to start by defeating or neutralising the enemy's Navy, but this is not an end in itself but merely one of the means towards the end. The advent of the submarine has reduced the relative effect of a naval victory as we found in 1917.

Before an Army can bring direct pressure to bear on the enemy people, it must defeat their army, and this may to some extent be counted as an end in itself, since the knowledge that their army has been beaten has a great effect on the minds of a people.

The case of an Air Force is different. It can bring direct pressure to bear on an enemy people from the very commencement of a war irrespective of whether the enemy Air Force has been defeated or not. It does this by attacking what may be termed their national centres namely their seat of Government, their transport system and productive centres.

13. The Objective for an Air Force

Paragraph 13 addresses a central issue in air power doctrine. In our opinion, both official doctrine during World War I and contemporary doctrine place far more stress on the need to establish air superiority *at the essential time and place,* than Wrigley does here. See Document 14 for an official statement on 'control of the air' from October 1918.

The point for consideration is whether an Air Force should, on the analogy of a Navy or Army, devote its energies first to defeating the enemy's Air Force, or whether it should proceed at once to bring direct pressure on the enemy people. It must be admitted that the position of our bombing squadrons would be a happier one if the enemy were driven out of the air but as has been shown in paragraph 11, this is unnecessary and usually impossible. Even if we could achieve it by constant attacks on the enemy's national centres, so surely it is more reasonable to attack these centres and thus affect the enemy's will power at once.

It may be necessary to obtain a certain measure of local air superiority in order to enable our bombing squadrons to reach their targets but this is a very different thing to aiming at complete defeat of the enemy in the air.

During the war of 1914-1918 we fought in the air in order to allow our reconnaissance and observation aeroplanes to carry on their work freely and it may be noted that in this case the area of operations was so restricted that the need for local air superiority became of very great importance. But even in this case there was no question of postponing our reconnaissance and artillery work until we had defeated the German Air Force and had we waited for this event co-operation would not have made much progress in the war.

An air force acting separately can and must make the enemy national centres its main objective and not the enemy force.

This is I know regarded as a heresy, but the basic fact to bear in mind is that victory in the air cannot be gained in the same way as victory on land or victory at sea. The conditions are entirely different and so the methods of operation must differ.

14. The Selection of Bombing Targets

The selection of targets for bombing, or in other words the decision as to what constitutes the most important centres of the enemy nation, is a matter of policy to be decided by the War Cabinet and must vary with the psychology of the enemy nation and its mode of life.

It may be considered that the will power of the enemy nation will not be broken until his army is defeated in which case military arsenals might be the main targets; or the defeat of his navy might be thought essential and targets might then be naval bases.

The point to bear in mind is that the will power of the enemy nation is what we have to break. If we can do this and so induce the people to force their government to sue for peace, we have won the war, even though the enemy may still have intact 50 battleships, 100 divisions and 5000 aircraft.

It might be argued that the Japanese capitulation following the atomic attacks illustrates the point made above, as at the time of the surrender Japan still had a large standing army in its homeland.

15. Co-ordination of National Effort

Army argument as to whether an Air Force can win a war by its own unaided efforts is not likely to lead to any conclusion, but in any case of another great national war it seems certain that victory will only be obtained by co-ordination of every national source of energy towards the common end, economic and financial energy as well as that of the fighting services. How will this co-ordination take place?

It does not require any great effort of imagination to foresee the possibility of two armies facing each other commencing elaborate trench systems; and an air force bombing the communications of one army with such good effect that it is unable to bring up ammunition or supplies. Would it not soon get into the dangerous situation that it would never dare to face a determined attack and be forced to withdraw on a preliminary bombardment?

Again, the air force may proceed to lay waste an area of country so as to delay the movements of an enemy army, similar to the German procedure before the Battle of Lodz in November, 1914.

I would suggest that we must overhaul our conceptions on the matter.

After the South African War the Army began to realize the value of co-operation between the various arms, and to think out how to combine the special attributes of infantry, of cavalry and of artillery towards the common end, the defeat of the enemy's army on the battlefield.

Now we want to step on to a higher plane and to think out how to combine the potentialities of all three services and also of economics so as to bring the requisite pressures to bear upon the enemy people as quickly as possible.

The chief attributes of the fighting services appear to be of a Navy mobility, of an Army resistance, and of an Air Force offensive power. Is it then not logical to foresee the Navy form a barrier from behind which the Air Force can operate in safety?

I have heard it suggested that this is derogatory to the Army and converts it into a mere aerodrome guard. Surely this is not the way to look at things. It is setting up walls between the services. If they all realize the common end and the interdependence of all, is not the attack of the enemy's capital just as much part of the Army's and of the Navy's work as it is of the Air Force's. Does a gun complain because the shell has all the fun of hurtling through the air and exploding amongst the enemy?

16. Points for an Army to Consider

Looking upon us all then, rather as belonging to one service than to three, there are a few points to consider. First the offensive must be as strong as possible, therefore the proportion of the air force to be retained for direct co-operation with the army and navy must be as small as possible.

Secondly the number of aircraft to be retained for defence must be reduced to a minimum, therefore a navy and an army must be made as invulnerable to aircraft attack as possible. Thirdly an army must keep as mobile as possible so as to allow the fullest possible scope to the offensive weapon, the air force.

17. Concluding Remarks on Bombing

In conclusion I would like to refer briefly to three points:

The object of the Air Force in attacking first of all the enemy national centres is not to avoid fighting, but to win the war. Heavy casualties will undoubtedly occur. Next the targets should be whatever will have the greatest effect on the enemy will power and so bring the war to an end in the shortest time. All war is brutal whether the weapons are guns, bombs or starvation but the acid test of brutality is the total number of casualties inflicted and in this the governing factor is time.

Finally the following remarks by an officer who combines experience with a sound judgement of human nature, will bear quotation:

> Those who hold that the effect of air action diminishes as bombing continues, have either had little experience of its effect, or are ignorant of human psychology. There are three well marked stages in the effect of air bombardment; the first is one of considerable fear, the second indifference as the chance of personal injury is seen to be small, the last an intense weariness as life becomes more and more disturbed and intolerable.

DOCUMENT 13.

Examples of Effect of Air Bombardment

Sir Arthur Harris and Sir John Slessor were two of the principal architects of the formulation of bombing theories in the RAF before 1939. There can be no doubt that the strategies they developed would have been strongly influenced by the kind of detail reproduced in this document. The results from the bombing attacks reported here must have seemed highly encouraging. They were results which justified the RAF as a separate and equal service.

These examples **are** classified under the heads:
1. Physical 2. Economical 3. Moral

1. PHYSICAL EFFECT

(a) **On Aerodromes**

(i) In August 1917 the French formed a great concentration of aircraft near Verdun, in preparation for a comparatively small attack. This was being arranged by Petain with the object of strengthening the French Army's morale which had fallen very low after the failure of Nivelle's offensive in the preceding Spring.

In order to have every probability of success Petain had called in a large number of tanks and aeroplanes to assist the Infantry. Aerodromes in that country are few and bad and [630] French aircraft had to be concentrated on seven aerodromes . . .

All these [aerodromes] are covered by a circle of 3 miles radius, the centre being about 10 miles behind the lines. On the night of September 25/26th 1917, Osches and Lemmes were attacked by Gothas. These flew very low and used two types of bombs, viz a 50 kilo bomb and an anti-personnel bomb. Sixty of the French aircraft were destroyed. The next night [various airfields] were attacked by 36 Gothas which dropped a total weight **of** 24000 lbs. of bombs about the size of our 251b and 1121b. The French lost 25 aircraft destroyed and 20 damaged besides 2 men killed and 13 wounded. In addition 19 MT vehicles, 6 hangars and a considerable quantity of equipment were destroyed.

(ii) Between 15.8.18 and 21.9.18, a total of 117 aeroplanes of the Independent Force attacked Boulay aerodrome, 32 miles on the German side of the lines. A total of 46 tons of bombs were dropped and according to German reports they had seven aeroplanes wrecked and 1 5 aeroplanes damaged.

Counting this as the equivalent of a total of 12 wrecked it took 3.8 tons of bombs to wreck one aeroplane. We lost no aeroplanes missing during these attacks on Boulay but would probably have had 7 struck off for other causes. We were therefore 5 up on the exchange, irrespective of the moral effect on the Germans. Altogether the Independent Force made 160 attacks on hostile aerodromes which was about 30% of the total attacks made on all objects,

(iii) Late on 24th August, 1918, No 48 Squadron was bombed at Bertangles by five German aircraft, which dropped a total weight of 6601bs of bombs. The squadron had nine aeroplanes burnt and two badly damaged. Most of the heavy transport was destroyed, as well as 5 hangars and several huts. The total casualties were 8 killed and 28 wounded. This includes 6 killed and 14 wounded not belonging to the squadron. The first German bomber made a lucky hit and set a hangar containing six Bristols on fire, thus forming easy targets for the other four. Of the German aeroplanes four returned safely and one had a forced landing on its own side of the lines owing to its oil tank being hit; the aeroplane was wrecked but no one injured.

No 48 Squadron was moved to Boisdinghen, a distance of 100 miles and in 48 hours was re-equipped.

The moral effect on the squadron remained great for some time, especially as Boisdinghen was on the line of German bombers proceeding to the coast and air alarms were constantly occurring.

(iv) Extract from Neumann's The German Air Force in the Great War', page 208:

> During July 1918 large squadrons of 70 or 80 machines would appear, and while two-thirds of their number remained at various heights to act as escort, the remainder would systematically attack our aerodromes one by one. Thus, for example, in the neighbourhood of Lille and Cortoyle, in the course of two days they succeeded in completely destroying three formations of fighting machines by bombs and machine gun-fire . . .

Ammunition dumps

The ammunition dump at Andruicy was hit by bombs on the night of 20/21st July 1916. The ammunition was blown up and the whole dump destroyed. The attacking force consisted of four German aeroplanes carrying about 15001bs of bombs each. NB—Effective precautions were afterwards taken to minimise the effect of air bombardment on ammunition dumps.

England

The casualties per ton of bombs dropped for the whole of England averaged 17 persons per ton. About 2 5 per cent of these casualties were killed . . . Generally speaking, except for certain notable successes, the material damage done by bomb raids was small in proportion to the economic and moral effect.

2. ECONOMICAL EFFECT

Industries in England

(i) On Monday 3rd April, 1916, a Sheffield firm reports that after a previous night's air raid, out of a total of 2000 men, 633 did not turn out the first quarter and 196 were off all day, the usual number being 450 and 170 respectively. After the next raid 821 men did not turn out the first quarter and 254 were off all day.

(ii) At Yarrow shipyard *3Vz* times more than the normal number of men were absent after an air raid.

(iii) The pig iron output in the Cleveland district dropped from an average of 50 000 tons per week to 20 000 tons for any week in which air raid warnings were given in the Cleveland area. The reduction in output for that year was therefore 390 000 tons of pig iron; in other words one-sixth of the total annual output.

This reduction was due to the dousing of blast furnaces whenever an air raid warning was given,

(iv) In September, 1917, air raid warnings at the largest clothing manufacturers in England resulted in the output dropping from 40 000 suits per factory to under 5000.

(v) At Messrs Vickers Works, Crayford, on days when air raids occurred output fell by from 75 to 100 per cent and took several days to recover.

(vii) At Woolwich Arsenal during the week ending 29th September, 1918, the output of .303 cartridges was reduced by approximately 50 per cent.

Industries in Germany

. . . It is clear from the reports . . . that the loss in production due to air raids on the Rhine towns must have been similar to our own experience in England. The most interesting case . . . is that of the effect on the factory at Oppau giverf in The Economic Blockade':

> Fodder and Fertilisers—Germany has a poor sandy soil but her peace imports of fodder and fertilisers enabled her to produce 85 to 90 per cent of her requirements in food . . . By cutting off these supplies the fertility of her soil was so greatly reduced that her home food production fell off by about 30% and it was only by successive invasions of enemy countries that she was able to stave off starvation and even so, after the bad harvest of 1916 a large proportion of the population was reduced to turnips and swedes. The lack of fertilisers—especially nitrate—was to some extent ameliorated by the home production of synthetic ammonia by extracting nitrate from the air which was largely developed during the war. Later however the company's great factory at Oppau was so much injured by repeated bomb raids that new works had to be erected near Merseburg. The company was the Badische Anilin und Soda Fabrik.

Railways

English railways. The Great Western Railway Company's aggregate of delays to trains in the London and Birmingham districts as the result of one raid only was: Passenger trains, 195 hours; Goods trains, 65 hours.

German railways. Owing to damage done by air bombardment great difficulty was experienced in 1917-1918 in repairing damaged locomotives and rolling stock. As a consequence the Germans in 1918 were very short of locomotives. The railway authorities at Saarbrucken stated that each raid resulted in the stoppage of traffic for two hours.

French railways. In March 1918 the Germans attempted to stop the movement of French reinforcements towards the break through in front of Amiens.

By attacking Chalons and a point 5 miles west of it they forced the French to stop using the line through Epernay and to use that through Somme Sours and Coulimmiers causing congestion on the latter . . .

The total delay caused was ten hours to each of five Divisions and one Army HQ. It might have been more serious had the attack been continuous instead of spasmodic and had been directed on Vitry le Francois instead of Chalons, since at the former place the Germans would have delayed traffic on both main lines instead of on one. They seemed to prefer attacking railway stations in big towns presumably with the object of damaging either one or the other, but the result was they failed in both.

3. MORAL EFFECT

(a) On Chemical Works

The Badische Anilin und Soda Fabrik near Mannheim was bombed on 26 occasions. Total weight of bombs dropped on it was 34 tons. The manager stated that the material damage done by these bomb raids both from a military and destructive point of view was small. The majority of bombs having burst between the buildings, little or no damage was done except to pipes.

On the other hand, the Chief Engineer reported:

> A general state of nervousness commenced and became more and more intensified. Directors and workmen alike found that the continued alarms were a great strain to the nerves and had raids been more frequent the results might have been disastrous. The workers were not perturbed by the damage as this was quickly repairable, but constant alarms and raids ruined their nerves, in some cases for life.

(b) On Indian Tribes

In his report on the RAF in India [see Document 10], Sir J. Salmond has some interesting remarks on the effect of bombing. He says:

> It is as well here to refer to the effect of continued air action. Those who hold that its value diminishes as bombing continues have either had little experience of its effects or are ignorant of human psychology. There are three well marked stages in the effect of air bombardment, the first is one of considerable fear, the second indifference as the chance of personal injury is seen to be small, the last an intense weariness as life becomes more and more disturbed and intolerable. There is no doubt that all people who hold out against the first stage arrive sooner or later at the third, though the effort necessary to bring them to that point will differ greatly in the case of people of varying temperament and mode of life.

(c) On London

During the raid of February, 1918, a total of 300 000 persons took shelter in the tubes. The majority of these were aliens from the east and north-east ends of London.

(d) On German Towns

The mayors of the towns visited (by the Commission on the effects of air bombardment in Germany) did not attempt to deny that the moral effect produced by these air raids was very considerable.

Men, women and children, rich and poor, were affected alike and in some cases health was seriously impaired due to nights spent in cellars and dugouts. The principal anxiety of the inhabitants seems to have been the uncertainty as to whether they would obtain compensation from the government for the material damage done to their property by the bombs.

There is no doubt, however, that the majority of the population went to ground on the alarm signal and remained there until the all-clear sounded. This if continued would ultimately affect both the efficiency and the morale of the inhabitants.

11. A German Gotha long-range bomber. The Gotha raids on London in broad daylight on 13 June and 7 July 1917 probably caused more concern in England than any other event during the war. RM.

PART FOUR

Operational Orders and Instructions

Notes on Recent Operations Prepared by Headquarters RAF

(Probable date, October, 1918)

Several important operational considerations are raised in this official document. The most significant is the categorical statement that an air force's prime task must be the establishment of air superiority.

The experience of fighting during 1918 has again proved the value of a vigorous and continued offensive in the air whether the army is advancing or retiring. At the same time the tasks allotted to the RAF in direct connection with the fighting on the ground continue to increase, and each new task imposed has the effect of reducing the offensive power in the air. A conflict of interests thus arises between the requirements in the air and the requirements on the ground, but the latter being dependent on the former, it stands to reason that the primary task of the RAF must be to gain and maintain superiority in the air, as without such superiority the effective co-operation of aircraft with other arms is hindered, and the Army may be deprived of all assistance from the air at a time when it is most needed.

The methods by which the RAF can assist the Army are as follows:

(a) By close co-operation with the other arms, Cavalry, Artillery, Infantry and Tanks, in the battle.

(b) By reconnaissance and photography.

(c) By the destruction of enemy communications by bombing.

In addition assistance can be afforded by:

(d) The attack with bombs and machine gun fire of enemy troops and transport on the ground by low flying machines.

(e) The formation of smoke screens by dropping smoke bombs.

(f) The dropping of ammunition and food to the troops in the front line.

These latter tasks absorb machines and reduce the offensive power of the RAF in the air. They can, therefore, only be justified if superiority in the air is assured.

Superiority in the Air

The normal method of gaining superiority in the air is by the defeat of the enemy fighting machines in the air. This postulates two conditions:

(a) That the enemy fighting machines can be found.

(b) That when found they can be engaged in combat.

With the number of machines available on any given front it may not always be possible to be strong in the air throughout the hours of daylight. To attempt to keep fighting machines in the air during each hour of the day would probably result in being weak everywhere and at all times. Apart then from local fighting patrols the available fighting machines should be concentrated both as to time and as to place. Their radius of action being limited, it may so happen that enemy machines are not encountered, or only encountered in such strength as to preclude engagement.

Recently the enemy has consistently refused combat against regular formations, and has adopted tactics against single machines and stragglers. In addition he has concentrated large formations of fighting machines with the object of attacking our bombing machines.

In order to counteract these tactics and to compel the enemy to accept battle in a locality and at a time of our own choosing it may be advisable to carry out organised raids against hostile aerodromes and to repeat such raids at fixed intervals during the day. Such raids should be carried out by mixed forces consisting of low flying scout machines and bombers protected by high flying scouts. A definite objective should be assigned to each raid.

By these tactics it may be found possible to force the enemy machines into the air where they could be engaged by superior forces. If, however, the enemy refuse battle in the air, considerable damage both material and moral will be inflicted. To be successful a close study of the enemy's habits is essential.

12. The Eindecker, which revolutionised air warfare in 1915 with its forward-firing machine gun. RM.

DOCUMENT 15.

Instructions Issued by Headquarters, Royal Flying Corps, 14th January, 1916

The emergence of the Fokker Eindecker in late 1915 suddenly and dramatically swung the advantage in the air war to the Germans. The Eindecker was a manoeuvrable monoplane, with a singular ability to sustain long, almost vertical dives. Its **real** strength, however, was the fact that it was the first fighter to employ an effectively synchronised forward firing gun. Technological superiority was now recognised as a vital factor, all else being equal.

Note also that the use of formations was already established **as** the best way of achieving the dual aims of defence and the concentration of force.

Until the Royal Flying Corps [is] in possession of a machine which is as good as, or better than the German Fokker, it seems that a change in the tactics employed becomes necessary. It is hoped very shortly to obtain a machine which will be able to successfully engage the Fokkers at present in use by the Germans. In the meantime it must be laid down as a hard and fast rule that a machine proceeding on reconnaissance must be escorted by at least three other fighting machines. These machines must fly in close formation and a reconnaissance should not be continued if any of the machines become[s] detached. This should apply to both short and distant reconnaissance.

Aeroplanes proceeding on photographic duty any considerable distance east of the line should be similarly escorted. From recent experience it seems that the Germans are now employing their aeroplanes in groups of three of four, and these numbers are frequently encountered by our aeroplanes.

Flying in close formation must be practised by all pilots.

DOCUMENT 16.

Royal Flying Corps Orders Regarding Offensive Patrols at Arras

Move and countermove: like their naval and military counterparts, airmen had quickly learnt the value of tactical innovation.

There was an unhappy footnote to the April offensive at Arras. The month became known as 'Bloody April' as the RFC sustained some of its heaviest casualties of the war.

1st Brigade
2nd Brigade
3rd Brigade
4th Brigade
5th Brigade
9th Wing

The GOC wishes the attention of Brigadiers drawn to the necessity, under present conditions, of working our offensive patrols at medium as well as extreme heights.

The enemy seems for the moment to have given up, to a certain extent, his method of depending entirely upon height and his machines and formations are undoubtedly slipping underneath our high patrols without being seen by them. His tactics are, of course, rendered easier by the cloud layer which, even on fine days, has extended of late somewhere between 5000 and 7000 feet. By coming up through or underneath these clouds his machines have on several occasions attacked our artillery and photographic machines unseen by our scouts although large numbers of the latter have been in the area at the time.

High patrols must be maintained, otherwise the enemy will undoubtedly adopt his former tactics once again, but they often miss an opportunity through being too high. It must be remembered that the conditions which favour this form of attack by the enemy apply equally in our own case and that low patrols working under or through the clouds should obtain many opportunities of acting by surprise.

While, therefore, the GOC is very strongly opposed to anything in the nature of a local escort of scouts, he would like Brigadiers to consider carefully the advisability of working some of their patrols at or about the height at which the Corps machines are working, with high patrols up at the same time.

Headquarters
Royal Flying Corps
15th April, 1917

(Signed) R.J. Barton, Capt.
for Brigadier General
General Staff

DOCUMENT 17.

Orders to Army Corps on Method to be Adopted in Dealing with Enemy Low Flying Aircraft

This brief order illustrates some of the numerous complexities introduced into warfare by the aeroplane.

To:
VI, **VII,** XVII, XVIII, XIX Corps

Third Army Diary
April, 1917

Cases have recently become frequent of hostile aeroplanes flying at low altitude over positions occupied by our troops, directing artillery fire and even engaging targets with their machine-guns.

Neither RFC patrols nor AA guns can deal adequately with these machines and the enemy are certain to continue this practice so long as they can do so with impunity.

So as to obviate any chance of mistake fire must not be opened unless the Black Cross on the hostile aeroplane is distinctly visible.

In the above connection attention is called to 'Notes on firing at aircraft with machine-guns and other small arms'.

(Signed) E.A. Bradfield, Lt. **Col**
G.S., Third Army

19-4-17

Notes on Formation Flying

Formation flying as a means both of defence and concentrating force in time and place is impressed on pilots. Von Richthofen's 'Flying Circus' became the best known example of that theory in practice during the Great War; while in World War II, Douglas Bader's 'big Wings' and Sir Arthur Harris's '1000 bomber' raids were a dramatic expression of combining those objectives.

The symbolic effect of massed formations also should not be forgotten. To a considerable extent, the development of formations was manifest evidence that air warfare had become an end in itself, and was no longer merely an adjunct to land and sea power.

It is not clear from Wrigley's notebooks whether this pithy set of instructions is a transcript of official advice or his own work. Certainly, his experiences flying RE8s with the AFC on the Western Front would have made him expert in the kinds of procedures mentioned here.

The emphasis in the text appears in the original.

The golden rule is to *always keep together.* This applies both to flying during a reconnaissance or escort duty, and when attacking HA [hostile aircraft) (either when they are in groups or singly).

The enemy knows the value of this and it is the aim of their better pilots to endeavour to break up our formations and then concentrate on one of our machines with odds on their side.

Reconnaissance. This is sent out for the purpose of bringing back information. Every reconnaissance has an escort of some form or other, and it is the latter's duty to remain as close as possible to the reconnaissance machine or machines, and not to be drawn away under any consideration by enemy aircraft; further there is far less chance of being molested when a group is flying good formation.

It frequently happens that when the reconnaissance machine is separated from the escort the latter say that 'they couldn't keep up with him'. The former must of necessity be the leader, and it is his duty to throttle down to enable his escort to fulfil their role. *The leader of any formation must suit his pace to that of the slowest machine.*

Fighting. The importance of keeping together is again of vital importance. It often happens that when one of our offensive patrols meets an enemy patrol, each man picks out a hostile machine and the whole become scattered and lose any chance of cohesion or method. In such cases, if the enemy patrol happens to be in superior numbers the result is, to say the least, rarely satisfactory.

Fighting in the air closely resembles fighting on the sea, where it is always the endeavour to concentrate the guns of several ships on to one enemy ship and to destroy him by weight of metal.

This must be our aim also. There is far more chance of destroying an enemy machine if several machines have a 'go' at it than there is if each man tries to single out a machine for himself, which is often in itself a difficult matter and always means several 'indecisive' engagements.

Therefore, it must be impressed on all our pilots that the correct method of attack is to endeavour to concentrate on one particular hostile machine, eg, the leader would first attack, *closely* followed by his 'partner'. If the former missed, the latter carries on, and so on with the rest of the patrol. This does not mean that the leader has a go first and the rest wait to see what happens; they must attack in as close formation as possible and concentrate on the one enemy machine singled out.

General. Our formation or group flying when properly carried out is much admired and feared by the Hun. He is now endeavouring to emulate it, but we had the start and it takes a good deal of practice to perfect. A good formation means good piloting, both combined mean method, and method always wins. On the other hand straggling and lack of cohesion in formation have been the cause of most of our casualties and in any case is playing into the enemy's hands.

Some Notes on Bombing Attacks

Lacking the benefit of past experience, airmen were developing their tactics and doctrine on the run. Documents 19 and 20 on strike operations show how quickly and well they were learning.

A process for developing doctrine is evident in the first two paragraphs. Experience is one of the pillars, but should not be used by itself to set 'hard and fast rules'. Indeed, the purpose of this order was not simply to circulate information, but also to obtain 'suggestions which may be of assistance in shaping future policy'. Ideas were being sought from the operational and tactical levels. It was appreciated that doctrine must move with experience and innovation.

The tactical message contained in the order is clear enough—force must be concentrated.

Considerable experience has now been gained in the methods of carrying out bombing attacks. The experience so gained is insufficient to lay down any hard and fast rules as to the system to be adopted, and probably it is undesirable to do so.

The following notes are issued primarily with a view to circulating information of what has been done, and secondly, to obtaining suggestions which may be of assistance in shaping future policy.

Methods of Attack

The 'go-as-you-please' methods have been abandoned definitely by the French and by ourselves in favour of attacks carried out by swarms of aeroplanes. It is now an accepted principle that attacks on all important objectives should be carried out by as many aeroplanes as possible, all the aeroplanes flying together and reaching the objective together. This method is calculated to give AA guns **the** least possible chance of effect, and to render attacks by hostile aircraft most difficult. Large intervals between aeroplanes are to be avoided as presenting a target to AA guns for a greater length of time.

Attacks **on** trains in motion appear to be the single exception to the swarm formation. Against this form of target, continuous bombardment by small detachments of aeroplanes is necessary. This practice was certainly most effective during the operations at the end of September. The enemy's traffic was considerably disorganised, four or five trains were cut and the line damaged in many places. Casualties to personnel in the trains is also reported by agents, in one instance a train being cut in half and 40 soldiers killed.

Height

All machines flying in line ahead at the same height is a formation above all to be avoided, as being the most vulnerable against attack by AA guns.

The French fly at varying heights, and this undoubtedly increases the difficulties of the AA gunner. Varying heights of 6000 feet and over have proved satisfactory. The chances of one aeroplane bombing another are so small as to be negligible.

Rendezvous

Alternative methods are:

(a) All aeroplanes of all squadrons taking part are instructed to rendezvous over a given spot at a given hour.

(b) The aeroplanes of each squadron taking part are given a separate rendezvous equidistant from the objective and are ordered to start at a given time.

The former method is adopted by the French. Both methods have been tried in the 3rd Wing. In the attack on Hervilly on the 14th December (b) method was tried. The squadrons reached the objective in rapid succession not absolutely together as was intended. The system requires careful planning and synchronisation of watches.

The rendezvous must invariably be selected well behind the lines, out of view from the enemy.

French method—The Group Commander is the first to leave the ground and he leads throughout the raid. His aeroplane is distinguished by the tricolour rosette on the sides and front of the nacelle and by metal pennants on the rear centre struts. The escadrille [squadron] commanders also take part and usually follow the Group Commander. As soon as all aeroplanes have arrived at the rendezvous the Group Commander fires a succession of Very lights and leads off towards the objective well throttled down. The rest close in, keeping as close as is practicable.

For short distance raids it would seem sufficient for the leader to give the signal for the start, on seeing which the aeroplanes move as fast as possible along a predetermined route on to the objective without further reference to the leader. The homogeneity of the aeroplanes would ensure their arrival over the objective approximately together.

For raids of longer duration the leader should lead throughout, fly at the pace of the slowest machine, and displaying some easily seen distinguishing signal.

Aeroplanes should make the return journey in the same close formation. They must not disperse.

(Signed) Evelyn B. Gordon
G.S.Major

HQ RFC
21st December, 1915

Orders from GHQ Restricting Bombing by Armies

Document 19 impressed on aircrews the importance of the concentration of force in bombing. This document points out some of the limitations of aerial bombardment; with paragraphs 2 and 5 addressing close air support, and paragraph 4 offensive counter air operations.

The central theme is presented in the third (also visually central) paragraph. Planners are cautioned to be very selective in their choice of targets and timing. Note the importance of timing. The selection of a target is only half the battle: it is timing which determines whether or not that target is worthwhile. Many strategists would agree that GHQ's very good advice was ignored in the subsequent wars in Korea and Vietnam, where the effectiveness of the air interdiction campaigns was disappointing. A well-planned, well-executed air strike is useless if the target is not worthwhile.

That does not mean that all interdiction is bound to be largely a waste of effort. For example, interdiction bought time in Korea during the retreat from the Yalu, forcing Chinese troops to move only at night; while it was a decisive factor in breaking German resistance at the Gustav line across Italy in 1944.

SECRET
OA 431

AH 204/5/889
General Headquarters
17th February, 1916

First Army
Second Army
Third Army
Fourth Army

1. With reference to OAD 291/3, dated 26th January, 1916, on the subject of air raids, Armies in future will base their proposals to General Headquarters on the following policy, which will be followed in determining suitable objectives under existing conditions.

2. No bombing should be done at a distance greater than a few miles from our front unless the results to be obtained and the object in view are commensurate with the possible losses involved in pilots and machines.

3. The bombing of such objectives as ammunition depots, Headquarters of formations, etc. which have been definitely located, and of railway stations and bridges, should be reserved until it can be carried out in connection with definite operations of an important nature. Depots and Headquarters might be moved, or given special protection, if prematurely bombed and might then be unlocated, or too well protected to be attacked with success, at the time when bombing would be of particular value. Damage to railways can be so quickly repaired that no appreciable results are gained by attacking them unless such enterprises are undertaken at the right moment, ie, at a time when even a temporary interruption to traffic on these railways would interfere with important operations then in progress.

4. Raids on enemy aerodromes should only be undertaken when specially recommended by the RFC, and then they should be carried out on a sufficient scale to give a reasonable prospect of success. Bombing of aerodromes on a small scale produces little result and is not worth the risk involved.

5. There is no objection to bombing raids against objectives such as billets close to our own line, intended to destroy or harass enemy personnel. These raids provide valuable practice to the RFC.

(Signed) L.E. Kiggell,
Lieut-General,
Chief of the General Staff

GHQ
17-2-16

DOCUMENT 21.

Application of Theory of Multiple Penetration to Principle of the Object in Air Operations

Success in air warfare depends largely on concentrating the right amount of force, proportionally adequate yet economic, in the right place at the right time. These models illustrate that principle geometrically. They also indicate that, while many of the tenets of air power were (understandably) emerging from practical experiences, theory was not being ignored.

Figure 1

Shows how the striking force is plotted with regard to the defensive force, and how all axes of effort converge on the object to be attained.

Figure 2

Represents three different cases.

Cases I and II may be compared as follows. The lines AO (Case I) and AO^1 (Case II) represent the respective difficulties of attaining the object in the case of Powers with capitals 90 and 60 miles from the coast. The line AO^1 = % AO, assuming that a proportion of 30 offensive to 22 defensive squadrons is correct in Case I, AT represents the time to attain the object and AO/AT the speed of attainment. Case II shows that with the easier object (line AO^1)/ and with the speed of attainment kept constant (ratio AO'/AT^1 compared with AO/AT) the time to attain the object is shortened by the length T'T, and a proportion of 32Vi offensive to 19'/2 defensive squadrons can be used as compared with 30 to 22 in Case I.

Case III shows what is necessary to redress the balance with the harder object (line AO) in order to attain the object in time AT^1, and increase the speed of attainment (ratio AO/AT^1 compared with AO/AT), if 22 squadrons are maintained on the defensive as in Case I. Then 38 squadrons (line DAD^1) are required for the offensive instead of 30, making a total of 60 squadrons in all to produce the same result with the harder object, that the total of 52 produce with the easier object. It is assumed that morale, training and equipment are identical.

Analysis of Cases II and III
Strengths Required to Produce Same Result

	Offensive	*Defensive*	*Total*
Case II. Object 30% less difficult	32¥2	19V2	52
Case III. Object 30% more difficult	38	22	60

FIGURE 4.1

APPLICATION OF THEORY OF MULTIPLE PENETRATION TO PRINCIPLE OF THE OBJECT IN AIR OPERATIONS.

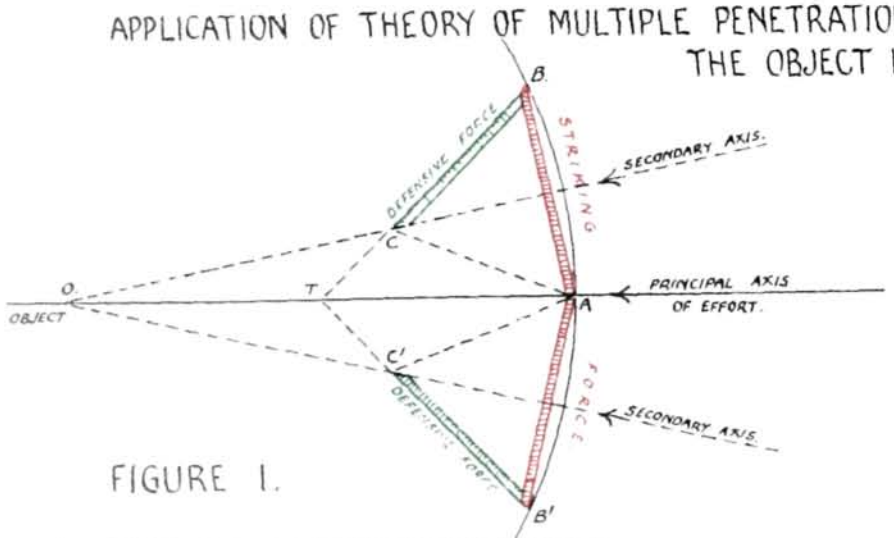


FIGURE 1.

LINE BAB' REPRESENTS THE STRENGTH OF THE STRIKING FORCE.
LINES BC AND B'C' REPRESENT THE STRENGTH OF THE DEFENSIVE FORCE.
LINE AO REPRESENTS IN LENGTH THE DIFFICULTY OF ATTAINING THE OBJECT.
LINE AT GIVES A MEASURE OF THE TIME TO ATTAIN THE OBJECT.
THE RATIO AO/AT INDICATES THE SPEED AT WHICH OBJECT IS ATTAINED.

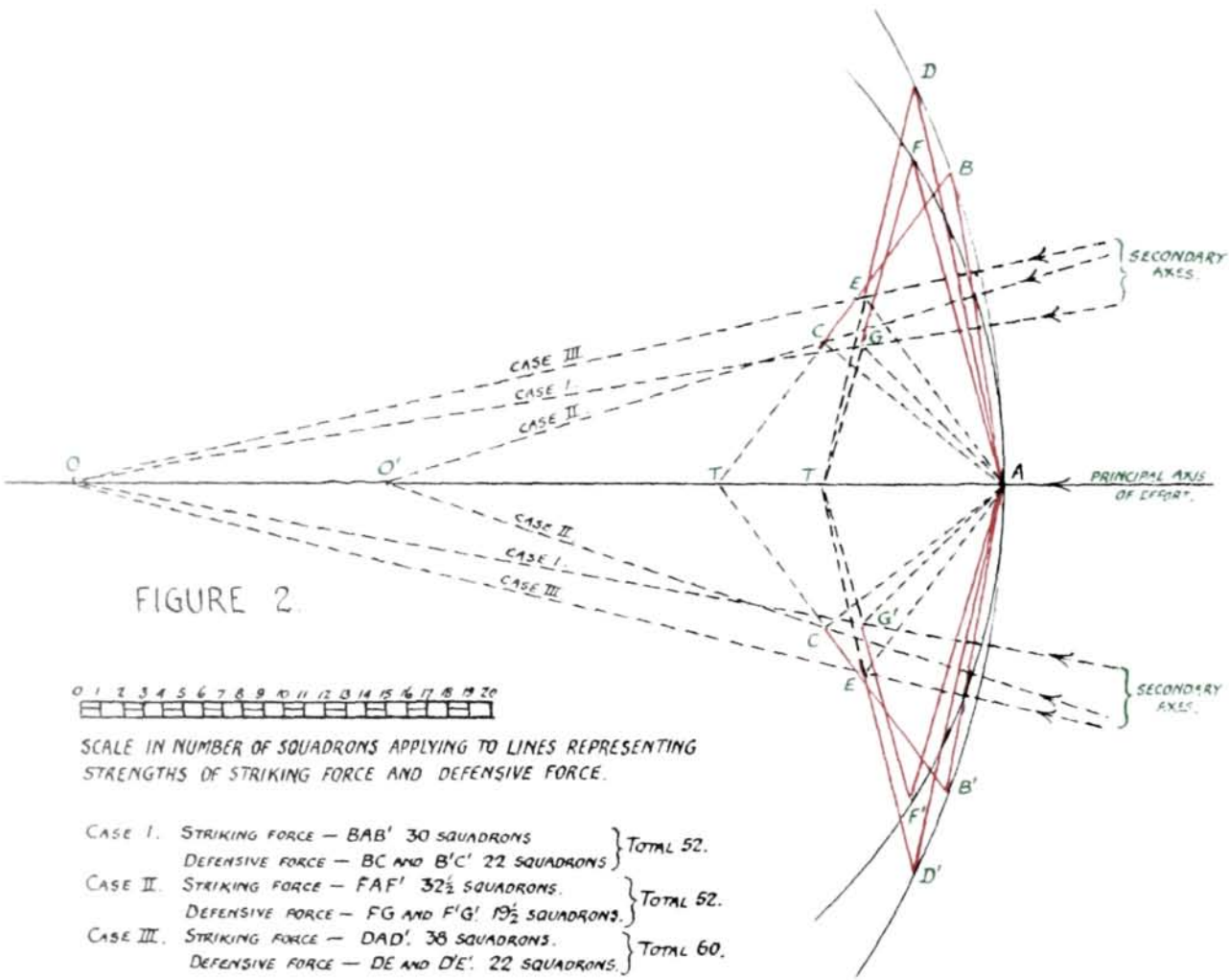


FIGURE 2.

SCALE IN NUMBER OF SQUADRONS APPLYING TO LINES REPRESENTING STRENGTHS OF STRIKING FORCE AND DEFENSIVE FORCE.

CASE I.	STRIKING FORCE — BAB' 30 SQUADRONS DEFENSIVE FORCE — BC AND B'C' 22 SQUADRONS	TOTAL 52.
CASE II.	STRIKING FORCE — FAF' 32½ SQUADRONS. DEFENSIVE FORCE — FG AND F'G' 19½ SQUADRONS.	TOTAL 52.
CASE III.	STRIKING FORCE — DAD' 38 SQUADRONS. DEFENSIVE FORCE — DE AND D'E' 22 SQUADRONS.	TOTAL 60.

CONCLUSION

In recent years there has been a growing belief among airmen that, in one important aspect, they have not been well served by their theorists. The work of men like Douhet, Mitchell and Trenchard is acknowledged for the breadth of its vision and the critical part it played in establishing air power as the decisive factor in national security. However, by consistently overstating some of the capabilities of the air weapon, those great theorists raised expectations which could not always be met.

The admirable notes of Air Vice-Marshal Wrigley go a long way towards redressing that circumstance. Wrigley's thoughtful comments and astute observations are always planted firmly in reality. His outlook remains balanced; for example, when addressing the seminal issue of air bombardment, he examines ideas and realities, and German as well as British experiences. While the classical theorists presented air bombardment unambiguously as the key to victory in future conflicts, Wrigley has also noted its failings and, to some extent, left the final judgment to the reader. In that context, his frequent references to the 'moral' effects of war are noteworthy.

Several important threads emerge from the notes. Air power doctrine does not develop in isolation. Wrigley's clear appreciation of the national objectives of war—the 'Grand View'—is significant, as is his emphasis on the nature of conflict and human behaviour, and the roles of the other two services. His grand strategic view is complemented by discourses on the operational art of war and air combat tactics which are presented with gratifying clarity. The place of offensive action in the air, and the aircraft's singular mobility, flexibility and capacity to concentrate force rapidly, are constant themes.

Despite dramatic changes in the global security equation, the world remains an uncertain place in the last decade of the 20th century. It is incumbent upon professional airmen to understand air power and promote its constructive use in national security considerations. We believe a careful examination of Air Vice-Marshal Wrigley's air power notebooks can make a valuable contribution to that process.

BIOGRAPHICAL NOTES

These notes have been deliberately kept brief. Our intention has been simply to identify personalities sufficiently for them to be placed into their historical context.

To quote Sir Walter Raleigh from *The War in the Air*, some apology may be necessary for the variety which 'has been found inevitable in naming particular men'. Each of those listed below was successful in his chosen career: for the military man especially, that meant numerous changes of title. However, we are confident readers will have few problems in reconciling listings in these notes with names from the text.

Arnold, General H. H. (1886-1950). Commanding General, USAAF, World War II.

Bacon, Francis (1561-1626). English philosopher and writer.

Balfour, Arthur James (1848-1930). British statesman. Prime Minister 1902-05; Cabinet Minister during World War I.

Ball, Captain Albert (1896-1917). British fighter ace in World War I.

Below, General Fritz von (1853-1918). Commander of the 1st, 2nd and 9th German Armies during World War I.

Bismarck, Prince Otto von (1815-98). Founder and first Chancellor of the German Empire.

Brooke-Popham, Air Chief Marshal Sir H. R. M. (1878-1953). Senior RFC/RAF Commander in World War I; C-i-C Far East at the start of World War II.

Carlyle, Thomas (1795-1831). Scots historian and essayist.

Clausewitz, Carl von (1780-1831). Prussian soldier, writer and philosopher. Possibly the most influential military strategist: his book *On War* remains a classic.

Corbett, Sir Julian (1854-1922). British naval historian.

Cromwell, Oliver (1599-1658). Lord Protector, Commonwealth of England, Scotland and Ireland, 1653-58.

Darwin, Charles (1809-82). English naturalist, author of *Origin of Species.*

De Castlenau, General N. J. E. (1851-1944). Commander of French 2nd Army; Chief of Staff.

Douhet, General Giulio (1869-1930). Italian air power theorist; author of perhaps the definitive theoretical work on strategic bombing, *The Command of the Air.*

Du Peuty, Commandant (-1918). Notable French aviator and tactician, World War I.

Evill, Air Chief Marshal D. C. S (1892-1971). Staff member, RAF Staff College, 1927-28; VCAS 1943-46.

Foch, Marshal Ferdinand (1851-1921). Supreme Commander of the Allied forces on the Western Front at the end of World War I.

Funnell, Air Marshal R. G. (1935-). CAS of the RAAF, 1987-

Garibaldi, Giuseppe (1807-1882). Italian Republican and revolutionary; played a major role in the unification of Italy.

Haig, Field Marshal Sir Douglas (1861-1928). C-i-C of the British forces in France during most of World War I.

Halsey, Admiral William Frederick (1882-1959). Allied Commander in the South Pacific theatre, and later of the USN 3rd Fleet, World War II.

Harris, Marshal of the RAF Sir Arthur (1892-1984). C-i-C RAF Bomber Command, World War II.

Henderson, Major General Sir David (1862-1921). First GOC of the RFC in France.

Hewitt, Air Vice-Marshal J. E. (1901-85). Commander of the RAAF's No. 9 Operational Group, SWPA, 1943.

Hoeppner, General Ernest von (1860-1922). Commander of the German Air Service from October 1916; author of *The German War in the Air.*

Holt, Air Vice-Marshal F. V. (1886-1931). RFC Squadron Commander; AOC Air Defence 1931.

Hopwood, Admiral R. A. (1868-1949). British seaman and author; specialist in naval gunnery.

Jackson, T. J. 'Stonewall' (1824-63). Outstanding Confederate commander of the American civil war.

Jellicoe, Admiral of the Fleet Earl (1859-1935). Commander of the British fleet at the Battle of Jutland.

Kidd, Benjamin (1858-1916). Author, philosopher.

Kiggell, Lieutenant General L. E. (1862-1954). CGS in France, 1915-18.

Kipling, Rudyard (1865-1936). British author.

Kitchener, Field Marshal Lord (1850-1916). British Secretary for War at the beginning of World War I.

Lanchester, F. W. (1868-1946). Early air power theorist.

Le Bon, Gustave (1841-1931). French psychologist. Veteran of the Paris Commune of 1871; author of *The Crowd.*

Leigh-Mallory, Air Chief Marshal Sir Trafford (1892-1944). RAF fighter commander; Air C-i-C AEAF 1943-44.

Lincoln, Abraham (1809-65). 16th President of the United States of America.

Lloyd George, David (1863-1945). British statesman, Prime Minister in the latter years of World War I.

Ludlow-Hewitt, Air Chief Marshal Sir Edgar (1886-1973). RFC Squadron Commander; Commandant RAF Staff College 1927-28; C-i-C Bomber Command 1937-40.

MacArthur, General Douglas (1880-1964). Supreme Commander, Allied Forces, SWPA, World War II.

Machiavelli, Niccolo (1469-1527). Italian author of the definitive treatise on power politics, *The Prince.*

Mack von Leiberich, Baron Karl (1752-1828). Austrian general.

Mackinder, Sir Halford (1861-1947). Academic, statesman, author.

Mahan, Rear Admiral Alfred Thayer (1840-1914). Perhaps the most widely read theorist of sea power. An American naval officer and historian.

Mitchell, General William (1879-1936). Pioneering American military aviator. Forceful advocate of air power.

Moltke, H. K. B. (1800-91). Chief of the Prussian and German General Staff.

Montgomery, Field Marshal Viscount (1887-1976). Outstanding British Field Marshal in World War II.

Napoleon Buonaparte (1769-1821). French general; Emperor of France 1804-14, 1815.

Nelson, Viscount Horatio (1758-1805). England's greatest naval hero, victor at the Battle of Trafalgar, 1805.

Nietzsche, Friedrich (1844-1900). German philosopher, proponent of the concepts of 'eternal recurrence' and 'superman'.

Petain, Marshal Henri (1856-1951). C-i-C of French Armies; Premier of unoccupied France 1940-44.

Salmond, Marshal of the RAF Sir John (1881-1968). GOC of the RAF in France, 1918; Commander of the RAF in the Middle East 1922; CAS 1930-33.

Seversky, Major A. (1894-1974). Russian-born American aviator, engineer, entrepreneur and air power theorist. Author of *Victory Through Air Power.*

Slessor, Marshal of the RAF Sir John (1897-1979). Staff officer to Trenchard; notable writer on air power; CAS 1950-52.

Smuts, General Jan (1870-1950). South African statesman, soldier and philosopher. Prime Minister of South Africa 1919-24 and 1938-48.

Steel, Air Chief Marshal Sir J. M. (1877-1965). RNAS and RAF; C-i-C Air Defence then Bomber Commands mid 1930s.

Stefansson, Dr (1879-1962). American naturalist and explorer.

Sun Tzu (c.400-320 BC). Chinese author of *The Art of War,* one of the great treatises on the nature of war.

Tennyson, Alfred Lord (1809-92). English poet.

Thucydides (c.460-400 BC). Greek general and historian, whose only known work, *The Pelopponesian War,* recounts the war between Athens and Sparta from 431-404 BC.

Trenchard, Marshal of the RAF Viscount (1873-1956). GOC of the RFC in France, and the dominant figure in the RAF from 1918 to 1929. An immensely influential practitioner and theorist of air power.

Wellington, Arthur Wellesley, Duke of (1769-1852). Principal architect of British victory in the Napoleonic wars.

Williams, Air Marshal Sir Richard (1890-1980). First CAS, RAAF, and CAS for most of the period 1921-38.

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