

ALFRED · A · KNOPF · LIMITED
Telephone · Museum 7436

To the Editor of

"Servant of India"

*We have pleasure in sending
for review a copy of*

*THE WORLD THE AIR AND THE
which will be published on* ^{FUTURE.}

Published

at the price of 21/-

*It is particularly requested that
no review shall appear before
the publication date*

£

37 BEDFORD SQUARE
LONDON W. C. 1



3273

8273

Dhananjayrao Gadgil Library



GIPE-PUNE-008273

8273

THE WORLD, THE AIR, AND THE FUTURE



R.100 in her Shed

(Frontispiece)

8273

THE, WORLD, THE AIR
AND THE FUTURE

BY

COMMANDER

SIR CHARLES DENNISTOUN BURNEY
BART., C.M.G., R.N. (RETD.)

19  29

ALFRED A. KNOPF LONDON

PRINTED IN ENGLAND FOR
ALFRED A. KNOPF, LIMITED, BY
PURNELL AND SONS
PAULTON, SOMERSET

X43.1.N

F9

8273

TO
MY WIFE

PREFACE

IN presenting my first book to the public, I have various acknowledgments to make. A book that purports to deal with the whole problem of the air is necessarily dependent for its inception not only upon a theoretical analysis, but also upon practical experience of the technical difficulties involved in the construction of aircraft. I have therefore to acknowledge a debt of gratitude to all those who have assisted me in the construction of the R.100, the designing and building of which have been the corner-stone on which the structure of the book has been erected.

The construction of the R.100 was rendered possible primarily by the patriotic outlook of Sir Trevor Dawson, Sir Herbert Lawrence, and Mr. Douglas Vickers, Directors of the Board of Vickers Limited, who undertook the financial responsibility of an experiment upon a great scale; and also by the support given to the scheme by Lord Thomson and Sir Samuel Hoare, who were Secretaries of State for Air during the period in which the Airship programme was approved, adopted, and carried out.

During the design and construction stages, I have had the able assistance of Mr. J. E. Temple, who, as chief calculator, was responsible for the theoretical design; of Mr. B. N. Wallis who was responsible for the mechanical design, and who for the latter period as chief engineer was in charge of the construction at Howden; of Mr. N. S. Norway, who succeeded Mr. Temple as chief calculator; of Mr. J. Watson, the works manager; of Mr. A. E. Palmer, who was responsible for the engine and electrical installations; of Mr. W. Horrocks, the

CONTENTS

| CHAPTER | | PAGE |
|---------|--|------|
| | PREFACE | ix |
| | LIST OF ILLUSTRATIONS | xvii |
| I. | INTRODUCTION | I |
| | Aeronautical science—Its meaning and value for our age | |
| | —Various problems connected with its development | |
| | —Survey of the ground covered in the present book. | |
| II. | AIR TRANSPORT AND EMPIRE DEVELOPMENT | 16 |
| | Great Britain's changed position in the modern world | |
| | —The solution of her problems lies in the economic development of the Empire and in the unification of the Imperial system. Potential influence of Aviation on Empire development. Arguments grouped under three chief headings: | |
| | 1. Redistribution of Population. | |
| | 2. Commercial and Economic Expansion. | |
| | 3. Imperial Sentiment and Cultural Unity. | |
| III. | AIR TRANSPORT AND THE REORIENTATION OF DEFENSIVE POWER | 54 |
| | Defence problems completely revolutionised by the Invention of Aircraft: | |
| | 1. Criticism of Britain's air defence policy. | |
| | 2. Effect of aircraft development on the strategic position of Great Britain. | |
| | 3. Meaning and value of sea-centrality. Its influence on the history of Great Britain. Sea-centrality her permanent possession, but trade-centrality now passing into the hands of the United States. Lessons to be drawn from England's sea power for the framing | |

CONTENTS

| CHAPTER | | PAGE |
|---------|---|------|
| | of a right air policy. Her maritime development due to her geographical position; her air development must depend on her own exertions. | |
| | 4. Relation between air power and sea power. | |
| | 5. Uses of aircraft in Naval strategy. The rôle of airships. | |
| | 6. Defence problem considered in its Imperial and International aspects. Anglo-American friendship the keystone of world peace. | |
| IV. | AIR TRANSPORT AND INTERNATIONAL PEACE | 141 |
| | Civil aviation postulates an International development: | |
| | 1. What do we mean by Internationalism? War the only alternative to an International as opposed to a National world order. What modern warfare means. Various forces working to-day in the direction of Internationalism. | |
| | 2. The progress of civilisation on its material side a matter of improved communications.—The three means of communication—the Land, the Sea, and the Air, studied under their historico-metaphysical aspects. A synthetic, expanding, and universalising process always manifest. This process culminating in aviation. The air, the universal element, a symbol of the International principle. | |
| | 3. Economic forces working towards Internationalism; political forces still pulling in a contrary direction. The economic position of the United States of America. | |
| | 4. Practical ways in which the development of civil aviation will help to build up an International world order—A United States of Europe. The establishing of closer relations between Europe and America—The unification of the Atlantic peoples. | |

| CONTENTS | | PAGE |
|----------|--|------|
| CHAPTER | | |
| V. | AIRSHIPS: THEIR DEVELOPMENT AND PROSPECTS | 199 |
| | 1. The Evolution of the Airship. | |
| | 2. Description of the R.100. | |
| | 3. Facing Facts. | |
| | 4. Solutions to the Three Main Problems. | |
| | 5. Possibilities of the Future. | |
| | 6. Justification of Airship Development. | |
| VI. | HEAVIER-THAN-AIR CRAFT (By <i>Nevil S. Norway</i>) | 259 |
| | 1. The Land Aeroplane. | |
| | 2. The Flying Boat. | |
| VII. | COMPARISON BETWEEN HEAVIER-THAN-AIR CRAFT AND LIGHTER-THAN-AIR CRAFT | 291 |
| | 1. General Observations. | |
| | 2. Different Types of Aircraft Classified and Compared. | |
| | 3. Summary of Conclusions. | |
| VIII. | ADMINISTRATION AND POLICY | 319 |
| | The International organisation of civil flying. Airworthiness certificates—The Denationalisation of aerodromes—The League of Nations to be the controlling authority—The Law of the air. | |
| | The air problem of Great Britain and the Empire—Need of administrative reforms—Waste under present system—Fusion of Navy and Air Force desirable in interests of efficiency and economy—Money saved to be devoted to Air development of the Empire—Suggestions as to how the money can best be spent—Programme of Policy outlined. | |
| | Conclusion. | |
| | INDEX | 345 |
| | | xv |

ILLUSTRATIONS

| PLATE | | PAGE |
|-------|--|------|
| I. | R.100 IN HER SHED <i>Frontispiece</i> | |
| II. | R.100. THE STERN A general view. The sealing strips are not in place. | 16 |
| III. | R.100. THE HULL FRAMEWORK A view showing the transverse and longitudinal girders which divide it into its several compartments. In the space between each transverse frame a gas bag is placed. | 32 |
| IV. | R.100. ONE OF THE GAS-BAGS BEING TESTED IN POSITION | 48 |
| V. | R.100. THE FRAMEWORK Interior view in early days of construction. | 64 |
| VI. | R.100. ONE OF THE GIRDERS BEING ERECTED IN THE JIG | 80 |
| VII. | R.100. A SPIDER JOINT | 96 |
| VIII. | R.100. THE INTERIOR A view facing passenger quarters, and showing corridor (uncovered) on right. | 96 |
| IX. | R.100. THE ELECTRIC KITCHEN | 112 |
| X. | A SLEEPING BERTH | 112 |
| XI. | R.100. THE PASSENGER QUARTERS View of upper part of gallery in passenger quarters, showing sleeping berths. | 144 |

ILLUSTRATIONS

| PLATE | | PAGE |
|--------|--|------|
| XII. | R.100. THE DINING SALOON | 144 |
| XIII. | R.100. ONE OF THE ENGINE CARS Comprising two Rolls-Royce engines. | 160. |
| XIV. | R.100. ONE OF THE AUTOMATIC AND MANŒUVRING GAS-VALVES | 160 |
| XV. | R.100. THE FINS, RUDDERS AND ELEVATORS | 176 |
| XVI. | R.33 AT THE CARDINGTON MOORING MAST | 192 |
| | The new Mooring Mast at Cardington, with the R.33 riding at the masthead. (Royal Air Force Official: Crown Copyright reserved. Reproduced by the courtesy of the Air Ministry.) The Mooring Mast is 200 feet high, with a covered way connecting the landing stage and airship. Lifts are provided for passengers and cargo, and mains carrying water, gas and fuel are constructed right to the masthead. It will be seen that the Airship has two small aeroplanes suspended from her. | |
| XVII. | R.33 AT THE PULHAM MOORING MAST | 208 |
| | The Government Airship R.33 at the Mooring Mast at Pulham. Reproduced by the courtesy of the Central News Ltd., London. The experiment of an aeroplane being released while the R.33 was in flight was carried out at Pulham, and the photograph shows the aeroplane attached to the airship at the Mooring Mast before being released. | |
| XVIII. | THE GRAF ZEPPELIN IN HER SHED | 216 |
| | xviii | |

ILLUSTRATIONS

| PLATE | | PAGE |
|-------------|---|------|
| XXIX. | THE GRAF ZEPPELIN OUTSIDE HER SHED This and the preceding photograph are reproduced by the courtesy of the Luftschiffbau Zeppelin G.m.b.H. The Graf Zeppelin is 749 feet long, and has a dis- placement of 3,375,000 cubic feet. It will be seen how small the people look in comparison with her giant structure, so that the difficulty of handling her by man-power requires no emphasis. The impossi- bility of man-handling a ship of twice or three times her displacement is at once apparent. | 224 |
| XX and XXI. | THESE TWO DRAWINGS ILLUSTRATE THE OPERATION OF THE MOORING AND DOCKING RAFT Plate XX shows the ship attached to the Mast (the masthead being telescopically extended) and ready to be clasped by the claws of the rotatory raft which has its arms open to receive her. Plate XXI shows the completed operation. Here the masthead is telescopically shut, the ship is securely clasped in the claws of the raft, and ship, raft, mast, and claws are in position to be run into the shed as a unit. | 232 |
| XXII. | THE ELLIPTICAL SHIP. A MODEL IN FLIGHT | 240 |
| XXIII. | ELLIPTICAL SHIP. A MODEL SHOWING VIEW OF BOW | 240 |
| XXIV. | THE ELLIPTICAL SHIP. A MODEL ALIGHTING ON THE WATER | 248 |
| | | xix |

ILLUSTRATIONS

| PLATE | | PAGE |
|--------|---|------|
| XXV. | THE ELLIPTICAL SHIP. A MODEL TAKING OFF FROM THE WATER | 248 |
| XXVI. | IMPERIAL AIRWAYS 'ARGOSY' 21-SEATER AEROPLANE, G-EBLF: EXTERIOR | 264 |
| XXVII. | INTERIOR OF 'ARGOSY' AEROPLANE, 21-SEATER | 272 |

This Aeroplane was built by Messrs. the Armstrong-Whitworth Company to operate the "Silver Wing" Service de Luxe between Croydon and Paris. The passengers saloon has accommodation for 18 passengers. At the rear end of the saloon is a buffet, from which cold luncheons and liquid refreshments of all kinds are served. Communicating with the saloon at the forward end is the pilot's cockpit, and at the other end is lavatory accommodation. The aeroplane carries a crew of three, consisting of 1st Pilot and 2nd Pilot, and Saloon Steward.

Its total weight loaded is 8 tons and it can lift a useful load, including crew of $2\frac{1}{2}$ tons. These aeroplanes are fitted with dual control and equipped with three Armstrong-Siddeley Air-Cooled Jaguar Engines, each developing 385 h.p. They can fly comfortably with any two engines; this fact also eliminates the possibility of a forced landing due to engine trouble. They have a cruising speed of 95 m.p.h. and a top speed of 120 m.p.h. The wings from tip to tip measure 90 feet, and the overall length of the aeroplane is 65 feet.

Passengers' luggage including heavy cabin trunks is accommodated in two luggage compartments situated behind the engine, and immediately in rear of the passenger saloon. The petrol used in the engines is carried in two large tanks situated near the centre

ILLUSTRATIONS

| | | |
|------|--|------|
| PAGE | <p>of the top plane. These tanks have a total capacity of 250 gallons. The flight of 225 miles between Croydon and Paris takes an average 2½ hours.</p> <p>These photographs are reproduced by the courtesy of Imperial Airways Limited.</p> | PAGE |
|------|--|------|

| | |
|---|-----|
| XXVIII. MODEL OF NEW 40-SEATER HANDLEY-PAGE | 272 |
|---|-----|

Model of the new 40-seater Handley-Page Aeroplane. "Flight" Photograph, reproduced by the courtesy of the Editor of "Flight."

This machine will be propelled by four motors totalling 2,000 h.p. and will have a maximum speed of 120 m.p.h. It is the largest aeroplane yet designed, and will be the first air liner with cabins of sufficient size to enable passengers to move about freely.

| | |
|------------------------------|-----|
| XXIX. AUTOGIRO C.8 IN FLIGHT | 280 |
|------------------------------|-----|

Autogiro C.8. Mark II Type fitted with Lynx Engine. Reproduced by the courtesy of the Newcastle Aeroclub and the "North Mail."

| <i>Description</i> | |
|--------------------------|-----------|
| Weights— | |
| Tare weight | 2,650 lb. |
| Fuel capacity 40 gallons | 95 " |
| Oil capacity 6½ gallons | 63 " |
| Crew 2 | 320 " |
| Extra disposable load | 148 " |
| | 2,476 lb. |

| <i>Guaranteed Performance</i> | |
|-------------------------------|------------|
| Maximum speed | 108 m.p.h. |
| Cruising speed | 90 " |
| Minimum speed level flight | 25 " |
| Duration of flight, cruising | 3 hours |

ILLUSTRATIONS

PLATE
XXX. SUPERMARINE 'SOUTHAMPTON' TWIN-ENGINE FLYING BOAT

PAGE
 288

Supermarine "Southampton" twin-engine Flying Boat HB-6, fitted with Lorraine engines. Reproduced by the courtesy of the Supermarine Aviation Works Limited.

Description

This machine has a maximum speed sea level of 107.7 m.p.h. and a landing speed of 56 m.p.h. It has an estimated range of 680 miles and its total useful load, including fuel, is 5,290 lb.

If converted for use as a commercial machine the useful load could consist of:

| | |
|-----------------|----------------|
| Crew of two | 360 lb. |
| W-T | 150 " |
| Electrical gear | 80 " |
| Instruments | 40 " |
| Marine gear | 70 " |
| Seating, etc. | 50 " |
| Sundries | 50 " |
| | <u>800 lb.</u> |

And in addition any combination of passengers, freight and fuel, totalling 4,490 lb., as under.

| Petrol Carried. | Approx. Miles. | Approx. Duration. Hours. | No. of passgrs. with baggage at 200 lb. each. |
|-----------------|----------------|--------------------------|---|
| 400 | 680 | 8 | 6 |
| 300 | 510 | 6 | 10 |
| 200 | 340 | 4 | 14 |

XXXI. 60-SEATER DORNIER FLYING BOAT

296

The 60-seater, three-decker Dornier Flying Boat recently completed at the works of the German Dornier Aircraft Company at Lake Constance. Reproduced by the courtesy of Pacific and Atlantic Photos Limited.

ILLUSTRATIONS

PAGE

Description

The Dornier Flying Boat has twelve engines developing 6,000 horse-power, and its total weight fully laden is about 50 tons. Three decks provide for spacious saloons and sleeping accommodation for 60 passengers. This winged liner took two years to build, and has carried out its trial flights with success. It is by far the largest heavier-than-air craft that has been built up to the present time.

MAPS

1. SHOWING THE NON-CENTRALITY OF NEW YORK 81a
2. SHOWING THE PERMANENT SEA-CENTRALITY OF ENGLAND 81b

THE WORLD, THE AIR, AND THE FUTURE

THE WORLD, THE AIR AND THE FUTURE

CHAPTER I

INTRODUCTION

Aeronautical Science—Its Meaning and Value for our Age—Various Problems connected with its Development—Survey of the Ground Covered in the Present Book

THE GREAT WAR of 1914-18 marked the close of one epoch of our civilisation, and we are now laying the foundation of a new world order to take the place of the old. The world is passing through a period of transition; and, like all periods of transition, the present age is tentative and inconclusive, feverishly eager in experiment, but very much at sea in the formulation of its ideas. It lacks direction, unity of purpose, concentration of effort. We are feeling our way earnestly towards what we hope will be a better world than our fathers knew; but what the new order will be like, how we are going to bring it about, or what precisely we want to make of it, are matters on which we are by no means clear.

Everywhere around us we are conscious of vital new influences at work, affecting the psychology of nations and individuals alike, and bidding fair to transform the whole structure of world politics and economics. Up to a point the changes in progress are the result of our organised efforts, being the reaction of civilisation to the appalling catastrophe of the war; but to a large extent they are being forced on us by economic pressure, and by the rapid advancement of technical science. Indeed, we are as much the blind instruments as the conscious agents of the new forces at work. The point is, however,

THE WORLD, THE AIR AND THE FUTURE

that being in the midst of the ferment, we cannot properly foresee the outcome. Busily engaged in revaluing our standards, in discarding old formulas and testing new, and in grappling with the host of unfamiliar issues that vex our war-worn world, we can perceive but dimly the form of the new era that is being shaped by our endeavours. Nor is the work of reconstruction proceeding as quickly as it might; for being, not altogether clear as to our ends and hopelessly disunited in our efforts, we are not by any means making full use of the opportunities that lie our way.

The triumphs of technical science, for example, of which our age has witnessed so many, have given various new directions to the civilising energies of mankind. But can it be said that in all cases we are developing them as they ought to be developed, or that we fully grasp what valuable instruments some of them may be in helping us to build up the new and better world order we have so much at heart? In one direction, at all events, the answer must be an emphatic negative. I refer to the new means of transport that has been given to the world by the invention of flying.

The attitude of the world towards the problem of air development is, I think, typical of the mind of the present age. The problem, while giving rise to much fanciful speculation, has been treated throughout in a desultory, short-sighted, haphazard way, and without any clear appreciation of its far-reaching significance for this and future generations. That the science of aviation has some meaning for the world is vaguely realised, and it arouses interest, even enthusiasm, of a general kind. But to what precise uses the new science can be put, how it can be made to serve the purposes of civilisation, or what policy shall direct its development, are matters to which far too little thought has been given. Little or no attempt has been made to analyse the present

INTRODUCTION

and potential uses of the various types of aircraft; to co-ordinate effort for their development; to study the profound effects that this development will have on national organisations and international relationships; to prepare to meet the many political and economic problems that a growing world system of air communications must necessarily give rise to. In our own country, especially, the whole question of civil as distinct from military aviation has been woefully neglected. Our attitude towards it has all along been hesitant, short-sighted, unenterprising, uninspired. Only now are we beginning to wake up to its vast potentialities. Only now are we beginning to realise what a magnificent aid to Empire development air transport is likely to become, and how vitally it is going to affect the whole structure of world politics. Even in those countries where air transport is already being extensively used, the full implications of its further development are not often realised, and nowhere does there seem to be a clear conception of the important part it is destined to play in unifying the structure of our civilisation.

The consideration of these matters has convinced me that a comprehensive and systematic statement of the case for the development of civil aviation is badly needed, and in this book I have tried in some measure to supply the need. A statement of the case for aviation, however, necessarily implies a detailed analysis of the manifold problems—political, financial, economic, cultural, technical, administrative—connected therewith. In the following chapters therefore I have attempted two things.

Firstly, I have tried to evaluate the actual and potential uses of air transport in the issues both of war and of peace, as they are likely to affect the economic and strategic position of Great Britain, the development and unification of the British Empire, and the reconstruction of the international situation. These

THE WORLD, THE AIR AND THE FUTURE

considerations form the subject-matter of the first half of the book.

But the uses of aircraft depend on their technical capacity. The second half, therefore, is devoted to technical considerations, and contains a survey of the present state of aeronautical science, and an attempt to estimate its probable lines of development. In a final chapter, based on conclusions previously reached, certain constructive proposals are put forward on questions of administration and policy.

The book being addressed to the British and English-speaking public, special emphasis has naturally been laid on the effect that the development of air transport will have on Great Britain and the British Empire, and on Anglo-American relations. The issues here are many and vital, and a proper understanding of them is of the first importance.

To-day after a century of unbounded prosperity, Great Britain stands at the crisis of her history. The economic supremacy she has so long enjoyed has passed across the Atlantic, and not only is she being ousted from her old position, but she finds herself faced with a number of economic problems that are proving too much for her own unaided efforts. Meanwhile the United States, advancing with giant economic strides, already possesses nearly half the purchasing capacity of the world, and neither Great Britain, nor Germany, nor any other country can possibly compete with her single-handed. Only a continental organisation can do so. The framework of such an organisation lies ready in the British Commonwealth of Nations. All that remains to be done is to develop it into a solid and efficient structure. This is the task that lies before Great Britain to-day. Her future greatness lies in the advancing prosperity of the Overseas Dominions. She must devote all her energies, therefore, to the work of Empire development and consolidation.

INTRODUCTION

Only so can she hope to revitalise her economic life and recover her former prosperity. Otherwise, in competition with the larger units of power that are growing up in the world—and the formation of which is one of the marks of the age we live in—she will be out-weighted and out-distanced, and must inevitably sink to the rank of a second-class Power. Our first task then will be to evaluate the uses of air transport in the light of the Imperial issue; to examine the various ways in which, by shortening the distances that separate the various parts of our Imperial system, it will help to weld that system into a solid economic and political structure, and so give it an efficient power such as will enable it to compete on level terms with a continental organisation like the United States.

Aircraft, however, have their belligerent as well as their peace uses. Their development therefore must closely affect Armies and Navies, the tactics and strategy of war, and the whole problem of defensive organisation in every country; and as a consequence, it must also bring vital new influences to bear on questions of foreign policy.

Strange as it may seem, in spite of the lessons of the war, the momentous changes that aviation has brought about in the orientation of defensive power, are only partially realised in this country. The Debates in the House of Commons during the last few years have been illuminating as showing a complete failure on the part of our statesmen to grasp the fundamental facts of the changed conditions. No definite defence policy has yet been evolved, to meet the needs of this island and the Empire, and the drastic reorganisation of our fighting services called for by the increasing importance of the air arm can hardly be said to have begun. Yet issues here are of great moment, as even the briefest survey of the situation will show.

THE WORLD, THE AIR AND THE FUTURE

To begin with, there is the question of our national security. If, as seems clear, aerial warfare has rendered our insular armour practically useless, we must take the measure of our new strategic position. Has the "Silver streak" of the Channel, looked upon for centuries as a sheet anchor of security, the same value to-day as heretofore, or has it not rather become an added source of danger? From being virtually invulnerable, are we not now in actual fact, the most vulnerable of all the Great Powers?

What policy then ought we to adopt in face of the threatening possibilities of the new situation? How can we best build up an air defence system that will give reasonable security to our island, without promoting an air armament race and thereby stultifying our earnest efforts in other directions in the cause of European peace? This is one problem that now calls for solution. A difficult one no doubt; but can anyone pretend that we are attacking it in the right way at present?

Again, how will the new strategic issue affect the orientation of our foreign policy? If, by destroying our insularity, air power is going to link us indissolubly with the continent, shall we not find ourselves becoming more and more entangled in the network of European politics? But if our foreign policy is directed towards Europe, instead of away from Europe towards the Empire, how will the Dominions react to such a policy? Aviation will accelerate the process of their expansion, and will help in many ways to bring them closer to the Mother Country, but if it is going to involve the Mother Country more and more in Europe, will not this have the effect of making the Daughter States turn their thoughts inwards, or towards the United States? This is another serious issue that lies before us; and we shall meet it successfully only if we make a determined effort to

INTRODUCTION

co-ordinate Imperial and Foreign policy while there is yet time. Are we making this effort?

Then there is the whole question of the relation between air power and sea power. Will air development tend to diminish the value of that sea-centrality the possession of which has meant so much to Great Britain? How will it affect the function of Navies? What bearing will the partial transference of naval duties from surface craft to aircraft have on the naval problems of the Empire? Or on the naval psychology of the United States? Will it simplify, or tend to complicate still further, such questions as Naval Disarmament and the Freedom of the Seas, the two delicate contemporary issues which but lately put so severe a strain on Anglo-American relations? And another matter of some importance to Europe and Great Britain: How will the development of long distance aircraft ultimately affect the foreign policy of the United States? Will it mean, perhaps, that the idea of American "isolation" will have to be discarded as impracticable, like the "splendid isolation" idea that inspired British foreign policy at the end of last century?

These are only some of the issues that the inquiry into the Reorientation of Defensive Power undertaken in our third Chapter brings to light.

In Chapter IV the international implications of air development are examined under a totally different aspect. Here, aircraft are considered as agents of world reconstruction, and as efficient instruments of the economic and other synthetic forces of our time that are steadily breaking down the national divisions of mankind and imposing on the world an international conception of society.

To many, the ideas advanced in this chapter will seem premature and far-fetched. In giving serious consideration to such questions as the elimination of war, universal disarmament, a United States of Europe, and the

THE WORLD, THE AIR AND THE FUTURE

building up of an international world order, at a time when the spirit of nationalism is everywhere aggressively awake, I shall seem to many to be losing all sense of realities, and to be indulging in the idle speculations of the Utopian theorist. Yet unless these ideals are treated as something concrete to work for, how can we hope to avert another world-crash? We can only defeat war by organising the forces of international peace, however scattered, ineffective, and ill-equipped they may seem at the moment. However, it is one thing to urge the claim of new ideals, of a new conception of society; it is another thing to insist on their immediate application. It is one thing to study the end desired in relation to the practical ways and means of achieving it, and then to advocate a steady concentration of effort along the best lines of approach; it is another thing to be so dazzled by the vision of the goal that lies ahead, as to lose sight of the difficulties of the road, to clamour for direct political action in support of theories that the contemporary world will not accept, and to hope to effect a sudden transformation of society by a few sweeping strokes of legislation. It is this attitude that marks the visionary and doctrinaire, and it is certainly not the one adopted here.

There must be a philosophy of "gradualness" in these matters. Ideas must ever be some generations ahead of what is termed "practical politics." However reasonable and desirable the movement away from Nationalism in the direction of Internationalism may appear to many minds, it cannot be hurried. Anyone to-day who advocates the immediate abolition of territorial nationality, or even a drastic limitation of its exercise, is branded as a traitor rather than acclaimed as a patriot of the human race. So it will be for many generations to come—until the idea of a world-community has had time to permeate the general consciousness.

INTRODUCTION

Meanwhile we must take the world as we find it, and not expect legislation to proceed as though we were already living in an age of Reason. Democratic statesmanship especially—and it is the weakness of Democracies that it should be so—has to adjust its vision to the outlook of the man in the street. A democratic leader cannot legislate for humanity or for future generations. All he can do is to give effect to the demands of those who have invested him with authority, and to press forward such reforms as they are willing to accept. Nevertheless, ideas may be sown upon the fruitful soil of the popular imagination, in the hope that some of the seeds may grow and fructify at a later date—and that is the explanation of the International Chapter. In the Defence Chapter, account is taken of the conditions and accepted doctrines of the age we live in. In the International Chapter we look ahead, and on the basis of some of the deeper forces underlying the trend of the age, we develop ideas for the building up of some more rational world order of the future. And it is suggested that in clearing the approach to this more rational world order, air transport will play a part of ever increasing importance.

This brings us to the cardinal question: Are the claims here put forward for civil aviation justified on technical grounds? Will the flying machines of the future be able in actual fact to perform the functions anticipated from them? On this point considerable scepticism still exists among the general public. And for this scepticism, the war is, I think, largely responsible. It came when the science of aviation was in its first infancy, and aeronautical development was therefore given a one-sided direction. The new science was at once enlisted in the service of war and forced ahead for purely military purposes. Thus, while we all have bitter experience of the belligerent uses of aircraft,

THE WORLD, THE AIR AND THE FUTURE

their commercial uses are still largely a matter of speculation. When it is remembered too, that civil flying, as distinct from military flying, necessitates inter-state co-operation; also that the value of aircraft as a means of transport depends not only on speed but on range and endurance as well, and that airships and long-distance craft generally, owing to the greater difficulty of the mechanical and aerodynamic problems they present, are not nearly so advanced technically as the short-distance land plane, it is not surprising that civil aviation has not reached the relative maturity of military aviation.

All this has had an unfortunate effect on aviation psychology throughout the world. Among Governments and peoples alike, there is still a tendency to regard aircraft as primarily a form of aerial artillery and only in second degree as a means of travel and of promoting trade and intercourse between nations. It is their terrible effectiveness in war that strikes the public imagination. Often we speculate on the giant flying machines that the future may bring forth; but it is usually on the sinister side of their activities that the mind dwells, and almost always we picture them as engines of death and destruction. Only rarely, and then but vaguely does our vision see them as agents of peace moving from place to place and from country to country on errands of friendship and service, working industriously in the causes of civilisation, and helping to unite the nations of the earth into one human family. Yet it is my firm conviction that on a fair estimate of technical possibilities, this vision of the future can be justified no less surely than the other.

The grounds on which this technical assumption is made are set forth in the second portion of this book, where a brief survey is made of the present state of aeronautical science, and the technical aspects of the situation are carefully examined. The problems and

INTRODUCTION

difficulties that face the aviation expert to-day are frankly stated. No attempt is made to gloss over unpleasant facts, or to press forward the claim of one branch of aircraft activity at the expense of another. The three types of flying machine—the airship, the land aeroplane and the flying boat—are each treated separately. Each is studied in relation to its technical evolution, its specific problems and functions, its present performance, and the basic laws governing the possibilities of its further improvement; and a comparison is then made of the relative merits of the three types, and of their present and prospective uses. From this analysis the reader will be able to draw his own conclusions as to how far the arguments for the intensive development of civil aviation, advanced in the first half of the book, rest on a sound basis.

An analysis of the kind attempted has involved a fairly wide discussion of technical matters, which the average reader will no doubt find dull and uninspiring. The book, however, is intended for the general public rather than for the expert, and the technical positions have therefore been stated as far as possible in non-technical language. There is nothing, I think, that an intelligent reader, however uninitiated, cannot easily grasp.

The reader whom all technical matter affrights, and who may be tempted to ignore this part of the book altogether, is asked to remember that though the story of the working out of a technical problem can hardly be made exciting in the telling, it does, on occasion, lead up to an arresting dénouement; in which case the significance of the final result cannot but lend a certain interest to the preliminary investigations. An illustration of this occurred in connection with the building of the R.100, the airship on which I have been working during the last few years, and to the

THE WORLD, THE AIR AND THE FUTURE

story of whose construction a certain amount of space is given.

There are two great problems connected with airships. Firstly there is the handling difficulty. At present the airship can only be docked in her shed when the wind is light and in a favourable direction. Otherwise she has to be fixed to a mooring mast, itself a delicate and difficult operation in rough weather. This is a most unsatisfactory arrangement, for it means that so long as she is fixed to the mast she is exposed to the elements, and runs risk of serious damage to her structure in the event of snow, storms and hurricanes; and during all this while major repairs and overhauls cannot be undertaken, which means that her next flight may be held up. Secondly, airships are designed to operate to and from a land base, and therefore suffer the disadvantage that they do not obey one of the fundamental laws of transport, in that they cannot make a landing of their own accord, but require extraneous aid. In this the airship is unlike all other vehicles in use to-day. The aeroplane or flying boat can, as a rule, make a forced landing without damage. A marine vessel can always anchor or heave to. A train or a motor car can stop at any time. An airship, however, can only make a landing at a base previously prepared at a cost of many thousands of pounds. It became increasingly clear to me while working on the R.100, that unless a solution could be found to both these problems, the commercial utility of the airship would be much restricted, and development would be slow. At the same time I could see no really efficient solution to the problem if we retained the generally accepted design of airship. I therefore turned my thoughts in another direction. Might not airships be made into a form of flying boats. The idea pleased me as a theory, for reasons which those who follow the argument of this book will quickly appreciate. I therefore developed in

INTRODUCTION

collaboration with able assistants a scheme whereby an airship could alight on enclosed water and manœuvre stably thereon in a strong wind, and at the same time anchor or be moored to a buoy in harbour, like any steamship. Allied to this new design of ship was a method of enabling the ship to be put into her shed in strong winds from any direction. I believe the scheme to be satisfactory; and though so fundamental a change in design must expect to meet with considerable criticism and opposition in the first instance, it is hoped that financial arrangements will be made to expedite the laboratory research work, which will, of course, be necessary before an airship can be constructed on these new lines.

It is not too much to say, I think, that this revolutionary development in airship construction may make the airship of the future more of a sea-craft than a land-craft. Taken in conjunction with the fact that flying boats admit of greater possibilities of development than do land planes, this means that for long-distance air transport, it is probable that airships and heavier-than-air craft will utilise terminal and intermediate bases situated on the water. The importance of this change will be apparent to anyone who considers the many advantages that water transport has over land transport, or who has learnt from the teachings of history how much freer and wider in range, more synthetic in influence and more cosmopolitan in all the implications of its development is communication by sea than communication by land—points that are frequently insisted on in the ensuing chapters.¹ It fits in therefore with the logic of history that long distance air transport should operate from the water rather than from the land, since, of all methods of communication, that by air is the most definitely

¹ See especially Chapter II, Section III; and Chapter IV, Section II.

THE WORLD, THE AIR AND THE FUTURE

international in character, both in the conditions it postulates for its exercise and in the influences it will tend to foster.

Thus the seeming impossibility of finding a solution to the airship handling problem may prove a blessing in disguise; for it gave the first impulse to a train of ideas that has led to the conception of a new type of airship which, if satisfactorily developed, may give to the world a more efficient type of vessel than could have been evolved out of the present type, even if the handling problem were successfully solved. Moreover the publication of these ideas coupled with the spectacular world-flight of the Graf Zeppelin, should give new impetus to the prosecution of airship development.

Some of the practical suggestions and constructive proposals put forward in the final chapter will seem petty and inconclusive when compared with the great possibilities outlined in the Empire and International chapters. This is in the nature of things. Our vision may be large and the goal clear, but, in an imperfect world, the approach can only be made in short steps and by gradual stages. In our own country—perhaps because the vision is still lacking and the goal not yet clear—air development has hardly made a serious beginning; so that to hope for great and decisive measures at the present juncture were futile. Sometimes, too, the criticisms levelled at our policy, not only in the last chapter, but throughout the book, may seem too impatient and dogmatic. This, again, cannot be helped. Anxious not to add to the length of a book that is already too long, I have often been compelled to dogmatise when I should have preferred to elaborate an argument and discuss possible objections; and it must not be supposed that I wish anywhere to insist on the infallible rightness of my own opinions on the various controversial topics with which the air problem bristles.

INTRODUCTION

Finally, let me add that my primary object in writing this book has not been to advocate my personal views on air issues and air politics. These find frequent expression of course; but such value as the book may have lies not in the author's opinions, but in the intrinsic importance of the subject. Briefly stated the objects of the book are mainly three. I have tried in the first place to bring home to the general public, here and in the Dominions, the vast significance of air transport as a means of welding our great Commonwealth into a single economic and political entity; secondly, to make equally clear its importance as a means of cementing Anglo-American friendship, of bringing Europe and America closer together, and of giving unity to our Western Atlantic civilisation; thirdly, by dwelling on its parallel uses in the service of world re-construction—by pointing out the various ways in which it will help to consolidate the forces of European peace, to internationalise the framework of society, and so prepare the ground for the world-community of the future—I have sought to press home the further point that in developing civil aviation for our National and Imperial needs, we shall at the same time be working in the causes of civilisation and World Peace. These are the three main arguments on which I have built up my case for the intensive development of civil aviation. If the book carries conviction on these three points it will have achieved its purpose.

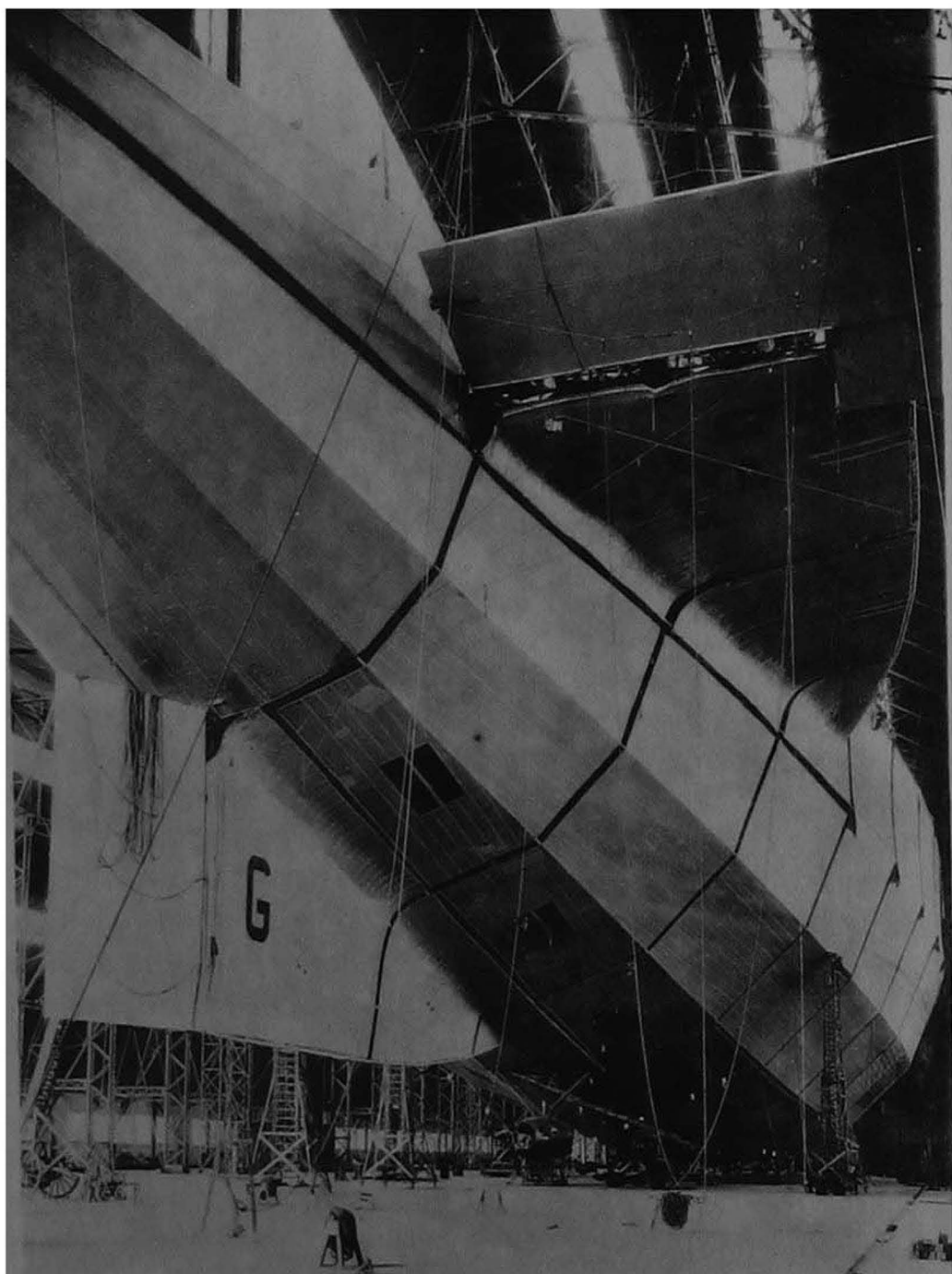
CHAPTER II

AIR TRANSPORT AND EMPIRE
DEVELOPMENT

Great Britain's Changed Position in the Modern World—
The Solution of her Problems lies in the Economic Develop-
ment of the Empire and in the Unification of the Imperial
System—Potential Influence of Aviation on Empire Develop-
ment—Arguments Grouped under three Chief Headings:

- I. Redistribution of Population
- II. Commercial and Economic Expansion
- III. Imperial Sentiment and Cultural Unity

ENGLAND's position as a World Power has undergone a great change during the last fifty years. Throughout the greater part of the nineteenth century this small island was the financial and economic overlord of mankind. Her maritime supremacy was unchallenged, and she was *facile princeps* among the nations of the earth in trade and industry. Besides being the centre of the world's trade, she was the world's banker and the world's workshop as well. She manufactured more goods of every kind than any other country, and she carried these goods to the distant parts of the earth in her own ships. Young or backward nations who wanted to develop their economic resources applied to her for money and material, and put all their big contracts in her hands. She constructed and organised their railways, built their ships, manufactured their armaments, and set up their factories. In a word, her credit was the universal factor in the world's economic progress; and, as she provided the goods as well as the money, she enjoyed an economic



R.100. The Stern. The sealing strips are not in place.

AIR TRANSPORT—EMPIRE DEVELOPMENT

ascendancy such as no single power has enjoyed since the days of the Roman Empire.

All that has now changed. The massive development of Germany and the United States, and the rise of a great commercial and industrial Power in the Far East, have completely revolutionised the whole situation. Britain is still the centre of the world's markets, but her economic overlordship is at an end. Her maritime supremacy, so long unchallenged, she has now to share with the United States and Japan; while as an industrial power she has been outdistanced by younger rivals with bigger populations and vaster resources than her own. Statistics of production in the various industries show clearly how completely she was being ousted from her old position even before the war. Take pig iron, for example. During the years 1876 to 1880, the pig iron production of Great Britain averaged 6,600,000 tons; that of Germany 2,100,000, that of the United States 2,200,000. In 1913 the figures were 10,404,000 tons, 16,656,000 tons and 31,212,000 tons for the three countries. Such figures speak eloquently of the changed situation, and can be paralleled from the production statistics of several of our other industries.

Since the war this process of change has been developing at an increasing rate. It is obvious, therefore, that if Great Britain had to rely on her own strength and resources, her day as a Great Power would be over. Fortunately she need not. Coincident with the development of Germany and the United States, and with the rise of Japan to the rank of a world-Power, has been the growth to something like maturity of our Overseas Dominions. In the middle of the last century, Britain stood before the world as a small but impregnable and immensely wealthy island with a number of rather tiresome Overseas adjuncts, each in a state of political and economic incubation, and all of them together of

THE WORLD, THE AIR AND THE FUTURE

such doubtful profit, that even a statesman of vision like Disraeli could in his Protectionist days refer to "these wretched Colonies" as "a mill-stone round our necks."¹ To-day she is a member of a Commonwealth of British nations whose combined potential resources are greater than those of any single state, or of any Federation of States that has yet been or is now in process of being welded into a single economic system. Not the United States of America, nor the two Russias, nor the agglomeration of Republics that will one day achieve statehood in a reorganised China, has the resources and potentialities of the British Empire. As compared with the United States, the British Empire has four times more raw material of commerce, four times the territorial area, and a four times greater population. Not only is it self-supporting; economically, it is self-sufficing. In fact, if the rest of the world were blotted out, the British Empire could still provide everything that is required for the needs and comforts of the modern man. Hence it is that for years past our wisest statesmen have taken not Great Britain, but the Empire as the unit of their political consciousness. They have realised that if Britain is to maintain anything like her old position in the world, she must regard herself not as the single pillar on which the whole Empire rests, but as one of the many pillars whose combined strength holds together the Imperial fabric. In other words, we must think and act Imperially; our political orbit must coincide with those territories from which the roots of our economic existence draw their substance.

On the other hand, though every intelligent subject of the King-Emperor, whether he be a citizen of this island or hail from one of the Dominions or Crown Colonies, has come to realise that the Empire must function as a whole,

¹ Quoted from "The British Empire," by Basil Williams, page 220 (Home University Library).

AIR TRANSPORT—EMPIRE DEVELOPMENT

it is true to say, I think, that at the present time, Imperial patriotism is with most of us rather a vague sentiment, or, at best, an inspiring thought; it is not yet the fundamental reality of our political life. It has not yet acquired the force of a religion, like the feeling for "Imperium Romanum" among the Romans. This is due partly to the peculiar character of the Empire itself, and partly to the fact that its constituent elements are scattered all over the world.

Properly speaking, the term "Empire" as applied to the British Empire is something of a misnomer. As has been truly said: "The British Empire is such an abnormal and incongruous entity that it is difficult to define or describe it except in the widest terms."¹

It did not come into being as the result of a conqueror's exploits or a statesman's fiat, and it has not been developed on logical lines. It simply grew; and it grew almost haphazard, in the sense that the manner of its development was neither foreseen nor laid down. Hence it has many of the characteristics of a spontaneous growth, and, as such, it "defies classification and bears no real resemblance to any other political organisation which now exists or has ever been tried."² We cannot speak of its constitution, for it is not constituted into any organised system of control. Its Government is as multiform as the peoples who compose its membership are various. Just as its area embraces all climatic conditions, peoples of all races and colours, and communities in various stages of political, cultural and economic development, so does its political organisation find room for almost every conceivable form of legislative system and administrative control. For the historian and political theorist such an institution is a study of absorbing interest; but for the

¹ Basil Williams, *op. cit.*, page 175.

² Report of Imperial Conference, 1926.

THE WORLD, THE AIR AND THE FUTURE

practical statesman it offers problems of unparalleled difficulty. It is not its size that matters, nor even the diversity of its character; but it is the distances that separate its component parts from each other. If we remark that some of these Empire distances represent the widest intervals of space that separate place from place on the map of the world, enough will have been said to illustrate the immensity of the distance problem that confronts our Imperial statesmen.

It is quite clear that if our loose-knit, far-flung Commonwealth is to function effectively as an Imperial entity, its member states must be welded together into a physical unity; and it is equally clear that with the present system of communications, physical unity in any real sense is an unattainable ideal. In such an Empire as ours there can be no talk of spiritual cohesion or economic solidarity, unless the parts gravitate towards each other naturally, from the dual motive of affections and self-interest. On the one hand, they must hold together as members of a family, conscious that they are of the same stock, and eager to work together towards the realisation of a common ideal. On the other hand, they must feel that the Imperial partnership is a good business proposition, that they can develop their resources and work out their economic destinies more fruitfully within the Empire than outside it. It is hardly necessary to point out how adversely distance reacts upon this gravitational process. Nations that are far apart soon lose their sense of kinship, just as family affection weakens between relatives who never see each other, and does not survive the passing generation; while the difficulty of forming economic ties increases with the distance that separates the parties concerned.

The problem then that faces Imperial statesmen to-day is how to annihilate distances within the Empire so as to give its component parts physical unity. The solution

AIR TRANSPORT—EMPIRE DEVELOPMENT

is to be found in air navigation. The future of the Empire lies in the air. It is no exaggeration to say that not only its economic and political development, but its continued existence, depends on our capacity to establish within the next generation an efficient system of Imperial air communication. The organisation of air travel will make it possible to cover the longest distance between any two parts of the Empire within a week. The journey from London to New Zealand which now takes six weeks will be covered by an airship or flying boat in under seven days. London will be within sixty hours of Bombay, sixty hours of Canada, eighty hours of Capetown and five days of Australia. Similarly the airship and the flying boat will bring Canada, India, South Africa and Australia all within one hundred hours of each other.

I shall deal later with the respective rôles of airships, flying boats, and aeroplanes in the development of civil aviation. It will suffice to say here that the three are not competing types, but supplementary to each other. The airship, for example, owing to its greater radius of action and the ampler provision it can make for comfortable travelling, is the best adapted of the three for long journeys; the aeroplane, being the speediest and easiest to manipulate, but having only a limited range, is the type most suitable for short distances; while the flying boat forms a half-way house between the two, being faster, but shorter in range, than the airship, and being capable, so far as can be seen to-day, of greater development than the land plane. Thus the trunk lines of the Imperial air system, spanning continents and seas and forming the main highways of inter-state communication, will be the big airship and flying boat routes, which will serve within the Empire a function similar to that served by the great trunk railways of the United States of America. A host of

THE WORLD, THE AIR AND THE FUTURE

short distance or feeder aeroplane routes linking every town and province with the main arteries, will complete the system.

By means of air travel and air travel alone, can the British Empire conquer her great enemies—Time and Space. This is a fact of such vast significance that we might expect the elaboration of a complete system of Imperial airways to be the main plank of our Imperial policy, and that our political parties would try to outbid each other in plans for air development, as they do in respect of pensions and doles. Unfortunately, this is far from being the case. Our policy has so far been one of talk and potter. There is as yet no sign of that "sustained and united effort" which, as Sir Samuel Hoare rightly said in his statement to the Imperial Conference in 1926, will be required, if our Empire communications are to be effectively improved. Historians a century hence will be amazed at our dilatoriness and lack of enterprise. Flying will then be the order of the day, and the technical and financial difficulties which seem so big to us, and behind which our timorous statesmen always take cover when they are urged to launch the great air offensive that the Empire needs, will seem to them the peddling excuses of incompetence. All they will see is that we failed to make use of a tremendous opportunity; and they will hold us to scorn as a nerveless generation, lacking in courage and vision, and unequal to our destiny.

Unquestionably, our slackness and lack of vision in this matter of Empire air development are largely due to the fact that, as already stated, our Imperial consciousness is not yet fully awake. It is quite true that for Great Britain alone, the development of civil aviation, as distinct from military and naval aviation, is not a matter of the first importance. Her distances are so small that the amount of time saved by flying is not

AIR TRANSPORT—EMPIRE DEVELOPMENT

sufficient to give air travel a real commercial value. She is so amply served by her excellent roads and railways, that if she stood alone as a single island entity, self-enclosed and self-sufficient with no responsibilities or commitments or liabilities outside her own narrow borders, her lazy attitude of aloofness towards the problem of civil aviation would be understandable and even excusable, and she might continue to remain as now on the edge of the world's aerial development for at least another generation. In the industrial and commercial centre of a world-empire, however, such an attitude, besides being short-sighted, implies a provincial outlook which is indefensible, and we shall continue in it at our peril. On no other public question of the day is it so essential that we should think and act Imperially; and in this, as in all other issues, we shall find that an Imperial policy is the one that best serves our own national interests. We shall find that the development of Imperial air communications will not only help us to solve the economic problems of the Empire, but that, in doing so, it will go a long way towards solving our own domestic problems as well.

I have said that the main key to the solution of our Imperial problem lies in the development of civil aviation. The subject is vast and complex and it will be convenient to approach it along three lines of thought. In the first place, a more rapid system of inter-state communications will help us to correct the unequal distribution of man power in the Empire, which is one of the chief obstacles to Empire development; secondly, it will facilitate to an enormous extent the exploitation of the resources of the Empire and the marketing of Empire goods, and thus help to give economic solidarity to our Imperial system; thirdly, it will help to keep

THE WORLD, THE AIR AND THE FUTURE

alive, in every corner of the Empire, the consciousness that the British Commonwealth is a family of nations derived from one stock and working towards a common ideal. For convenience, therefore, we will group our arguments under the three headings of:

1. Redistribution of Population.
2. Commercial and Economic Expansion.
3. Imperial Sentiment and Cultural Unity.

These three lines of thought, however, closely interconnect, each reinforcing the other two at a number of points.

§ I

Redistribution of White Population of the Empire

A glance at the population statistics of the Empire makes it quite clear that when we speak of the redistribution of its white population, what we really mean is the transference of man-power from the congested areas of Great Britain to the thinly populated areas of the Dominions. The total white population of the Empire amounts to some 60,000,000 souls. Of this number over two-thirds are crowded in Great Britain, leaving approximately twenty millions scattered about the Dominions and Crown Colonies. The population of the whole Continent of Australia is only three quarters that of Greater London; while Western Australia, which is the largest state in the Dominion and has an area eleven times the size of Great Britain, has fewer inhabitants than Bristol. Similarly Canada, which is as large as Europe, has a population of only nine millions, whereas her neighbour, the United States, has a population of one hundred and twenty millions,

AIR TRANSPORT—EMPIRE DEVELOPMENT

though her territory is one sixth smaller.¹ Manifestly, these large tracts of unpopulated country need manpower for their development; and if that development is to take place within the British Empire, the manpower must come from Great Britain.

The urgency of the problem is fully realised both by the Home Government and by the Governments of the various Dominions, and in 1922 the Empire Settlement Act was passed to assist and direct migration from Great Britain and Northern Ireland to Canada, Australia and New Zealand. The results of the Act have so far proved most disappointing. In 1927 the gross outward movement of population from Great Britain and Northern Ireland to other parts of the Empire was 122,733, the numbers assisted under the Act being 62,027. If we remember that the needs of the situation require an annual outward movement of at least a quarter of a million, it will be seen that we are a long way yet from solving this, the most urgent of all our Imperial problems.

The comparative failure of the Act is due to a multitude of causes, all of which hang together and may be said to spring from two root causes. One is the wholly wrong attitude of our people towards settlement overseas. Most of us regard it as too much of an adventure to embark on, so long as we can find suitable employment in the old country; and we only think of seeking our fortunes in the Dominions when things are not going too well at home. The other root cause is the inability of the Dominions to take more than a certain number of immigrants yearly, and their frequent restriction of even this limited number to certain specified classes. Each of these causes reacts on the other, and we can look at the migration problem from either angle.

¹ In comparing the geographical area of Canada with that of the United States, we have to remember, of course, that only the southern and central portions of Canada can support a civilised community.

THE WORLD, THE AIR AND THE FUTURE

Before we go any further, however, one point must be strongly emphasised. The primary object of our state-aided settlement policy is not to solve this country's internal difficulties. Often we hear it said: "We have a permanent army of a million unemployed. Why not ship them overseas? There are vast empty spaces in Canada and Australia yearning for labour to develop them." Unfortunately the problem is not so easily settled as that. Quite regardless of the fact that the Dominions are not yet ready to absorb all the persons of both sexes we can send them, we must remember that they are self-governing, and, therefore, have a perfect right to decide for themselves on the type of immigrant they are prepared to admit. And being young and energetic countries with their way to make, they refuse to admit any but the best.

Now, unquestionably, large numbers of those who cannot find employment in England to-day are just as skilful, energetic and able-bodied as their luckier brethren who can. It is equally true that there is among them a considerable percentage of persons who either physically or mentally are below standard. Also there is a residue of "unemployables." Consequently, the Dominions who have labour problems of their own can hardly be blamed if they scrutinise would-be immigrants in receipt of the dole with an almost excessive severity. Quite properly they reject in principle the linking up of our unemployment problem with the problem of immigration, and they rightly resent the very idea of our using them as dumping grounds for our own surplus population, or of our trying to get rid of our "unemployables" at their expense.¹

It is essential, then, if our migration policy is to bear fruit, that public opinion be taught to appreciate

¹ See article, "What is Wrong with Migration," by Sir Archibald Weigall, K.C.M.G., *Empire Review*, August, 1928.

AIR TRANSPORT—EMPIRE DEVELOPMENT

the problem in its wider issues. For this a great deal of propaganda work is necessary.

Above all what we have to do is to inspire our own people with the will to migrate. This is almost entirely lacking at present; and if we ask why, we shall find that a complexity of reasons may be reduced to the one word, Distance.

At the present time anyone who leaves England to settle in one of the far-off Dominions knows that he will not see his native land again except at widely separated intervals. He is bidding a long good-bye to the home of his youth, the land of his attachments. In a word, he is condemning himself to what is virtually a lifelong severance from home ties. And the more intelligent, the more highly educated he is, the deeper he has dug his roots in the soil of English or European culture, the stronger his home ties and the wider his home interests, the more he will feel the wrench.

Now there are two types of emigrant. There is first of all the emigrant class proper, consisting of men and women in the lower ranks of life—agricultural labourers, artisans, factory hands, miners, domestic servants, etc.—who emigrate because they must, rather than because they want to, and whose outflow is limited by the capacity of the Dominions to absorb their labour. Owing to our internal difficulties, our supply of emigrants of this class at present exceeds the demand. The labour market in Australia and New Zealand is already congested, and Canada can at the moment take in only farm hands and domestic servants, while India, Burma, South Africa and Rhodesia provide practically no openings for them at all.

But there are emigrants of a totally different type—men of education and substance who have capital or ideas to dispose of, and who see in the undeveloped portions of the Dominions a unique opportunity of

THE WORLD, THE AIR AND THE FUTURE

investing both to their ultimate profit. Emigrants of this type are all too few at present, but they are none the less an all-important factor in the migration problem. For the migration of such men means the economic growth of the town or district they settle in. It is they who do pioneer work in virgin country, who lay roads and railways across the wilderness, who discover new mines for exploitation, build up new industries, and open out new markets for trade. Their enterprise and initiative, and the uses to which they put their capital, provide labour for innumerable hands, thereby enabling the Dominions to absorb more and more emigrants of the other class. Such men the Dominions would welcome in shoals. But they are not forthcoming. And why? Because distances are too great for frequent or lengthy visits by way of experiment, and few are prepared to cut themselves off from the homeland for ever. For it is precisely this type of man who will be most likely to have strong material or cultural ties binding him to Europe, and who will therefore be most loth to migrate under present conditions. For his is not like the case of the Civil Servant in India or in the Crown Colonies, who has frequent long leaves to look forward to, with the ultimate prospect of a comfortable retirement in the old country after a certain number of years' service. With him it is a question of a permanent domicile. He has to stick at his job, and it may be half a lifetime before he can find the time or the wherewithal to take even a short trip home; by which time he will have become a stranger among his own.

Distance then is the main obstacle to migration, and it can be got over by air travel. Establish an efficient system of aerial communications throughout the Empire, and we shall no longer have to deplore the lack of the "will to migrate" among our people.

AIR TRANSPORT—EMPIRE DEVELOPMENT

There will be no more talk of severance of ties when the farthest corner of the Empire will be within a week's journey of the Mother Country, and within a fortnight's reply to correspondence. Yet strange to say, official opinion, which is keenly alive to the urgent necessity of speeding up the process of migration, does not seem to realise what powerful allies it has in the airship and aeroplane. In the Report of the Overseas Settlement Committee for 1927 occurs the following sentence (Page 8):

“Although an annual total of some 65,000 assisted settlers and a gross outward movement to the Dominions of some 130,000 a year may seem disappointing to those who expected or hoped that the Empire Settlement Act would bring about a transfer of population from the congested areas of Great Britain to the large and sparsely-inhabited districts overseas, of 250,000 or even half a million a year, yet this result cannot be regarded as other than successful if a count is taken of the difficulties under which modern conditions prevent a more rapid movement.”

A typical example, this, of the self-complacency of our officialdom, so pleased with its little best in the face of such mighty difficulties! But what pray “under modern conditions prevents a more rapid movement!” Only the lack of vision of our governing authorities. Instead of hesitating on the fringe of a great subject, let them make straight for its centre. Instead of frittering away their energies on the outposts let them concentrate their attack on the main fort. Once the problem of distance is solved, all the other obstacles to migration which now worry the heads of officialdom, will fall away of themselves. Marconi has solved the distance problem as regards human speech, and its solution in respect of physical transport lies to hand in air development.

THE WORLD, THE AIR AND THE FUTURE

To argue that with the best will in the world we cannot build a fleet of airships capable of carrying half a million emigrants overseas yearly is puerile. It is not suggested that airships will be used for transporting emigrants—at least not in our time. What we mean is, that by making the Dominions easy of access, they will stimulate Imperial intercourse, and encourage migration among business and professional men in this country. And it is the money and enterprise of the capitalist class that will provide openings for the ordinary emigrant. Or it need not be a case of actual emigration at all. Take for example, the case of a British capitalist who hears of a good investment for his money in some mining scheme or industrial venture in Australia or Canada. Under present conditions he cannot afford the time to go and investigate the matter for himself, and rather than trust an agent whom he does not know, he leaves it alone and invests his money nearer home. When flying is made easy, it will be possible for him to visit the spot by aircraft and to see for himself that the scheme is a good one; with the result that he will put his money into it, and give employment to a number of hands, thereby relieving the labour market and creating a demand for more man-power from Great Britain.

Or consider the far-reaching scheme that has been put forward for opening up the Peace River District of Western Canada, where it has been proposed to settle two million emigrants during the next ten years on a co-operative basis between the Canadian Government, Alberta, British Columbia and the Imperial Government. Speaking in the Debate on the Empire Settlement Bill Mr. Wardlaw-Milne asked the following question:

“What is to prevent,” he said, “this country approaching the Dominion of Canada and stating

AIR TRANSPORT—EMPIRE DEVELOPMENT

that, quite apart from the ordinary procedure regarding schemes of migration, one would be prepared, if they concurred, to take up a great portion of land in the Peace River District where there are something like sixteen million acres of land, an area larger than Scotland, eminently suitable for development, containing excellent wheat land, plenty of minerals, with every possibility of agricultural development for thousands of families from this country."¹

I do not for one moment pretend that all the obstacles to the promotion of such a scheme can be removed by air travel. Obviously, however, the scheme would stand a much better chance of being carried through if the Peace River District instead of being a fortnight's journey from this country could be reached within four days as would be possible by aircraft. We should then have financiers, agriculturalists, engineers, merchants, industrialists, architects and surveyors, and professional men of all kinds taking an active interest in its development. Many of these would take flight trips of investigation. The scheme would be widely discussed in the Press. It would capture the public imagination. Statesmen, instead of talking, would have to act; the various administrative difficulties that stand in the way of such a scheme would be removed—public opinion on both sides would see to that—and so an energetic beginning would be made. And once the experiment were properly started, it would move forward rapidly from its own momentum.

It is by big settlements of this kind that the migration problem is going to be solved. There is scope for them all over the Empire; not only in Canada but in New Zealand, on the tablelands of Queensland,

¹ See article, "What is Wrong with Migration," by A. A. Somerville, *Empire Review*, August, 1928.

THE WORLD, THE AIR AND THE FUTURE

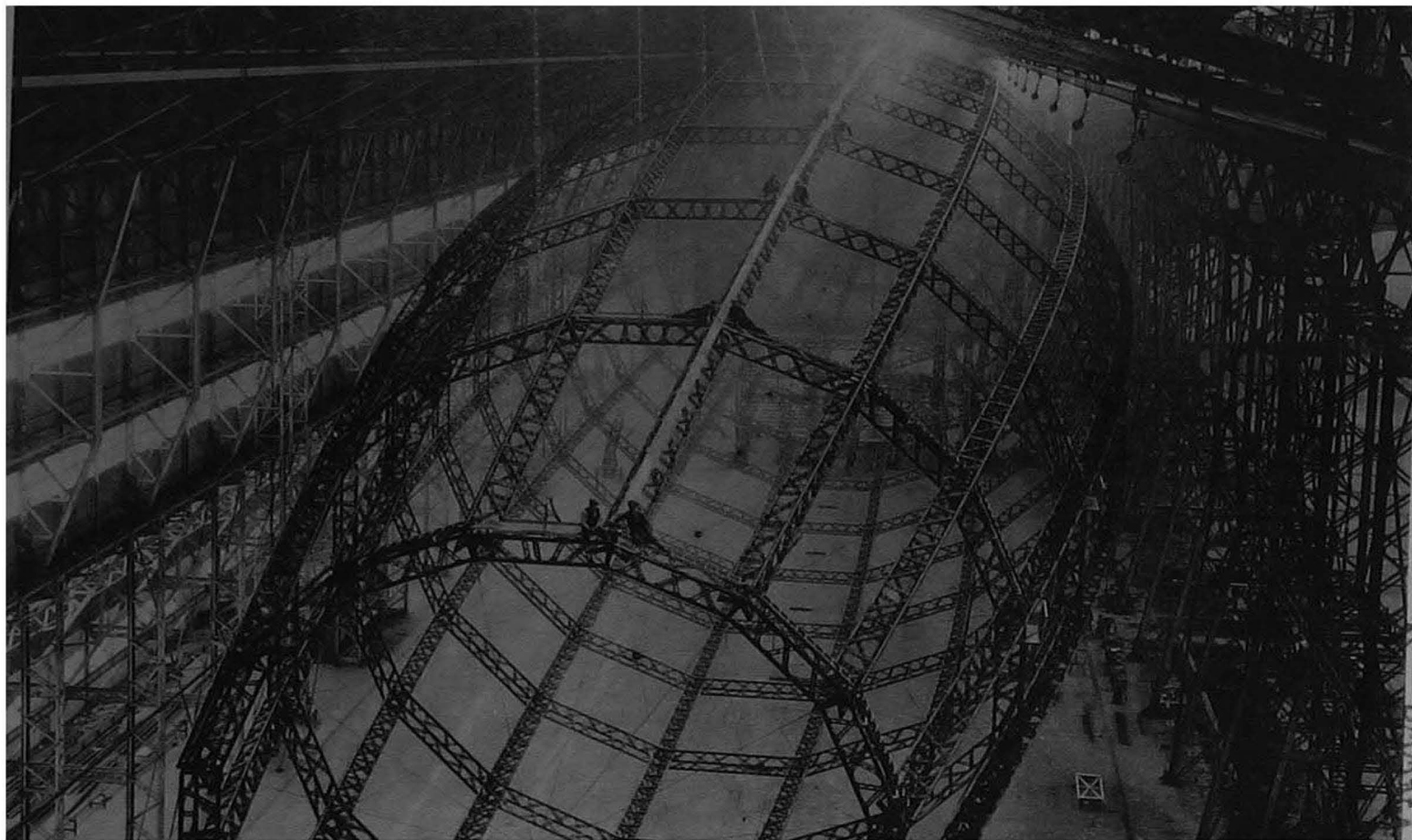
and in Western Australia, which could house the whole present white population of the Empire and still have room for more. And the obstacles to such settlements are not insuperable. They are mainly administrative, and will be easily overcome when distances are reduced, and our scattered Empire is welded into a physical administrative and economic unity. This brings us to our second heading.

§ 2

Commercial and Economic Expansion

I have pointed out that the transference of population from Great Britain to the Overseas portions of the Empire is an Imperial problem closely bound up with the economic expansion of the Dominions themselves. We cannot send the Dominions more settlers than they can absorb. If, therefore, our Overseas settlement policy is to be successful, all possible encouragement must be given to the development of Empire industry and Empire trade. Mr. Amery sums up the matter admirably in his excellent little pamphlet on "National and Imperial Economics" (page 66):

"The fact is that the policy of Empire settlement, as a means of securing Empire development cannot be carried effectively out by itself, but only as a part of a general economic policy framed to that end. Settlement cannot take place without the expenditure of capital, and neither capital nor settlers will be forthcoming unless conditions of production and of sale are favourable. Men, money and markets form an inseparable trio which have to go together to insure really successful development. It is no good spending large sums on irrigation works to enable many thousands of new settlers to grow fruit, unless that



R.100. The Hull Framework, showing the transverse and longitudinal girders. A gas-bag is placed between each transverse frame

AIR TRANSPORT—EMPIRE DEVELOPMENT

fruit, fresh, dried, or preserved can find a market. And if our policy and that of the Dominion Government is to take steps to promote settlement, it must be equally our policy to provide the market facilities as well as the capital to make settlement a success. In other words, co-operation in settlement must be accompanied by co-operation in economic policy."

Quite regardless of whether or no the doctrine of Imperial Preference commends itself to our thinking as "practical politics," it goes without saying that the intensive development of our Imperial resources and the marketing as far as possible within the Empire, of Empire raw materials, manufactured goods and food-stuffs, are objects on which we must concentrate all our efforts if we are to realise our dream of an Empire strong and secure in political cohesion and economic unity. And we shall find air navigation as powerful an ally here as we found it in helping us to a solution of the migration problem.

Other things being equal, manufacturers and producers will always deal at the nearest market; and the same is true of the consumer. It saves time and trouble; and it costs less. The greater the distance between the buyer and seller, the more difficult it is to establish a regular business connection; and in the case of certain foodstuffs and other perishable commodities, great distances make business impossible. If we bear in mind that Great Britain is 2,500 miles from the nearest of her daughter states, and 12,000 miles from the farthest, we can see at once what an obstacle distance is to the development of Empire trade. As a result of air travel, however, the Imperial globe will shrink to less than a quarter of its present size. London will be little farther from Montreal or Bombay than she now is from Rome. Australia will be as near to

THE WORLD, THE AIR AND THE FUTURE

her as New York is to-day, and Capetown will be as near as Cairo. And the distances of the Dominions from each other will shrink in the same proportion.

And the whole world, it will be argued, will shrink, too, so that the Dominions will likewise be brought within easy distances of the United States, Germany and all the other great economic centres of civilisation. True enough. British and Imperial goods will have to face friendly competition from outside as heretofore. But this is beside the point. The point is that the great obstacle to the economic co-ordination of the Empire will be in part removed, and the fundamental principle of our Imperial policy—the principle, namely, that the resources of the Empire must be developed for the good of the whole Commonwealth, that its wealth must as far as possible be made to circulate through all its parts—will at last become a workable proposition.

To-day an immense deal of "All-British" propaganda is being disseminated throughout the Empire, and this is no doubt an excellent thing. But propaganda cannot make much headway when it has to fly in the face of economic laws or profitable dealing. It is no good urging people to "Buy British" and "Eat British" if they have to put themselves out to do so. Loyalty and goodwill can make use of opportunities that are put in their way, but they cannot create them beyond a certain point. Our propaganda will have a tenfold effect, when an efficient system of Imperial airship and aeroplane services enables us in great measure to solve the dual problem of marketing Empire produce in the homeland and British manufactured goods in the Dominions.¹

Similarly profitable business connections between British firms and firms overseas will be more readily

¹ Here again let me repeat that it is not a question of transporting the actual produce by air, but of using air-travel to facilitate the arrangements for its marketing.

AIR TRANSPORT—EMPIRE DEVELOPMENT

established when air travel makes it comparatively easy for principals and clients to fix up big contracts at personal interviews, and when agents can fly backwards and forwards at frequent intervals, carrying samples and arranging credits.

Let us now turn our attention to one or two other directions in which aircraft can aid in Empire development.

There is, for example, the field of air survey and mapping; and connected therewith such matters as the organisation of aircraft patrols for controlling fire hazards in forests, and the use of aeroplanes for protecting crops and fisheries, for destroying mosquitoes and other pests, and for general investigation work of whatsoever kind. In all these directions there is ample scope for the utilisation of aircraft throughout the Empire.

Take the field of air survey alone. There are vast regions of forest land and undeveloped country all over the Empire, where the only alternative to flying is travelling on foot or in canoes, and where the difficulty of access makes ground survey practically impossible. The saving of time and trouble by air survey in such regions cannot be over-estimated, and the photographic records obtained from such survey are of an immense value to almost every branch of public administration. As the Report of the Imperial Air Communications Special Sub-Committee (page 85) rightly says:

“The air photograph if made to do its full work, serves the geologist, the forestry officer, the railway engineer, irrigation engineer, draining engineer, the town planning department, and the department of agriculture, the archæologist and the medical officer, as well as the surveyor himself and the hydrographer in coastal stations.”

THE WORLD, THE AIR AND THE FUTURE

This branch of aviation has been extensively developed in Canada, which probably leads the world in the application of air survey and in the use of aircraft for forest fire patrol. A constantly increasing area is surveyed each year, approximating to 60,000 square miles in 1925.¹

Improvement in medical facilities offers a further field for aircraft survey. A difficulty in receiving prompt medical aid is one of the great drawbacks to settlement in remote parts. Besides the risk of bodily injury, which is always present to the settler engaged in rough pioneer work, there is the danger to health from unfamiliar climatic and physical conditions, especially in tropical and sub-tropical regions. Rightly, therefore, the man who has a wife to think of and a family to bring up will hesitate before he leads them into inaccessible districts where medical aid is practically unget-at-able. Aircraft provide the only means of solving this problem, and as the time goes on we shall certainly have organised medical services by air in all the remoter parts of the Dominions. A move in this direction has already been made both in Canada and in Australia, notably in Australia, where numerous lives have been saved by the Medical Air Taxi Services carried on by the Queensland and Northern Territory Aerial Services Limited.²

Another most important use of aircraft is in the field of mineral exploration and development. In illustration of this usage I cannot do better than quote three or four passages from an article by Mr. E. L. Chicanot, which appeared in a recent number of *The World To-day*,³ and which shows how the aeroplane is revolutionising Canadian mining.

The writer describes how the first regular air service to be established in Canada, was "from the edge of

¹ See Report quoted, page 82.

² See Report quoted, Section, Australia.

³ August, 1928.

AIR TRANSPORT—EMPIRE DEVELOPMENT

civilisation into the wilderness of a new mining camp," a journey of less than an hour spent in comparative comfort in the air, being substituted for "five arduous days of canoe paddling through a forest area infested by mosquitoes and black flies."

"From its base at Haileybury on Lake Temiskaming, the company undertook to drop passengers or express in any part of the Rouyn Goldfield where there was a lake, a condition easily met, since the area is dotted with bodies of water of varying extent. It carried an average of more than thirty passengers a week, mining promoters, engineers, and prospectors; it supplied each camp, so drastically cut off from civilisation, with fresh fruit and vegetables regularly: the ship of the air transporting over the virgin forest freight of every imaginable description—cats and dogs, dynamite, lumber, iron piping, ammunition, pneumatic drills and gasoline, and on its homeward trips mineral samples for assay. According to authorities it set the progress of the new camp ahead by at least two years, and when at length, after three years, the railway reached it, more effectively bridging civilisation and the wilderness, such reliance had come to be placed upon the air service that it continued to function, competing with the railway, and carrying out certain phases of transportation in which it has no rival."

In another passage the writer gives an account of the exploration work undertaken by a syndicate of capitalists in 1925 in the unexplored regions of Northern British Columbia and Yukon. This was probably the first mining prospecting expedition by air ever planned.

"The territory to be flown over was completely isolated, largely unexplored and very inaccurately

THE WORLD, THE AIR AND THE FUTURE

mapped. Jumps were made from Prince Rupert, British Columbia to Wrangell Island, Alaska, thence directly over the coast range to Telegraph Creek, and then over seventy miles of rough country, absolutely devoid of landing places, to Dease Lake where the main base was located. With this route established, exploration was carried on in many sections by flying on Raddi from the base, and engineers were amazed at the manner aerial transport speeded up prospecting. To quote one instance:

It was necessary to transport seven men with sufficient supplies and mining equipment to last a month a distance of 200 miles over country quite unmarked by trails and with no sign of human habitation. The whole party and impedimenta was transported in a day, whereas by any other means of transportation such an expedition if not altogether impracticable would have taken at least a year. Another trip which Indians took twenty days to make, the plane accomplished in three hours."

In the following year the same pilots undertook an expedition into the North-West Territory, flying from Edmonton to Fort Fitzgerald on the Slave Lake and then to a point 400 miles north-east where a main base was established.

"Intermediate camps and caches were made about 150 miles apart. The region in which prospecting was prosecuted is known as the 'blind spot of Canada,' an immense desolate stretch of bad lands, bereft of verdure. No maps whatever exist of the area, and the position was determinable only by the sun and the stars. In flying from one cache to another the only guide to the pilot were the countless rivers and lakes as yet uncharted. An entirely satisfactory

AIR TRANSPORT—EMPIRE DEVELOPMENT

summer was spent, however, in taking the engineers on radial prospecting trips, all of which were accomplished without mishap of any kind."

As a result of these successful experiments, an enterprising Canadian mine-owner, supported by an outstanding man in the mining industry in Canada, has formed the Northern Aerial Mineral Exploration Company, with the object of establishing mineral prospecting by aeroplane on an organised basis.

"The company intends thoroughly to explore the mineral wealth of the north by organising the country from an exploration and prospecting standpoint as completely and efficiently as a large commercial concern does, with head offices, provincial branches, and field forces. From one large central base, complete control will be exercised over the company's operations. Bases will be equipped with aircraft of different kinds at centres throughout Northern Canada. Large planes capable of single jumps of a thousand miles will carry prospectors, their supplies, and an extra supply of fuel, to the field chosen for exploration. On that field a base will be established, and supplies will be dropped to keep the men for several months. Each base will have two smaller planes, and there will be about twenty field parties sent out. The smaller plane will be used to move field parties from place to place in the area they are to cover, and with the aid of wireless to keep them in touch with the base. . . . It is the claim of the organiser that, given wings, the Canadian prospector, mining engineer, and geologist will find more mineral deposits in the next five years than have been discovered in the last half-century."

I have quoted extensively from Mr. Chicanot's

THE WORLD, THE AIR AND THE FUTURE

impressive account of what the aeroplane is doing for Canadian mining development, as it illustrates a side of aircraft activity which in the next few years is going to play a big part in opening up the undeveloped portions of the Empire. For what is being done in Canada can be done, and in fact is being done, though as yet perhaps on a smaller scale, in other parts of the Empire as well. It requires no great stretch of imagination to realise how wide a field lies open for the exploitation of this and similar uses of aircraft in the interior of Australia, or in, say, Rhodesia, where there are vast mineral deposits of all kinds awaiting exploration and development.

Indeed it is impossible to exaggerate the extent to which this branch of aviation will accelerate the building up of the economic structure of the Empire. Even the economic growth of the United States will seem slow in comparison. What might have taken a century to accomplish will be accomplished in a single generation. The work of years will be done in a few weeks. A prospecting aeroplane surveys the wilderness. A mineral deposit is discovered; and in a few days, if a mining party is in readiness, men and tools are being transported there to work it. At once a mining camp is established, with all its complex needs and activities. It is the beginning of a town, which develops with a rapidity in proportion to the speed with which its requirements are constantly being met by air transport.

As it grows in importance, roads are built and railways laid down to connect it with the main centres of trade and industry, and in a few years an uncharted spot in the wilderness has become a flourishing city, a new centre of civilisation dotting its settlements over prairie and wasteland, and radiating light where hitherto all was darkness. And but for aircraft this new cultural metropolis would never have existed.

Now let us pass on to the third of our three headings.

§ 3

Imperial Sentiment and Cultural Unity

The development of Empire unity is a cultural as well as an economic problem. It depends on community of sentiment and ideals as well as on community of material interests; but the two issues interact, and are in fact complementaries.

Sentiment plays a large part in human affairs, larger perhaps than is sometimes realised. It is an imponderable influence, active everywhere in the complex workings of the social organism, and oiling, as it were, the machinery of the world's work. It sways our judgments of men, and causes, and events, and forms the basis of half our attachments and prejudices; and if we analyse most of the decisions we make in life, we shall find that they are determined, in part at least, by sentimental considerations. We shall do well, therefore, to appreciate the full significance of sentiment as an aid to Empire development.

Perhaps this is another way of saying that we must broaden and deepen our conception of Empire, and give it a full spiritual content. That is to say, we have to remember that the Empire is a spiritual organism as well as an economic organisation, and as such, it must look for sustaining power to other than economic forces. There must be the synthetic force of a common inspiration working for unity spontaneously from within, as well as external pressure from the forces of material interests imposing unity from without. And the basis of this inspiration will be a cultural basis—unity of race, language, traditions, aims and outlooks, the sense of a common inheritance and of a common destiny, and reverence for the Imperial ideal as the symbol of

THE WORLD, THE AIR AND THE FUTURE

both. We are bound together by ties of sympathy and mutual attraction as well as by reasons of self-interest. The ultimate sanction of the Empire is a spiritual sanction, which will be strong in the measure of our advance towards cultural unity. At present, as I have repeatedly said, our Imperial consciousness is not yet fully awake. We are apt to forget that Empire unity implies cultural as well as economic solidarity. Hence Imperial sentiment is weak and inadequate. Gradually, indeed, we are feeling our way towards the grand conception of the British Commonwealth as a comity of free peoples bound together by ties of blood and spiritual kinship, proudly conscious of a single glorious destiny, and working in harmonious concert for the common good and for the welfare of mankind; but until this conception becomes the living faith of each political unit of the Commonwealth, the sentiment of Imperial patriotism will continue to be a vague and inanimate thing; for it will lack the force of a genuine inspiration.

Sentiment, however, cannot thrive as an independent motive. To be an effective force it must go hand in hand with self-interest. One must reinforce the other. We know that even between individuals, sentimental ties cannot long bear the strain of diverging interests; and between men in the mass breaking-point is soon reached. And when we have to deal with an agglomeration of scattered states like the British Empire, it is useless to look to Imperial sentiment to hold the fabric together, if self-interest is acting as a disintegrating force, and all the parts are pulling different ways. Community of material interests will strengthen the tie of Imperial sentiment; and, conversely, the stronger that tie becomes, the more capable it will be of bearing any strain that may be put upon it from a temporary conflict between national and Imperial interests. It is safe to say that our American colonies would never have broken away from

AIR TRANSPORT—EMPIRE DEVELOPMENT

us in the eighteenth century, if our previous neglect of them had not so weakened the ties of sentiment between us, that when a conflict of interests arose, the bond of union snapped. To-day our statesmanship is wiser. It realises that loyalty to the Empire is a complex motive bound up of sentiment and self-interest, and that these two threads of motive are so inextricably interwoven that they cannot be separated without destroying the tissues of each. On this, as on most other Imperial matters, Mr. Amery has some wise words:

“Every measure that stimulates mutual trade, that encourages the individual to seek his career in the Empire must increase mutual comprehension and mutual interest, and, in a hundred different ways, must strengthen the ties of sentiment that bind the whole together. Sentiment may not always be identical with material interests. But from the affection of the family to the love of country all the forms of sentiment that bind men together have their roots in the association brought about by community of material interests.”¹

This digression was necessary; for there is much confused talk to-day about the development of Imperial sentiment, and it is necessary to clarify our ideas on the subject. Let us now examine it in its relation to the subject matter of this book.

The motive of sentiment as a sanction of Empire—and by sentiment we mean, here, the feeling of attachment based on blood ties, cultural unity, and sympathy of outlook—must be kept alive by frequent intercourse between the inhabitants of the Empire; otherwise it will die of inanition. We must see each other often or we

¹ Op. cit., page 73.

THE WORLD, THE AIR AND THE FUTURE

shall drift apart and become strangers. The population of the Empire must circulate, or the heart of the Empire will grow cold, and its organism cease to function; and there must be a constant exchange of ideas among its member-states, a constant assimilation on the part of each, of the motive forces at work in the others, or the unifying spirit informing the whole will become inanimate, and one by one the parts will drop away.

Again, vast though the Empire is, and diverse as are the elements of which it is composed, there must be a complete cosmopolitanism throughout its extent; no native of one part who settles in another part must feel himself a "foreigner" therein. This is cardinal; otherwise we cannot pretend that we are a single national entity. An Australian or a settler from South Africa going to Canada to live must regard himself as a Canadian citizen as soon as he sets foot on Canadian soil, nor feel that he is relinquishing anything of his own nationality in doing so. A New Zealander must feel as easily at home in Scotland or Rhodesia as in his own country. An Englishman establishing domicile anywhere overseas, must feel that he is settling among his own people. He must be as unconstrained about moving as is a Scotsman who comes to England, or as a Bavarian who moves to the Rhineland, or as a citizen of Boston who migrates to California. In a word, for every citizen of the Empire, "home" must be anywhere within its borders.

This idea of a British Cosmopolis is no idle dream. On the contrary, if the Empire is to endure, it must develop on the lines of this conception. And once again, we maintain that the means of such a development are at our disposal in air navigation. By the rapid transport of passengers and mails, the airship and the aeroplane will solve the problem of distance which alone prevents our scattered and undeveloped and some-

what amorphous system from being transformed into a real Cosmopolis.

Some while ago an ex-schoolmaster of my acquaintance was seriously thinking of taking up an educational appointment in New Zealand. After mature consideration, however, he abandoned the idea. As, at that time, I was giving a great deal of thought to Imperial problems, I was interested to know the motives that influenced his decision; and in response to my queries, he stated his reasons in the following letter:

“. . . For me to go to New Zealand would be to cut myself off from everything that means anything to me. I should be condemning myself and my wife to permanent exile. To begin with, personal and family ties have always been very strong with me, and to break with them all—and permanently, too—as I should have to, would be a wrench I have not the courage to face.

“Apart from the fact that my mother is growing old, and I should almost certainly never see her again, I have a host of friends, many of whom I make a point of seeing at frequent intervals, and with most of whom I am in constant correspondence. I could still keep up my correspondence with them in New Zealand? No, that is where you make the mistake. Letter writing, with me at all events, requires the spur of current intercourse. It is a matter of the mood of the moment; the impulse to say, ‘How goes it?’ to a friend, or to let him know my latest; the afterthought perhaps of a recent conversation, or the wish to exchange ideas with a kindred spirit. Such letters require a prompt reply; and so the correspondence is kept going. The thought that my letter would take six weeks to reach its destination, and that three or four months must elapse before I could get an answer, would prevent my ever putting pen to paper. By the time the answer to anything I

THE WORLD, THE AIR AND THE FUTURE

wrote did come, I should have forgotten what it was all about.

"Then there are my children. Either I should have to bring them up in New Zealand, which does not fit in with my plans for their future, or leave them in England and allow them to grow up complete strangers to me and their mother, which is an unthinkable proposition.

"But these are not my only objections. As you know, my cultural roots are deep in Europe, and I should suffer from nostalgia for the rest of my days. See what this means. I should be entirely cut off from the literary movements of the times. Almost every week, new books appear on some of my pet subjects, and can I be sure that the Wellington booksellers would stock them all? I might conceivably have to wait three or four months before I could get the books I wanted. Then there are the places I want to visit. What will become of my long cherished dream of visiting Rome and Sicily and the Isles of Greece, of my idea of a walking tour in Spain, of a holiday in the Touraine? And I want to see Venice again and Ravenna, and revive old memories of the Black Forest, and Prague and the Rhineland. I may never be able to do any of these things. Still I can always hope to. But in New Zealand good-bye to all such hopes for ever; or at any rate until I am so old that their fulfilment will mean little; for the great charm of travel is the memories it leaves behind.

"Again there is music and the theatre. Wellington or Auckland may be full of music. But will it be the best? Shall I hear Beethoven and Brahms played as they ought to be, or *Tristan* properly performed? Unfortunately I am a musical epicure, and only the best fare appeals to my palate. I am greedy, too, and want plenty of it. Don't infuriate me by suggesting

AIR TRANSPORT—EMPIRE DEVELOPMENT

wireless as a consolation, with its smudged tones and emasculated vocal reproductions. Besides, the electric atmosphere of the concert hall is half the fun. And what about the theatre? It is rotten enough here, God knows—though occasionally a good play does make a furtive appearance in the byways of our theatreland. But if the capital of the Empire has so little to offer, what about its furthest outpost? Has it even heard, say, of Pirandello? But, of course, I may be wrong. New Zealand may be running a theatrical renaissance of her own; though I doubt it, as the shock of such a wonder would shake the Empire to its foundations.

“Finally I am profoundly interested in the European situation and in all the political problems and reactions of our time. Here I am in the midst of the bustle and excitement of the world’s events. I am at the centre, so to speak, of the whirling wheel. In New Zealand I should be at the circumference, and should hardly know it was going round except for an occasional international jerk! But I have said enough. . . .

“P.S. Your suggestion of Canada as a possible alternative is more to the point. But I am afraid my wife could not stand the cold of the winter months.”

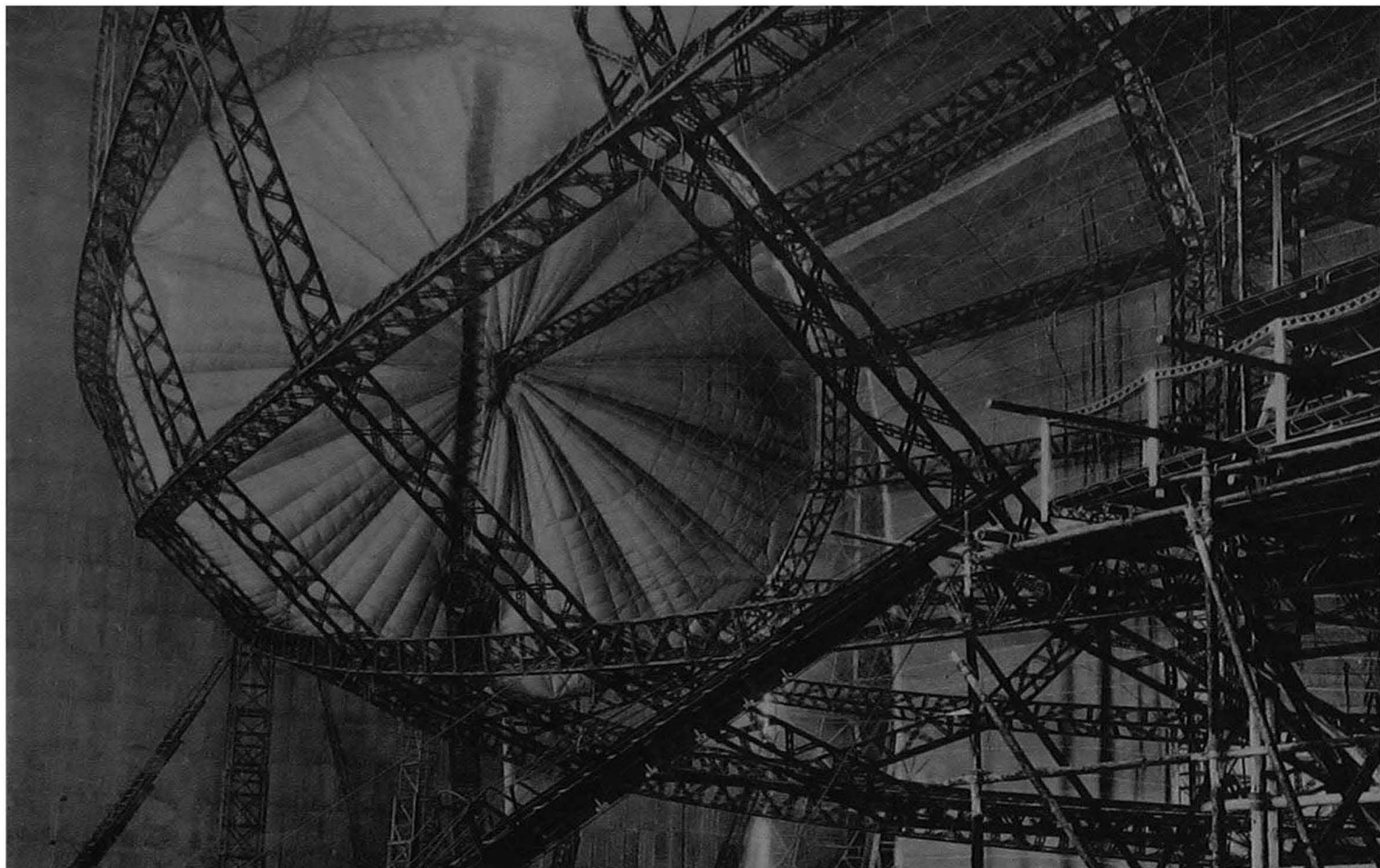
I quote this letter, because, if due allowance be made for a little wilful exaggeration on the part of the writer (who it must be said wickedly underrates the cultural position of New Zealand), it expresses pretty clearly the present day attitude of many educated Englishmen towards the idea of permanent domicile in one of the more distant parts of the Empire. Of course my friend is an extreme case, and not even the improved transport facilities offered by aircraft will remove all his difficulties. Probably if travel were as quick as thought, he would still be unable to take root anywhere outside

THE WORLD, THE AIR AND THE FUTURE

Europe. Unquestionably, however, most of the difficulties he raises will dwindle away as we advance towards a complete system of Imperial air communications. It may be noted, *en passant*, that my friend is an ardent Imperialist, who fully believes in the solidarity of the Empire; yet he speaks of New Zealand as "exile," which is, of course, to profane the very idea of the Empire—and incidentally, to stultify his own position as an Imperialist.

It is not necessary for me to go into all the points raised in the letter, as many of them were dealt with in the discussion on the migration problem. Let me repeat, however, at the risk of being wearisome, that an airship could cover the distance between the homeland and New Zealand in a week; which means that my difficult friend would get an answer to his letters (and all the books he wants!) within a fortnight. Hence, on one point, the burden of his "exile" would be appreciably lightened; for not even he would find it impossible to keep up an active and intimate correspondence under those conditions.

But let us consider (with an eye on our friend's difficulties) the full cultural significance of the fact that the maximum distance between any two points in the Empire will be reduced by air travel to a week's journey. This is the distance that now separates us from Canada; and no one regards the journey to Canada as an insuperable difficulty. Our friend's objection to Canada, we observe, was not on the score of distance but of climate, an objection which unfortunately not even accelerated travel can remove; though even here perhaps it can help. For when airships reduce the distance to two and a half days, prospective settlers who fight shy of the long Canadian winter, will take the risk more readily, knowing that if they cannot become acclimatised, the return to the mother country will



R.100. One of the Gas-bags being tested in position

AIR TRANSPORT—EMPIRE DEVELOPMENT

present little difficulty. We may safely say, then, that when all parts of the Empire are within a week's distance of each other, a tremendous impetus will be given to the migratory movement of our educated population, with a consequent diffusion of British culture and ideas. Further, this migratory movement to the Dominions will proceed from the Continent as well, to the ultimate profit of our Imperial system, which must develop not as an isolated unit, but as an integral part of the world-community of civilised nations. There will be a constant stream of European visitors to the Dominions for purposes of business and study. Members of our own intellectual, commercial, professional, business and technical classes will not hesitate to accept appointments anywhere overseas, when it is no longer a question of breaking finally with all home attachments. Even the settler who goes out to far-off Oceania will not feel that he is saying good-bye to the Mother Country for ever. There will always be the possibility of a holiday trip home; and this holds out the further prospects of negotiating a return to the old country if the call remains strong. It will be possible, too, for Great Britain and the Dominions to arrange for an exchange of personnel in certain of the more mobile professions like teaching. Universities, schools, technical and agricultural colleges and other educational establishments on both sides will benefit greatly from such a system of exchanges; and it will do much to give cultural solidarity to the Imperial structure.

Nor must we forget the increased facilities that will be afforded for the holding of Empire conferences of one kind and another. First of all, there is the Imperial Conference so-called, when the statesmen of the Empire meet together to discuss general questions of Imperial policy. The frequent holding of such conferences is

THE WORLD, THE AIR AND THE FUTURE

of vital importance from the point of view of political and administrative cohesion. They should be held annually. But with the present system of communications that is impossible. To-day when an Imperial Conference is held in London, the Prime Ministers of Australia and New Zealand have to spend at least three months on the journey alone. In the era of aviation, however, it will be possible to call a conference in London or in any other capital city of the Empire at a week's notice. The Imperial Conference will then become an annual affair, and what is more, the way will be paved for the setting up of a Commonwealth Parliament which shall be in permanent session like the League of Nations at Geneva.

Then there is the great work of collaboration in the manifold causes of human progress and enlightenment. Much has already been done to mobilise Imperial effort in such matters as scientific research, medicine and hygiene, education, social welfare work, and divers other causes affecting the common good that invite concerted action in thinking or well-doing. But here again the work of association is badly handicapped by difficulty of communication. If there is to be an effective concentration of the intellectual and moral forces of the Empire—a real “pooling,” so to speak, of its brain and heart power—the various leagues and associations that have been founded to promote this end in certain specific directions, must be able to meet in frequent conference so as to report progress, collate evidence, and exchange views on questions of policies and a common programme. And this, air travel will enable them to do.

Let our friend take courage. Life in New Zealand will not seem “exile” even to the most sophisticated product of European culture when a regular passenger and mail air service links her up with the European system,

AIR TRANSPORT—EMPIRE DEVELOPMENT

brings her within the circulation of all the complex activities of that system, and makes her a full participant in its intellectual and cultural life. The drama, for instance, will be stimulated by regular visits from our leading theatrical companies, who will tour the Dominions during the off seasons here just as they now tour the provinces. And as the result of this stimulus, promising young actors and actresses who are crowded out of their profession in this country, will be provided with openings for a career. Nor will our friend's musical soul be starved. With Europe only seven days journey away, it will be a simple matter for enterprising concert agents in New Zealand to arrange contracts with the leading European artistes, so that he will not be left with Hobson's choice of wireless or nothing. Then there is the question of the education of his children. In the new era he may no longer deem it necessary to send them to England to be educated; but if he does, he will not feel that they are quite out of his reach for a summer holiday. This is a point, however, which touches more closely parents who live in tropical countries. To them air travel will be a great boon. For with the tropics only three days from London, children will be able to visit their parents for the holidays, provided of course the parents can afford it.

From these suggestions thus briefly thrown out, it will be seen that under the ægis of aviation, the British Commonwealth will achieve a structural unity it has not hitherto possessed: and, further, that the Imperial entity thus created will be a cultural organism as well as an economic organisation.

If we look back in history, we shall find that a period of dynamic progress in the life of a nation rarely presents a one-sided development. A period of great national energy on the material plane, whether

THE WORLD, THE AIR AND THE FUTURE

it has shown itself in colonial or commercial enterprise, in industrial expansion or in political domination, has almost invariably been a period of cultural efflorescence as well, being marked by an equal outburst of creative energy in the things of the mind. It was so in the Athens of Pericles and in the great century of the Roman Republic that followed the fall of Carthage. It was so in the Golden Age of Spain in the Sixteenth century, and in the mighty days of Louis XIV, in France, a century later; in Elizabethan England, and in Victorian England, and in nineteenth century Germany. So it is now proving in the two Americas; and so it will be in the case of each of the Dominions. It is true that until our own day the United States did undoubtedly present the crude picture of a one-sided development, her rapid growth to material greatness seeming to stifle the growth of her intellectual culture. But there was a special reason for this. Her massive economic development, so marvellous in its rapidity, was built up on railways; and railways though they could give her the necessary internal unity, could not bridge the Atlantic and link up her organism with Europe, the big organic centre of the world's culture. She grew up divorced, as it were, from the parent source of her own civilisation. Thus, while she was able to create and amass wealth at incredible speed, and to lead the world in the sphere of mechanical progress, she lacked both the stimulus and sustenance for an equal development of her energies in other directions. An equilibrium between her practical and her cultural energies has now been established, however, with the result that she is to-day playing a part in the intellectual life of the world commensurate with her greatness on the material plane.

The prospect for the Dominions is somewhat different. Their economic potentialities are no less than were those of the United States; but the cultural

AIR TRANSPORT—EMPIRE DEVELOPMENT

opportunities of each will be immeasurably greater. For in the era of aviation their growing organisms will be able to develop in an international atmosphere—an advantage not possessed by the United States during her formative period. That the overseas portions of the Empire at present lag far behind the Mother country in the cultivation of the finer graces of civilisation is a matter of frequent comment by English and foreign observers alike; and in this connection it is often pointed out that none of the Dominions has yet produced a poet or artist of the first rank, or even, excepting in the political sphere, an intellectual force of world significance. All this is true enough. But let us not be in too great a hurry. As the young states of the Empire grow in national self-consciousness and develop the complex relations of an eager expanding life, there will be no lack of poets and artists and spiritual teachers of all kinds to give expression to the intellectual strivings and spiritual needs of each. And perhaps among them will be the great Imperial poet who will one day give imaginative expression to the soul of the British Empire in an immortal epic, just as Virgil embodied for all time the genius and destiny of Imperial Rome in his *Æneid*. We foresee a period of cultural efflorescence for each of the Dominions. Our vision is of the Empire inaugurating a period of world-culture that will be specifically British in character. It will be a composite culture embodying the distinctive affirmations of many national types. But amid all diversities of type it will be one in spirit and essence; for the several types will be rooted in the genius, character, and traditions of the British race.

And now, having examined the potential influence of aviation on Empire development, let us turn to the equally important question of its influence on National and Imperial Defence.

CHAPTER III

AIR TRANSPORT AND THE
REORIENTATION OF DEFENSIVE
POWER

Defence problems completely revolutionised by the invention of Aircraft:

1. Criticism of Britain's Air Defence Policy
2. Effect of Aircraft Development on the Strategic Position of Great Britain
3. Meaning and Value of Sea-centrality—Its Influence on the history of Great Britain—Sea-centrality her Permanent Possession, but Trade Centrality now passing into the hands of the United States—Lessons to be drawn from England's Sea Power, for the Framing of a right Air Policy—Her Maritime Development due to her Geographical Position; her Air Development must depend on her own Exertions
4. Relation between Air Power and Sea Power.
5. Uses of Aircraft in Naval Strategy—The Rôle of Airships
6. Defence Problem considered under its Imperial and International Aspects—Anglo-American Friendship the Keystone of World Peace

In the foregoing chapter it was stated that the two chief bonds of Empire unity were sentiment and self-interest. In discussing the motive of self-interest, however, I purposely made no reference to the very important fact that the overseas portions of the Empire looked to Great Britain to protect them from foreign aggression. This aspect of the matter, involving as it does the whole defence problem of the Empire, brings

AIR TRANSPORT

in its train an entirely new set of issues, and I have reserved it for separate treatment.

For here we have to change our ground somewhat. The problem of Imperial Defence is an international rather than a purely domestic problem; that is to say, the domestic issues involved are, as it were, the reaction to forces at work outside of the Imperial organism. They spring not from the workings of inter-Imperial relations, but from the changes of mood and direction in the development of International affairs. If war ceased to be a contingency of world politics, there would be no Imperial defence problem. Again, it is no use examining this problem from a pre-aviation standpoint. Issues here have already been completely revolutionised by air power; we know that if war were to break out to-morrow, aircraft would be a dominant factor in determining the result. Whereas in the last chapter we were speculating on the potentialities of air power as an aid to the solution of Imperial problems, we have now to deal with those Imperial problems of attack and defence which air power has itself created.

Finally, though the Empire is one nation in spirit and purpose, the specific defence problems of Great Britain must be carefully distinguished from the defence problem of the Empire as a whole. When the British Commonwealth is at war, not only has Great Britain, owing to her greater resources and reserves of manpower, to shoulder the main burden of the struggle, but the ultimate issue depends on her ability to preserve her island integrity; and it is precisely here, in its menace to the security of this island that air power so immeasurably complicates the issues of National and Imperial Defence. In the course of our inquiry, we shall find that whereas the commercial uses of aircraft are of Imperial rather than of National importance (if we may make a distinction which is of course purely

THE WORLD, THE AIR AND THE FUTURE

theoretical) the reverse is true of their belligerent uses. Here Great Britain is vitally affected, and the Empire only in a secondary degree, seeing that for many years to come the problem of Imperial defence will remain, as it always has been, primarily a Naval problem. And we shall find further, that in neglecting civil aviation as a matter of minor importance to ourselves, we are not only failing in our duty towards the Empire—a point I insisted on in the last chapter—but we are also failing in our duty towards our own people, since it is only by the intensive development of civil aviation that we can hope to establish a basis of aerial strength for war-time.

These are some of the issues I shall try to clarify in the present chapter. I shall begin by discussing the air defence policy pursued by Great Britain up-to-date. Next I shall examine the effect of aircraft development on the strategic position of this island. Thirdly, I shall go into the question of Britain's sea-centrality, and try to show how certain lessons to be drawn therefrom can help us towards the solution of current air problems. Fourthly, I shall deal with the relation between sea power and air power, and endeavour to define the actual position that has now been reached in the gradual transference of naval functions from surface craft to aircraft. Finally, I shall discuss the defence problem in its Imperial and International aspects.

§ I

Until our own time the problem of Imperial defence was in its general principles comparatively simple. Her daughter-states looked to Great Britain to watch over their interests and to keep at bay any potential aggressor from without. No foreign Power dared

AIR TRANSPORT

offer an affront to one of the Colonies as it meant an entanglement with the British Foreign Office. In exchange for this protection, the Colonies were expected to rally to the Mother Country, if at any time she found herself at war. Further, as the British Treasury shouldered practically the entire burden of the Imperial Defence Budget, it was the British Foreign Office which directed the foreign policy of the Empire.

But an arrangement that worked well enough when the Colonies were dependent states in a position of definite subordination to the Mother Country, became obsolete with their promotion to the status of self-governing Dominions with sovereign rights over their own domestic concerns. Each of the Dominions now enjoys an independent political existence, and save in matters affecting the security and integrity of the Empire, has complete freedom in its foreign relations; and as, too, each of them now looks after its own Defence Budget, it rightly claims a voice in the direction of Imperial policy.

The changed situation is aptly illustrated by the action of the British Government over the Kellogg Pact. On receipt of the American proposals, Great Britain did not at once sign acceptance on behalf of herself and the Dominions; nor did she sign for herself, and leave the Dominions to act as they pleased. On the contrary, she held back her answer until she had taken counsel with each of the Dominions; and the agreement was signed not by Great Britain but by the British Commonwealth of Nations. Here two principles were proclaimed to the world: the first being that the British Empire must no longer be regarded as consisting of a head state with dependent members, but as forming a commonwealth of free and equal nations; the second, that, in International affairs this Commonwealth acts as a single nation and must be treated as such.

THE WORLD, THE AIR AND THE FUTURE

This is the position to-day; and so long as Great Britain remains *de facto*, if not *de jure*, the predominant partner in the Commonwealth, there is not likely to be any great divergence of outlook on questions of Imperial Foreign policy, either between the Dominions and Great Britain, or among the Dominions themselves, and the mechanism of our Imperial Defence system will continue to run with comparative smoothness. But we must look ahead. The Dominions are progressive countries, and sooner or later some of them will become the equal of Great Britain in strength and importance. Already it is a patent fact that *we* need the Dominions very much more than *they* need *us*, and their dependence on British power and prestige is rapidly ceasing to be one of the links that bind the Empire together.¹ As time goes on—and we are not looking ahead more than a few years—Canada, South Africa, and Australia will grow into self-contained, self-supporting units of wealth and power in the pattern of the United States of to-day. They will become each of them, world-centres of commercial and industrial activity, with far-reaching ramifications of influence that will cross each other at numberless points in ever-increasing complexity of issues. And what then? Will the British Family of Nations still be a harmonious household?

That will depend in part, at least, on International developments. If, a generation hence, the civilised world is as disunited as it is to-day, the prevailing disharmony is bound to have a disturbing effect on inter-

¹ Canada is a case in point. There is a strong section of opinion in Canada which holds that it is unnecessary for her to subscribe to the upkeep of our Imperial Forces, since her natural defence lies in her contiguity to the U.S.A., who would never allow a Foreign Power to invade her. See my speech on the Air Estimates for 1925. (*Hansard*, Vol. 181, page 1607.)

AIR TRANSPORT

Imperial relations. In other words, a Europe for ever on the brink of war will mean a British Commonwealth strained at all points of the Imperial fabric by divergent interests and policies.

The point I wish to emphasise is this. In a world of warring elements, of mutual suspicion and hostility between nation and nation, the advent to power of the several Dominions will add to the International muddle; and as a consequence the moral unity of the Empire may well grow weaker as its separate parts grow stronger. Even if our statesmen have the wisdom to pursue an Imperial rather than a European policy, they cannot hope to keep clear altogether of European entanglements. British interests touch those of the other countries of Europe in all parts of the world, and consequently the doings of those countries affect her closely, as do their mutual relations. And if Britain cannot wash her hands of Europe, the Empire cannot. On the other hand, the Dominions will tend more and more to chafe at the Imperial connection, if it means dragging them into squabbles and wars, which upon the surface, seem to concern them but little. They will refuse to be sacrificed to the disorders of the European system. Hence friction in Europe will mean friction in the counsels of the Empire and a gradual weakening of the sanctions that hold it together.

Briefly stated then, Britain has to take stock of two basic facts. One is, that as the Dominions develop, the focal strength of the British Commonwealth will necessarily shift from Great Britain to the outer Empire, and this will mean a gradual lessening of European influence on Imperial policy. The stronger, the more self-sufficing the Empire becomes, the more its sustaining strength is spread over its several parts, the less will its concern be with happenings in Europe. And as the continued existence of the Empire postulates a

THE WORLD, THE AIR AND THE FUTURE

development along these lines, the only sound policy for British statesmanship to pursue is to treat this island as part of the Empire rather than as a part of Europe, and to reduce our commitments in Europe to a minimum. The other basic fact of the situation is this. So long as the wealth and man-power of the Empire are concentrated in Great Britain, or put differently, until the British Commonwealth can markedly overshadow Europe itself in strength and economic importance, so long must inter-Imperial relations to a lesser or greater extent re-act to the workings of the European system. The next generation is the critical period. A time will come, when the Dominions will have so expanded their populations that the economic strength of the British Commonwealth will be too great for any federation or combination of European Powers to think of challenging it to a struggle as did Germany in 1914. Then, indeed, it will be possible for Great Britain to turn her back on Europe altogether, at present she cannot; and until she can—until, that is to say, the work of Empire consolidation has been completed—it is my firm conviction that the smooth working of the Imperial organism must to no small extent depend on the stabilisation of the European situation on the basis of Peace.

I shall have more to say on both these points in the concluding section of this chapter. Here I am mainly concerned with the latter point or rather with its corollary. The more settled the state of Europe becomes, the happier will be relations within the Imperial Family, and the easier it will be for our statesmen to proceed with the work of Empire development. None of the great Powers, not even France, has less to gain and more to lose from another war, than Great Britain. Consequently in working out our defence problem, we must be careful not to defeat our own pacific intentions.

AIR TRANSPORT

Nothing that we do must prejudice the cause of European disarmament, or give colour to the charge that Britain is still animated by a war psychology. The measures we take for our defence must be free from all suggestion of militarism, and in no way conflict with our known desire for peace. They must be based on an economic rather than on a military conception of strength, and should be such as will enable us to deflect funds from unproductive expenditure upon armaments to Empire development. Let us examine our air defence policy in the light of these principles.

From this point of view, the fundamental question on which everything else depends may be formulated thus: Is it or is it not possible to frame an Air Defence policy which will give adequate security to these islands and to the Empire in the event of war, without at the same time aggravating the International problem by initiating a race in air armaments, and thereby making ultimate war inevitable? Can we, or can we not, take adequate measures to ensure our safety against the terrible menace of aerial warfare, without impeding the world movement towards disarmament, and violating the spirit of the League Covenant and the Kellogg Pact?

There can be no question here of a magnificent gesture on the part of Great Britain or of any other Power. No nation can take the first step in the work of disarmament; nor can it do so in the renunciation of any specific instrument of war. These are matters on which all nations must act in agreement and simultaneously; there can be no experimental first move on the part of one nation as an example to the others. Individuals may risk and suffer martyrdom for a cause they believe in and hold dear, and the world admires and profits by their sacrifice; nations may not. We

THE WORLD, THE AIR AND THE FUTURE

dissociate ourselves, therefore, from the Pacifist Group in this country who argue that Great Britain should "scrap" her Air Force on the ground that if she made a beginning other nations would soon follow suit. The chances are a hundred to one that they would not; and even if the odds were even, she would not be justified in taking the risk. Until all the Powers all over the world show that they are definitely agreed to abandon war as an instrument of policy, by reducing their armaments to the minimum required for police duties, we shall have to go on preparing ourselves against every conceivable method of attack; and of these methods of attack, that by air is, as the whole world realises, by far the most devastating, the most insidious and the most ubiquitous.

To return to our question. Is it or is it not possible to frame an air policy adequate to the needs of national and Imperial defence without prejudice to the cause of world peace? I think that it is. For by a happy paradox, the best and in fact the only way in which this, or for that matter any other country, can build up its war strength in the air is not by belligerent preparations at all, but by the development of civil aviation.

There are two methods of trying to solve the air defence problem. The right method is to concentrate our energies on the development of civil aviation throughout the Empire, treating an approach to air security in this direction as the criterion of our aerial strength, rather than basing our conception of such strength on the organisation of a gigantic air force. By adopting this method we shall not only be reducing the likelihood of war by promoting those beneficent uses of aircraft on which we have repeatedly insisted, but we shall, at the same time, be building up a reserve of air strength which in time of war will be of

AIR TRANSPORT

the utmost belligerent utility. This latter point cannot be too strongly emphasised. In the words of a leading London newspaper: "There is no rigid line between military and civilian flying. The nation with a small regular force and a larger regular civilian band of aviators is better equipped for defence than the nation which has starved or discouraged the latter to concentrate on the former. It has a reserve of pilots, a familiarity with the air, and a stock of machines that can be turned to the purposes of the war with hardly more than a moment's delay. The country, therefore, in which civilian aviation is most developed, is the country with the greatest military security."¹

The other way of attacking the problem is to concentrate on building up an air force capable of securing the defences of these islands against air attack from any Continental Power or group of Powers, leaving civil aviation to look after itself as best it can. This is the wrong method; and it is wrong because it is inefficient, and because from the standpoint of the International outlook, it is almost certain to result in an air armament race.

It is inefficient because it cannot achieve the end proposed. It is an attempt to do the impossible. However many defence or attacking planes we may choose to build, we can never build enough to render this island immune from destructive attacks by hostile aircraft. This fact is so obvious—it did not require the air exercises of 1928 to point the lesson—that a policy which ignores all its implications damns itself at once as futile and inept. Further, the more fighting planes we build, the more other countries will build so as not to be left behind in the race for air supremacy, and feverish competition among the Powers in air armaments can only end in another

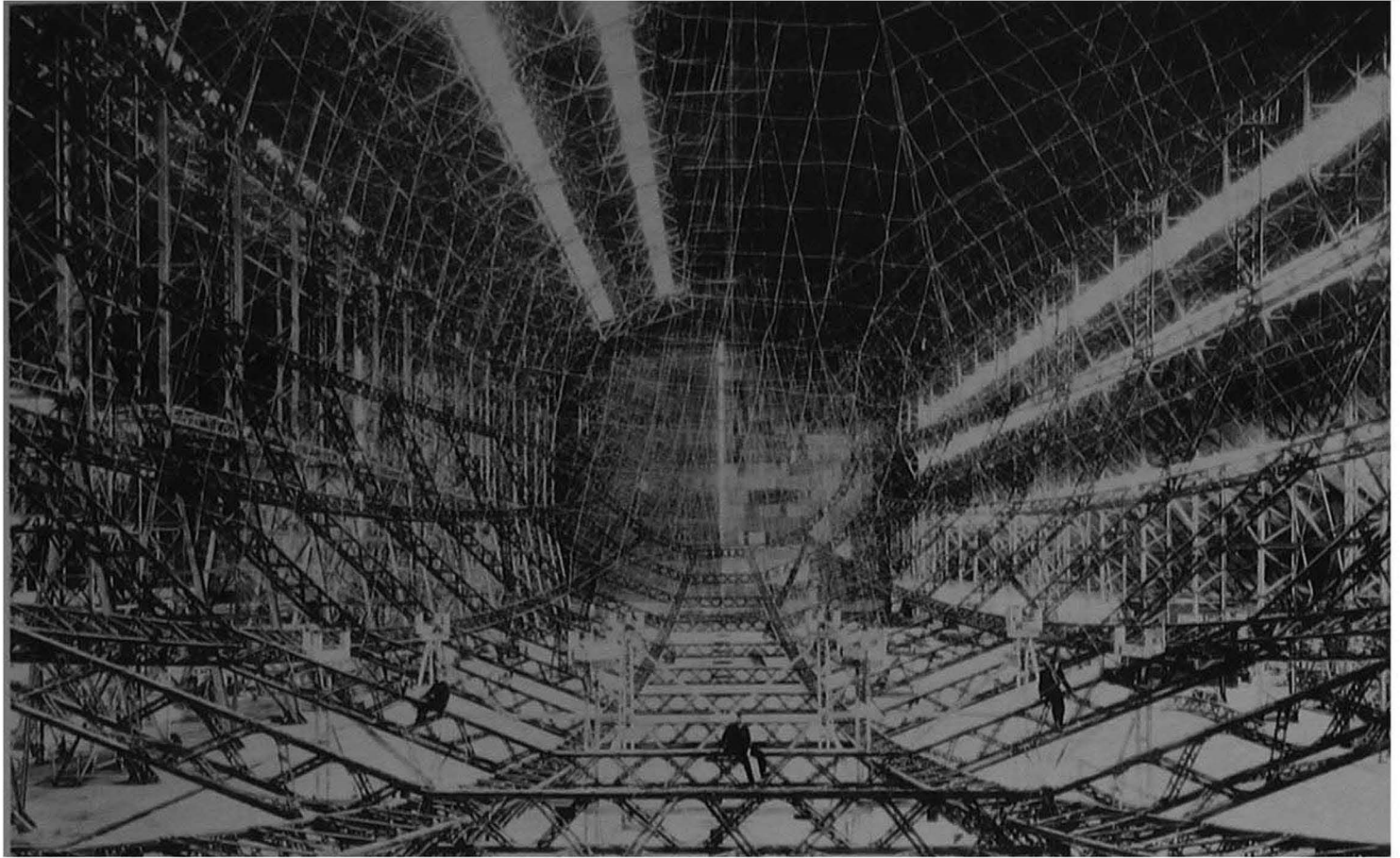
¹ *Daily Express*, 14.8.28.

THE WORLD, THE AIR AND THE FUTURE

world catastrophe. It is hardly necessary to add that the national enthusiasm for aviation in this country will grow in inverse proportion to the tendency of the public imagination to associate aircraft with armaments.

This second method which we have characterised as inefficient, inept and likely to lead to disaster, is the method that has been adopted since the war by Great Britain and all the other Powers (except Germany, whom the provisions of the Versailles Treaty have prevented from following suit), who, like her, pay lip-service to the League of Nations, meet at frequent Conferences to discuss the "limitation of armaments" and have agreed under the Kellogg Pact to "renounce war as an instrument of national policy"; the only difference being that whereas the Government of Great Britain has been spending millions of pounds annually on the military and naval air forces, and has done practically nothing to stimulate civil aviation, the other Governments, while concentrating their main effort on air armaments, have not by any means treated civil aviation in the same step-motherly way.

We insist then that our air policy during the last ten years has been wrong in principle, and barren of all profitable result. We have spent upon the air the stupendous sum of £200,000,000 and have almost nothing to show for it. Our policy stands condemned even from the point of view of the narrow vision and pre-war conceptions that have inspired it. Let us forget for a moment all the implications of the International movement towards world peace. Let us for the sake of argument take our stand on the principle that the stabilisation of Europe can be affected in no other way than on the pre-war basis of a Balance of Power, and that in consequence there is nothing to do but to prepare ourselves for the world war which must sooner



R.100. The Framework in the early days of construction

AIR TRANSPORT

or later be the outcome of a return to such conditions. How does our policy stand the test of its own principle? The answer is contained in the fact that our national effort to provide ourselves with an Air Force adequate for war purposes has resulted in giving us approximately 4% of the air force that we shall actually require in time of war. In 1917-18 the last year of the Great War we constructed a total of 34,147 machines. In 1926 we constructed under 1,000. In 1917-18 we trained no fewer than 8,000 pilots. In 1926 we trained 410. In 1917-18 we spent £150,000,000 on aviation contracts; in 1925-26 we spent £4,400,000. These figures¹ make further comment on the futility of our air policy unnecessary.

It is manifestly impossible for this or any other country to maintain in time of peace an air force which is adequate for war purposes. The real criterion of our air strength must necessarily be the rate at which we can develop and expand our peace time force in time of war; and this all important point has been completely ignored by every successive Government since the Armistice.

Speaking in Parliament on the Air Estimates for 1927 and 1928—one of the many occasions on which I appealed from the floor of the House for the re-organisation of our air policy on a rational basis—I argued at length on this aspect of the problem, questioning the advisability of spending practically the whole of the twenty million pounds provided in the Votes on a relatively small fighting force, when the only real basis of air security lay in the building up of an aerial mercantile marine on which we could draw for reserves in war-time, in the same way that the Navy is able to

¹ Quoted by me in the House of Commons on March 7th, 1927, from information supplied by the Secretary of State for Air (see *Hansard*, Vol. 203, page 2251).

THE WORLD, THE AIR AND THE FUTURE

draw upon that which we have at sea. I drew attention to the fact that our present Air Force had not more than a fortnight's supply of men and machines for a time of war; and I argued that until we could establish a great commercial air organisation, we must of necessity remain without that manufacturing capacity which could give us the rapid provision of fighting machines required by the exigencies of war. Pointing out that this capacity for rapid expansion is our real and only insurance, and that the twenty million pounds we now spend on aviation is spent solely as an insurance, and can be spent as nothing else, I suggested that the Secretary of State for Air might consider setting up a Royal Commission to enquire whether drastic curtailment could not be made in expenditure upon military aviation, and whether the sums so saved might not be devoted to forcing along the development of civil aviation.¹

My plea, needless to say, fell on deaf ears. The Secretary of State for Air was very courteous and sympathetic, and not in the least helpful. Taking his stand on the resolution passed by the Committee of Imperial Defence in 1922 and 1923, that "However attractive might be the development of civil aviation, the first necessity was to create a Home Defence Force within these shores," he expressed his sense of the danger of extending subsidies over too wide a field. "In the matter of civil aviation," he said, "my desire has been to adopt a policy which will make civil flying an economic proposition as soon as possible. To achieve that end I am not sure that it would be wise to go upon a system of almost limitless subsidies. If we can make civil aviation an economic proposition independently of subsidies, we shall then see the kind of development

¹ For a verbatim report of this speech, see *Hansard*, Vol. 203, page 2249 et seq.

AIR TRANSPORT

I wish to see and have a mercantile aviation as the reserve of our military flying power."¹

Unfortunately, however, as some years must elapse before civil flying can become "an economic proposition independently of subsidies," we are left in the interim absolutely without "a mercantile aviation as the reserve of our military flying power"; which means, of course, that all the millions of pounds we spend annually on the upkeep of an air defence force is a waste of public funds, as it goes to pay for a war-insurance which is in reality no insurance at all. Meanwhile, in contrast to our "wait and see" policy, other nations are busily engaged in laying the foundations of their air lines, preparatory to the time when aircraft will be economic and profit earning.

Again, anxious to repudiate the suggestion that the air policy pursued by this country since 1919 has conflicted in any way with our commitments in the cause of world peace, the Air Minister pointed out—and with perfect truth, be it said—that "our record in the matter of limitation and restriction of armaments has been better since the war than that of any other of the Great Powers of the World." In 1919 we had the greatest air force in Europe, and as an example to the world we at once reduced it to insignificance; and since then, whereas all the other Great Powers have gone on with their programmes just the same, we have deliberately retarded our programme of expansion "in order to show our sincere belief that the restriction of armaments was necessary; with the result that we remain in a state of marked inferiority to the other air forces of the world." A confession of failure, indeed; and the point is that this sorry state of affairs is the direct result of looking at air power

¹ See Sir Samuel Hoare's speech on the Air Estimates, March 17th, 1927. (*Hansard*, Vol. 203, page 2274.)

THE WORLD, THE AIR AND THE FUTURE

through military glasses, and trying to construct a policy on the basis of a distorted vision. If the problem were properly focussed, the unhappy dilemma in which each successive Air Minister finds himself would disappear.

However we look at it, therefore, it will be seen that our present air policy is both irrational and futile. I am well aware that the subsidising of civil aviation will not in the first instance prove a lucrative investment; but that argument carries us nowhere, since the sums expended annually on the Air Force must also, from the nature of the case, be unproductive from a commercial point of view. Whereas, however, money devoted to the development of civil aviation will at least be well spent as an insurance, and will almost certainly in the long run prove a sound financial investment, all the sums spent on military aviation are a wasted investment even as an insurance, besides being totally unproductive from a commercial point of view.¹

¹In the *Sunday Times* of February 10, 1929, appeared the following notice:

"R.A.F. TO PATROL TRADE ROUTES.

"A squadron of six all-metal supermarine Napier flying boats which has been formed at Cattewater Marine Air Station, Plymouth, will leave there between 6 a.m. and 8 a.m. on Thursday to fly to their permanent base at Basra, at the head of the Persian Gulf. The new squadron is to be known as the 203 Squadron R.A.F., and is under the command of Squadron-Leader H. R. Busteed.

"After leaving Plymouth the Squadron will fly to Hourtin, a sea-plane base near Bordeaux, across France to the Mediterranean, and then along the Mediterranean to Alexandretta. From there the flying boats, although marine craft, will fly over the desert to Bagdad, and then above the river to Basra.

"They are to be used for patrolling trade routes on the Persian Gulf."

This notice interested me for two reasons. Firstly, because Squadron-Leader Busteed was co-operating with me from 1912-14 in experiments upon a flying boat I had evolved, and the fact that he is now taking a squadron of flying boats out to the East, shows how enormously this

AIR TRANSPORT

We have established then what seems to us the incontrovertible fact that the one and only solution to the Air Defence problem of this country and of the Empire is to be found in the development of civil aviation. This fact is fundamental whether the spirit of the League Covenant or that of pre-war "Real Politik" is to be the guiding principle of our national policy.

If we now examine the issues bound up with the reorientation of defensive power that has been taking place during the last few years owing to the invention of aircraft, we shall find our argument re-inforced at every point.

§ 2

It is the pride of England that since Norman William landed at Hastings in 1066 no foreign invader has set foot on her shores. Alone among the nations of Europe, her soil has never echoed to the tread of a hostile army. The tale of her wars is invested with the glamour of victories in foreign lands, and of almost invariable conquest at sea. Her disasters have offended her pride; but that is all. They have not left her weak and distraught or with bitter memories to avenge. Never has she known the horror of war in her own country. She has no memories of a devastated land to brood over, of sacked towns and burning villages, of a fair countryside turned into a smoking ruin, of a broken demoralised people writhing under the heel of a triumphant foe.

branch of aircraft has developed in the short space of fifteen years. Secondly, because we have here, I think, an excellent example of the way money is being wasted under our present policy.

If these boats were used upon commercial operations in that part of the world to which they have been sent, the same experience would be gained, an equal number of men could be trained, the machines would be there in case of emergency, but all the time they would be earning a considerable portion of their keep.

PREFACE

chief draughtsman; of Major Teed, who was responsible for the hydrogen installation, and in the first instance for the fabric department; of Mr. W. A. Dove, the assistant works manager; and last, but not least, of Mr. C. S. Bamber, who has been my loyal and hard-working personal assistant throughout the whole period.

In so far as the actual compilation of the book itself is concerned, I want to pay a very sincere tribute to Mr. Conrad Bonacina, who has assisted me throughout both in the structure of the book and in its literary expression, and whose knowledge and experience of European politics have been most useful.

I have also to acknowledge the contribution of Chapter VI, on Aeroplanes and Flying Boats, by Mr. N. S. Norway, who was for some years on the design staff of the De Havilland Aircraft Company.

Finally, my thanks are due to all those by whose courtesy I have been allowed to reproduce the plates and photographs with which the book is illustrated.

There is one general criticism that may be directed against me, that I should like to meet in advance. Since the book is largely a plea for pushing ahead with the air development of the Empire, and contains much adverse criticism of our actual air policy since the Armistice, it may reasonably be asked why I did not advocate my views from the floor of the House of Commons during my six years in Parliament (November, 1922—May, 1929) as Conservative Member for Uxbridge. My answer is that I consistently did so; and it will be seen from the frequent footnote references to Hansard that occur throughout the book, that many of the ideas and suggestions here advanced have already found expression in my Parliamentary speeches. But Parliament is not the ideal place in which to expound ideas and urge measures involving fundamental changes of outlook and policy. The

P R E F A C E

speeches of a private member, especially, carry little weight, if they go ever so little beyond the limits that the tactics of party politics impose on the programme of his Party. I have therefore elaborated my plea for air development into the sustained argument of a book, hoping thereby to reach a wider audience and to stir up the interest of the general public in what I believe to be one of the most urgent problems of our time.

THE WORLD, THE AIR AND THE FUTURE

Our good fortune in this respect has had a marked effect on our national psychology. It has made us the most peaceable nation in the world. At no time in our history have we developed a war mentality. National fears and national hatreds are among the chief causes of war; and fearing wars less than do other nations, we have done less to provoke them. At the same time our war memories, being less bitter, have been correspondingly shorter; and revenge, secret or avowed, has never been the guiding precept of our foreign policy. When England sheathed her sword at the end of the Great War, she was probably the only nation in Europe who could honestly feel that so far as she was concerned, it might rust in the scabbard for ever.

It must be admitted, however, that we owe our unparalleled good fortune to our favourable geographical situation rather than to any preternatural wisdom in our statemanship. Strong in the sense of our island security, we have never treated the problem of National Defence in a scientific spirit. Indeed, all through history, our attitude with regard to it has been marked by a ~~casualness~~ ^{casualness} that would have brought us to ruin time and again, but for our insular position and the fact that our Navy, reliance on which has been the one solid principle of our policy, has always done its work supremely well. Then too, we have always had a developed Mercantile Marine to draw upon, and as none of our enemies has ever possessed this preponderating advantage of a great commercial navy, the British fleet has been able to take command of the seas in the initial stages of every war, even though the outbreak of hostilities may have found the Admiralty woefully unprepared for the struggle.¹ From the

¹ In early days, every large merchant vessel was armed and was a potential naval vessel. For example, only thirty-four of the one hundred

AIR TRANSPORT

middle of the seventeenth century, when we wrested the command of the sea from the Dutch down to the end of the nineteenth century, we were the one great Naval Power in the world; and so long as our control of the waters remained unchallenged, we could afford to neglect all other issues with comparative impunity.

To-day, Great Britain has to face the fact that the era of her good fortune, that is to say, of her virtual invulnerability, is at an end. The advantage of sea-centrality which her geographical situation gives her remains, though its value has been diminished; but her old Naval supremacy has gone. Not only have International developments compelled her to abandon the principle of the two-power standard, which in pre-war days was grudgingly accepted by the rest of the world as a legitimate basis for her Naval programme, but with the growth of technical science, a revolution has taken place in the strategy of Naval warfare, which has given a new orientation to the problem of sea-power, and has made it practically impossible for any nation in the future to hold a naval hegemony such as Britain held during the eighteenth and nineteenth centuries. The invention of the submarine, for example, weakened the whole basis of maritime supremacy; for the submarine is essentially a levelling instrument; in other words, it functions mainly to the detriment of the predominant Sea Power.

The greatest menace to Sea Power, however, comes from the air. Apart from the fact that certain other Powers have effectively challenged our historic claim to be the predominant Naval Power of the World—

and seventy vessels with which Drake defeated the Armada were naval vessels provided by the Government; the rest of the fleet was made up of merchant ships belonging to private individuals.

THE WORLD, THE AIR AND THE FUTURE

a claim that had almost come to be an unwritten law of International politics—the invention of aircraft has so completely transformed the problem of sea power, that the question that agitates Great Britain to-day is not so much how far she is prepared to share the command of the sea with others, as how far the centre of gravity of her Defence problem has been shifted from the sea to the air.

In our last chapter we dwelt at length on the beneficent aspects of aviation, and expatiated on the splendid prospect of Empire that its development opened out to us. From the point of view of our national security, however, the invention of aircraft is nothing short of a disaster. Indeed from this point of view it is no exaggeration to say that it is the most disastrous event that has ever befallen us. It scraps our insular armour and renders obsolete almost every canon of our defensive strategy. The age of our inviolability is over. We can no longer afford to muddle through our problems anyhow, with the confident optimism of a people who know not defeat; happy in the sure knowledge that so long as the Navy is all right, nothing very terrible can happen to us. Our island situation counts for nothing in aerial warfare, and in some respects, it increases our vulnerability. For example, we have always regarded the narrow strip of water that separates us from the Continent as a geographical asset of the first importance, and we have invariably turned down the scheme of a Channel Tunnel so as not in any way to weaken this pledge of our security. It is obvious, however, that, with the advent of aircraft, the control of narrow waters is passing from the sea to the air, and this adds immeasurably to the complications of our defence problem, making the Channel a source of weakness rather than of strength, and giving weight to the contention that

AIR TRANSPORT

the tunnel ought now to be built as a military safeguard.

With regard to this aspect of the situation, I may be allowed perhaps to quote a passage from a speech I made in the House of Commons during the Debate on the Air Estimates in 1926:

“Hitherto, we have been accustomed to look upon the English Channel, the silver streak, as the greatest safeguard for the protection of this country. I venture to think it may be our greatest danger in the future. Some of the modern seaplanes carrying torpedoes can sink and destroy a merchant ship—that is, if they hit it with their torpedo—within two or three minutes. It is also, I think, a fact that no escort of naval destroyers or light cruisers without aircraft is likely to defeat that attack. If we consider Naval policy in two spheres, one the narrow waters, and the other the great ocean spaces, the conditions are very different. In narrow waters I believe it will be found in the future that a country which does not control politically the lands on both sides of those waters will not be so safe as a country wholly surrounded by land. When once a merchant steamer is torpedoed and sunk, she is lost irrevocably with her cargo; whereas if a railway is bombarded, though the railway may be destroyed, it can be repaired; and a train, though it may be destroyed, never carries anything like the amount of produce that a ship does, and it can also be repaired; but a ship once sunk is lost for ever. In so far as the narrow waters are concerned, therefore, control of them must inevitably pass to the air, and I believe it is not too strong to say that such control has already passed to the air. Therefore it seems to me, both in the plan of our campaign, and in peace time preparations for war,

THE WORLD, THE AIR AND THE FUTURE

the kind of preparations must depend largely upon the capacity of aerial machines as they may be at the time of that war."¹

Nor is this all. One of the reasons that make aerial warfare so deadly, is, the fact that the advantage lies overwhelmingly with the attack; and in so far as this is so, it turns to the disadvantage of Great Britain. Owing to the speed and mobility of aircraft, the medium in which they move, their comparative invulnerability, and the small target they offer to an enemy, it is possible for a fleet of hostile aeroplanes to elude the most careful watch, and to drop bombs on a given objective in the face of the most vigorous opposition; and it is small consolation to the defence to bring the raiders down when the damage has been done.

The air exercises of 1928 proved beyond a doubt—if further proof were necessary after the experience of the Great War—how utterly impossible it is to provide London with an adequate defence against this method of attack. In any future war, all the vital parts of the city could be heavily bombarded within twenty-four hours, and all our defensive preparations would be powerless to prevent it. Of course, we could retaliate in the enemy's country; but this is just where we stand to lose heavily in the exchanges of aerial warfare. For it unfortunately happens that the power of others to inflict damage on us is out of all proportion to our power to inflict damage on them. For the purposes of air attack London, as has often been remarked, is appreciably nearer to Germany or France, than their capitals are to England; and moreover it offers a far more effective target to the raider. The virtual obliteration of Paris or Berlin or any other European capital would not cripple the national resources or paralyse

¹ See *Hansard*, Vol. 192, page 1997.

AIR TRANSPORT

the national effort to the same degree as would the virtual obliteration of London, the political and financial capital of the British Commonwealth, and the focal point of its commercial and economic life. And there is not only London to consider. The northern half of our island consists of a network of mining, shipping, and manufacturing centres, and this concentrated area of industrial activity is within almost as easy reach of hostile aircraft as London itself. In wartime the whole becomes a vast munition workshop, so that a hit almost anywhere on the target is likely to be of military value.

In fact, so devastating could an air attack be made, provided the enemy were equipped with sufficient machines, that within perhaps one week all the major towns of the country, including London, might cease to exist as organised communities. I know that many persons, including the older generation of naval and military officers, will say that this picture is grossly overdrawn, and will refer to the lessons of the last war, instancing the fact that the Germans had to throw thousands of tons of gas-shells into so small a place as Armentières before it became untenable, and that the long range bombardment of Paris was more of the nature of a "stunt," than intended as a serious military operation likely to produce material results. Against this opinion, however, and as indicating the necessity of making our analysis as to future possibilities upon a basis of fact and not upon the experience of conditions no longer relevant, I would quote the words used by the late Marshal Foch in a recent public address:

"I must impress upon you gentlemen to forget the last war—not to imagine that the next one will begin where that one left off. The next war will be as completely different from the last as the last one was from the one before."

THE WORLD, THE AIR AND THE FUTURE

The facts lost sight of are these. To begin with, in the last war, the carrying capacity of aircraft was infinitesimal as compared with that of the big flying boats now contemplated and likely to be ready in the comparatively near future. Then, too, the damage done by a given weight of projectile as fired from a gun is in no way comparable with that which could be done by the same weight of bombs dropped from a flying machine. The reason is that the charge of gas or burster of a projectile as fired from a gun is seldom more than 7.5 per cent. of the weight of the projectile, whilst the charge of burster of a bomb may be as high as 90 per cent. of the weight of the bomb. In the case of the projectile, the main portion of the weight has to be given up to the metal shell in order that it may withstand the stresses imposed upon it when being fired, whereas in the case of the bomb, gravity takes the place of the gun, and the shell has to be made merely strong enough to retain the burster. It may be calculated, therefore, that the total bursting charges of all the projectiles carried in a modern battleship would not amount to more than about fifty tons, or the equivalent weight that five flying boats could carry.

Again. It has been estimated that two thousand tons of poison gas¹ dropped over London would bury that city in a solid blanket of gas of sufficient thickness to reach to the roofs of most of the houses. That amount could be dropped in one night by two hundred flying boats.² The actual cost of these flying boats would be perhaps some fifteen million pounds or the

¹ The principal Powers have just signed a Protocol prohibiting the use of poison gas in war. In the present state of the world, however, such agreements have no finality. Vide *infra*, pp. 157 et seq.

² I am not dealing here with such questions as, how deadly the gases can be made, or whether it is possible to invent an infallible gas-mask, or whether adequate measures of defence will not be invented some time

AIR TRANSPORT

cost of two battleships. So the provision of such a number is well within the capacity of many countries. Then take the question of distance. I deal in a later chapter with the commercial range of such craft; the military range, however, is quite another matter. Commercial craft having to keep to a time-table must necessarily fly in adverse conditions; military craft, especially when acting as an independent arm in long distance air-raids, can select a favourable time for attack, and this makes the military range quite double the commercial range. The flying boat we contemplate as being produced in the not too distant future—within ten years perhaps—will have a range of 2,500 miles, allowing 1,250 miles each way for the journeys out and back. This will bring London and other large towns of Great Britain within striking distance of bases in Germany and Russia, and if, in another war, these two countries were allied against us, German bases could be used by Russian aircraft, and the dangers to this country from their combined air forces can well be imagined. I do not want to elaborate the possibilities of aerial warfare between highly civilised and contiguous countries. Much has been said and written on that subject by better informed and higher authorities. My only purpose in going into the question thus briefly, is to emphasise the mistake of basing our defence calculations upon data that are already obsolete. Any future war between Great Britain and a continental Power must be fundamentally different both in scope and in

in the future. I am concerned only to emphasise the possibility of such a happening so as to establish the fact that even if the Channel were full of battleships and millions of British troops were protecting London, the whole economic life of the nation could nevertheless be disorganised, and the means of nourishing and sustaining our armed forces effectively destroyed.

THE WORLD, THE AIR AND THE FUTURE

character from the last war, and if we continue to spend money upon defensive measures that are now out of date, not only shall we fail to gain the security we desire, but we shall be wasting economic resources that could be applied to a more useful and profitable purpose in other directions.

Aircraft then have put an end to our invulnerability and made us, in respect of their own specific activities, the most open to attack of all the Great Powers; and seeing that their potency as engines of destruction will be one of the deciding factors in any future war, it must be admitted that from the point of view of the safety of this island, their invention has been an unmitigated evil. Our psychological attitude towards war and the problem of war has undergone a complete transformation. We are not, as a nation, given to panic or alarmist fears. We do not dwell in constant terror of bogies raised by our own imagination. Yet the fact remains that the placid equanimity—the over-confidence perhaps—bred in us through the centuries by our sense of security, is fast giving way to a feeling of restlessness and disquietude in view of our perilous position in the face of air attack. We contemplate with ever-growing alarm the appalling horrors that await us in any war of the future, and there is danger of our becoming hypnotised by the sense of our peril.

One sign of this hypnotism is our short-sighted and unthinking policy of trying to fortify ourselves against the air peril by the building of air armaments—a policy which has been shown to be futile from every point of view. There is also the danger—though it has not manifested itself so far—of our developing a war mentality, and of our very fear of war precipitating the causes of war, as has so often happened in continental countries. On the other hand, of course, our

AIR TRANSPORT

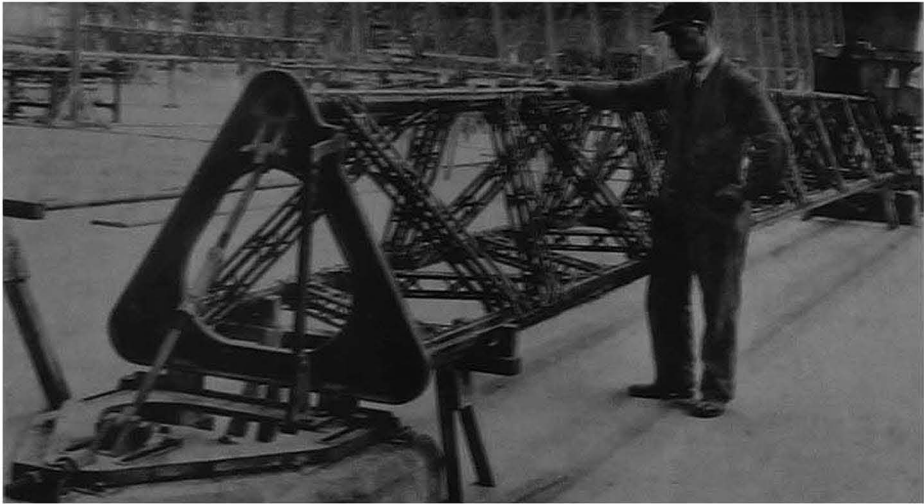
sense of danger may lead to happier results and induce us to work more whole-heartedly than ever in the cause of International peace; and in view of our national temperament and the trend of the age, this is the more likely contingency. However that may be, a rude shock has been administered to our nervous system, which is bound to have a disquieting effect on the national psychology, until we have re-adjusted ourselves to the changed conditions. Accustomed for so long to regard our immunity from attack, and our commanding position among the nations as part of the providential order of the universe, we have suddenly come to realise that our greatness is after all not a law of nature, but a fact of history, and as such, subject to the vicissitudes of the historical process; or, in other words, that those geographical factors on which our greatness was built up, are being rendered comparatively ineffectual as a means to preserve it, through the adverse workings of historical and scientific forces.

This all sounds very pessimistic: and pessimistic we are bound to be, until we can evolve a sound theory of defence to meet the new danger. Unfortunately this demands a revolution in fundamental principles which this country is always unwilling to face. So far our ruling authorities have run away from the problem, instead of trying to grapple with it in a realistic and scientific spirit. Year in and year out, it forms the subject of interminable discussions in Parliament, and probably more solid thought is now being given to the question of national defence than at any previous period of our history. All this thinking, however, remains barren and inconclusive, for the simple reason that the approach to the problem is fogged at the outset by departmental prejudices and differences of outlook. A question of urgent national import, which demands the intelligent co-operation of the best brains in the country

THE WORLD, THE AIR AND THE FUTURE

is treated as though it were a departmental issue, and left to be wrangled out between the Admiralty, the Air Ministry, and the War Office. Each of these Departments looks at the problem from the angle of its own interests or traditions, with the result that the fundamental issue is lost sight of in a muddle of irrelevant controversy.

We shall have more to say upon this point when we come to deal with the question of the administration of our air service; for the moment we will leave it and concentrate our attention on the essential nature of the problem to be solved. And the best method of approach is to examine it in relation to what has been the fundamental factor in the building up of our Imperial greatness, namely our possession of the sea-centrality of the world. What is the relation of Air Power to Sea Power? To what extent does the advent of aircraft threaten to destroy the advantages of sea-centrality? How far does it constitute a direct challenge to the exercise of naval security? Does it or does it not sound the death-knell of that security? These are the questions that agitate us to-day. And they are vital. If, however, we bear in mind that no orientation of our policy is worth a moment's consideration which does not base itself on the fact that, so long as this country endures, the secret of whatever power it has must always lie in its possession of the sea-centrality of the world, we shall formulate these questions rather differently. We shall frame them from a maritime standpoint. We shall ask ourselves how far it is possible to preserve the historical significance of our sea-centrality amid the changing conditions of the modern world; how far we can protect our Naval Dominion against the challenge from the air; and, most important of all, whether it may not be possible to enlist as an ally to Sea Power this new hostile power which seems at first



R.100. One of the Girders being erected in the jig



R.100. A Spider Joint

AIR TRANSPORT

sight destined to destroy it? Let us see if we can find a satisfactory answer to these questions.

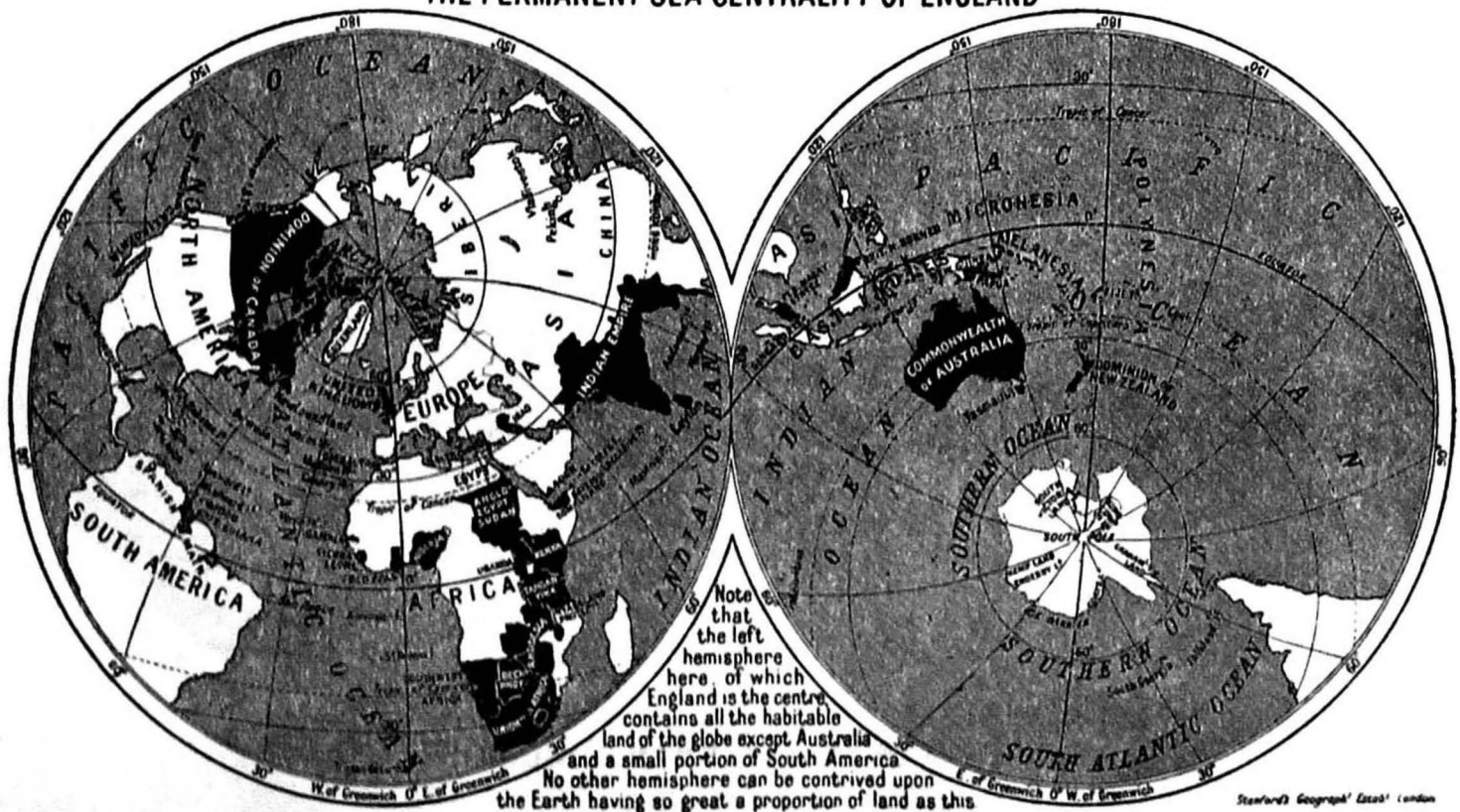
§ 3

The possession by England of the sea-centrality of the world is a geographical fact "written for all time upon the very surface of the globe." The fact is incontestable, but few people have troubled to analyse its real import. Equally incontestable, though even less widely appreciated is the fact that she enjoys a position of land centrality as well. This has been pointed out by my friend, Mr. George F. S. Bowles, in *The Strength of England*, where he shows that if the map of the world be divided into a land hemisphere and a sea hemisphere England will be found at the central point of the land hemisphere, which contains all the habitable land of the globe with the exception of Australasia and the extreme southern portion of South America. The island of England therefore "lies wholly in the sea and yet at the precise centre of all the land of the earth. No other spot upon the globe either fulfils or can ever be made to fulfil those two conditions. Turn the globe as you will, contrive and consider as you please; in the end the hard geographical fact will remain that England, alone of all the communities of men, has the sea-centrality of the world. And having it she must ever retain it. For the shape and extent of the land hemisphere of the globe are now for ever fixed."¹

Herein then, lies the secret of England's enduring greatness. To her unique geographical position, she has owed her historical invincibility, her commercial supremacy, and her world-wide dominion. That this is so admits of no dispute. The fact, however, is not

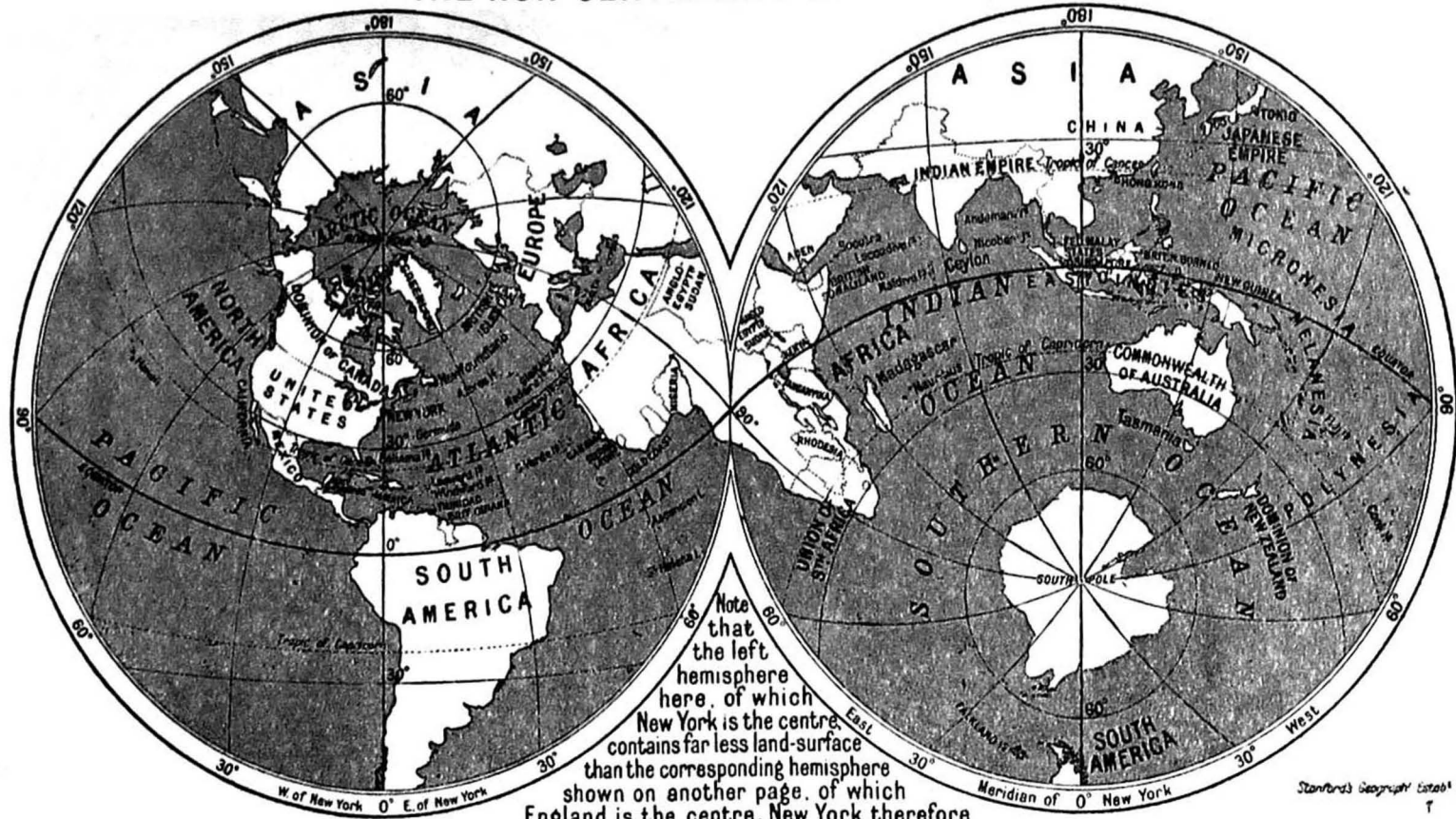
¹ *The Strength of England*, by George F. S. Bowles (Methuen), page 18.

MAP OF
THE WHOLE WORLD OF TRADE
SHOWING
THE PERMANENT SEA-CENTRALITY OF ENGLAND



Note that the left hemisphere here, of which England is the centre, contains all the habitable land of the globe except Australia and a small portion of South America. No other hemisphere can be contrived upon the Earth having so great a proportion of land as this.

MAP SHOWING THE NON-CENTRALITY OF NEW YORK



Note that the left hemisphere here, of which New York is the centre, contains far less land-surface than the corresponding hemisphere shown on another page, of which England is the centre. New York therefore can never occupy the centre of the trading world.

THE WORLD, THE AIR AND THE FUTURE

generally recognised even by England herself. We have indeed a hazy notion that we are favourably situated for the exercise of sea power; but that is all. Few of us have a clear grasp of what sea-centrality really means; of how it has functioned historically and why; and of all that its possession has meant and still means to the people of this country. The whole question is dealt with in all its aspects by Mr. Bowles in the opening chapters of his book, from which I have just quoted, and readers who wish to arrive at a clear understanding of the full significance of sea-centrality would do well to consult his masterly analysis. In the following paragraphs I cannot do more than touch the subject in broad outline.

It is a fact of history that great and enduring International strength, that is to say, the exercise of world-power over a period of centuries, has invariably been accompanied by sea-centrality. Broadly speaking, perhaps only four nations can be said to have achieved a world-power of this kind; Babylonia, Egypt, Rome, and Great Britain, and if we analyse the power of each we shall find, amid many differences, two striking points of similarity. These nations differed in race and religion, in their natural resources and in the character of their inhabitants. They grew up under different physical and climatic conditions, and the methods by which they achieved power were in no two cases the same. Two factors, however, they all had in common. Each was situated on the sea, and each was the centre of the then existing trading-world. And we shall find further, that as the centre of trading shifted, so did the focus of power.

These coincidences are too remarkable to be mere matters of chance, and the lessons they point are strikingly borne out by the course of European history. The international strength of Spain in the sixteenth century

AIR TRANSPORT

synchronised with the possession of sea-centrality that the discovery of the Americas and the sea-route to the Indies gave her. She lost her maritime supremacy (and with it her power) partly because her statesmen had not the vision to grasp its significance, and partly because her situation was not altogether favourable for its exercise. Portugal was better situated and also wiser. For a brief period first Portugal, and then Holland, held the central position of the trading world; and for so long as they did so, those small countries enjoyed an international power and prestige out of all proportion to their size and population. But neither could compete with Britain, who was slowly beginning to realise the implications of her advantageous geographical situation, and into whose hands the sea-centrality of the world now passed as by a natural process. Another illustration is afforded by France who, though for two centuries the dominating power on the Continent, was never able to build up a world Empire or even to consolidate her strength in Europe owing to her lack of sea-centrality and her consequent inability to cope with the naval power of Great Britain.

But what precisely do we mean by sea-centrality, and what are the advantages it confers on the country that has it?

In the first place, easy access to the sea means easy communication with the outside world. The sea is a universal, a cosmopolitan, and one might almost say a synthetic element, for it serves to promote trade and intercourse between peoples, and to unite them by means of a mutual exchange of the fruits and blessings of civilisation. Hence seafaring nations are less provincial and more progressive than those that have no sea-board; they have wider horizons and are better able to extend their influence and develop their national assets,

THE WORLD, THE AIR AND THE FUTURE

Secondly, transport by water is far easier than transport by land and infinitely cheaper; and so it is that all through the ages the sea rather than the land has been the high road of trade. Not even the invention of railways or the improvement of road transport during the last century has altered this fact. And the reason for this is simple. "It is that in all forms of transport by land, the laying, and above all, the maintenance of the road itself have at last to be paid for by the traffic carried, whereas the great road of the sea, unlimited in breadth and carrying power, and stretching in unbroken continuity to the farthest ends of the earth, requires no laying or maintenance whatever and needs merely to be used. This difference is irremediable and eternal; and must always render the sea a wider, longer and far cheaper road for trade than any that can be contrived upon the land surface of the globe."¹

Some striking figures showing the enormous disparity in cost between land freight and water freight were given by Mr. Walter Runciman in his Presidential address to the Chamber of Shipping of the United Kingdom on February 19th, 1926. "We carry ore from Algiers to West Hartlepool, a distance of 1,900 miles for 6/6 per ton. That same ore carried from West Hartlepool to Darlington, a distance of 15 miles, costs the ironmaster half as much as he paid for its voyage across the high seas; while from West Hartlepool to Leeds—a distance of 65 miles—the railway rate is 6/2 or practically the same as the sea-freight for 1,900 miles. We bring grain from Buenos Aires to London at 12/9 per ton, a distance of 6,294 miles, but for the shorter run of 66 miles from London to Northampton the Railway Companies charge 14/- from station to station."

From these considerations it is easy to see that quite

¹ Bowles, *op. cit.*, page 24.

AIR TRANSPORT

apart from any question of a colonial Empire, a state that stands at the point where the sea-routes of the world's great trading nations meet and cross, will have opportunities of commercial and economic development such as other states cannot possibly possess. The natural accompaniments of such a position are admirably summed up by Mr. Bowles in the following passage:

"There should be seen in unmistakable daily action the central spring of that vast economic power by which at last the movements of men, and even their existence, must ever be controlled; a thronging population, great and teeming cities; dense traffic in the streets; docks and warehouses filling at every tide with the infinite products of the earth; a ceaseless commerce embracing the whole world, spreading by sea to wherever the sea can reach and increasingly fed and fostered by all the communications of the land; bankers holding in trust for the most distant nations those ultimate credits upon which their economic strength depends; insurers taking in pre-eminent degree the final burden of the risks of fire, flood and disaster throughout the world; a machinery of credit at once wary and light, steadily endowing even the most distant trade, with so much as it needs of central stability and strength; and with all these, over them all, and alone rendering them practically workable a rule of calm, settled, and impartial law administered with an even hand to stranger and native alike."¹

This picture is not overdrawn. It describes exactly the part played by sea-centrality in building up the strength of England. For the story of England's development is as it were the epic of sea-centrality.

¹ Bowles, *op. cit.*, page 29.

THE WORLD, THE AIR AND THE FUTURE

To it she owed the discovery of her own destiny. It has been the source of her wealth, the secret of her power. On it she has built up the greatest commercial and maritime Empire known to history. Further, owing to a variety of causes both geographical and historical, no other country has been so favourably circumstanced for the exercise of its numerous advantages. Altogether then, her history may be taken as illustrating in supreme degree the manifold virtues that lie in its possession.

Her case is fundamentally different from that of the three great Empires of the Ancient World. These were land Powers as well as sea Powers, and it is at least arguable that maritime supremacy was in their case as much the result as the cause of Empire. Egypt and Babylonia, for example, were essentially continental Powers. They possessed sea-centrality, and so were enabled to consolidate their power over a number of centuries; but the original basis of that power was territorial dominion; and it was their land strength—or so it may be argued—that enabled them to dominate the seas and to utilise to the full the advantages that sea-centrality gave them.

The case of Rome is particularly instructive. Though Italy is the trading centre of the Mediterranean, the Romans were never a maritime people. When Rome entered on her life and death struggle with Carthage for the control of the Mediterranean, she had no sea experience and no fleet. She met the emergency by improvising ships in which her troops could use the fighting methods of land warfare. It was a triumph of efficiency. She secured control of the seas in the first round of the contest; and when the struggle was renewed fifty years later, it was her preponderance at sea that enabled her to turn defeat into victory, and to wear down the strategy of the greatest military

AIR TRANSPORT

genius of antiquity. Had the Carthaginian fleet controlled the Mediterranean, nothing could have saved Rome after Cannae; on the one hand, a constant supply of troops would have reinforced Hannibal's army in Italy, and on the other hand, Rome would have been unable to carry on the struggle in Spain. As it was Rome could combine her military operations, Carthage could not; and though, throughout the fifteen years during which the war lasted, there was no naval battle of importance, it was to sea power that Rome owed her final victory in the struggle. Having crushed her rival, the Roman Republic proceeded to build up an Empire round the shores of the Mediterranean, which she soon converted into a Roman Lake. Her maritime and economic supremacy was therefore absolute, as no new sea Power could possibly arise to dispute it; and to this fact is due, in great measure, the remarkable permanence and stability of the Roman Empire. The Empire survived as a geographical idea for centuries after it ceased to exist as a political fact. Indeed its theoretical existence endured until the sea discoveries of the fifteenth century redrew the map of the world and thus gave a new orientation to European politics. The point to notice, however, is that Rome developed her strength on land. She dominated Italy and was already the great Power in the Mediterranean world, when she suddenly found herself face to face with the great problem of sea power.

Thus neither Babylonia nor Egypt, nor even Rome, can be said to illustrate the absolute virtue of sea-centrality, in the same way as Great Britain, who until she was brought into the sea-centrality of the world, was a third-rate power on the outskirts of Europe, out of touch with the main currents of European affairs, and in no sense a dominant factor in International politics.

THE WORLD, THE AIR AND THE FUTURE

Then, too, the sea-centrality of each of the Ancient Empires was relative to a world that was only in part discovered. It functioned within the narrow limits of a civilisation that covered only a fraction of the habitable globe; and as the map of civilised man grew larger and larger, the centre of the world's trade naturally shifted from point to point on the larger map, and with it the focus of power. The sea-centrality of England, however, being relative to a world, every portion of which has been discovered, is absolute, and operates on what is potentially an enduring basis. On the other hand, though her sea-centrality not being conditioned by geographical limits, is in that sense absolute and permanent, this is not to say that England must always be at the centre of the world's trade. Here, I think, we must make a distinction between sea-centrality and trade-centrality. Sea-centrality in a general sense is indeed her inalienable possession; but its value may be lessened. It is always possible for some great nation to develop a trading power equal to that of the rest of the world; in which case the relative values of geographical areas will be altered, and the virtual centres of trade will be shifted accordingly. Such a power is already developing in the United States of America, and I shall return to this aspect of the matter in a moment.

Another point to be considered, is the central position occupied by England at the sea-gates of Europe. As a glance at the map will show, England commands the commercial gateways of the Atlantic coast. All merchandise going to and from Northern Europe must pass along the English Channel or between the Orkneys and The Naze; and this means that England's sea-centrality functions in Europe as well as in the outside world.

Finally, there is the all-important point that by the configuration of her coast line, England is able to utilise

AIR TRANSPORT

to the full the economic advantages her geographical situation gives her. In proportion to its extent, her coast line possesses a greater profusion of natural harbours than that of any other European country.

“Let any seaman, for instance, compare the harbours of England along the northern shore of the English Channel with those of France along its southern shore. The difference is striking in the highest degree; and no seaman needs to be told what that difference implies. It means that trade entering the European gates by way of the English Channel will ever tend to use the ports of England rather than those of France. It is at Falmouth and not at Brest, that ships call for orders as to their destination on the European range; and this preference for natural harbours, and against artificial and tide-bound basins, operated from the first as strongly as it does to-day in reinforcing the position of England as the chief magnet for sea trade in Europe.”¹

For three hundred years Great Britain has enjoyed the sea-centrality of the world and of Europe, and the story of her expansion from one of the minor states of Europe into the greatest commercial Empire of all time, has been one long commentary on the far-reaching significance of its possession. The profound influence exercised by her maritime supremacy on the course of history may be studied in the pages of Mahan's classic work. What mainly concern us here are the lessons to be drawn therefrom.

Before we go into these lessons, however, one preliminary point must be strongly emphasised. In speaking of sea-centrality as the basic fact of England's greatness, we must not forget that certain other economic

¹ Bowles, *op. cit.*, page 46.

THE WORLD, THE AIR AND THE FUTURE

factors that were working with it and which it enabled her to utilise so successfully, have ceased to operate to anything like the same degree, owing to the development of the world's industry. Formerly, besides being the world's market-place—the result of our centrality—we were also the greatest manufacturing nation. We could turn out manufactured goods under conditions that gave us a definite economic ascendancy in the world, and enabled us to build up a gigantic export trade. Now, however, that other industrial Powers have grown up, some of them—notably the continental organisation of the United States—with far greater productive capacity than our own, a great part of this trade has been lost. Clearly therefore the sea-centrality which gave us our commercial supremacy, has not enabled us to retain it.

Both the issue and its solution are, I think, plain, and may be stated thus. Owing to her geographical position and a combination of other favouring causes, this small island was able to develop an amazing economic strength, and to establish a commercial Empire of infinite potentialities; but the very greatness of the position she has achieved requires a proportionate energy to sustain it. And this energy must be an Imperial energy. The salvation of England, as I have insisted over and over again in this book, lies in the Empire. If she is to retain her position in the world, she must sink her own entity in the larger unity of the Empire. Alone she can compete with neither the economic nor the belligerent strength of some other countries; as the predominant partner in the British Commonwealth, she has it in her hands to mould an Imperial Power whose consolidated strength will be greater than that of any other organisation in the world. If only our statesmen would realise this fundamental fact and act upon it! All over the world there are units of economic power

AIR TRANSPORT

developing, that have either surpassed or must eventually surpass the economic capacity of this small island of Britain; and there is imminent danger of the focal centre of trading power shifting accordingly. Already, the centre of gravity of the world's trade is being drawn away from London to New York; and it is not England by herself, but the Empire as a whole that will be able successfully to resist this process.

Consider the significance of the enormous increase in America's buying power. "America's buying power," said Mr. Andrew Mellon, Secretary to the United States Treasury, "is one of the most important factors in Europe's recovery and future progress. . . . Although we have in this country less than 7 per cent. of the world's population, we consumed last year 48 per cent. of the world's total production of coffee, 53 per cent. of the tea, 56 per cent. of the crude rubber, 21 per cent. of the sugar, 72 per cent. of the raw silk, 36 per cent. of the coal, 42 per cent. of the pig-iron, 47 per cent. of the copper, and 69 per cent. of the crude petroleum. Furthermore, we had twenty-three million out of thirty million automobiles in the whole world. That is some measure of what American buying power means, not only to ourselves, but to European debtor nations and to the entire world."¹

Meanwhile we see our own industrial position weakening from year to year, and our national strength dwindling away; and we do nothing to stop the rot. We adhere with sickening persistence to a pedantic policy of free trade which worked excellently well in the nineteenth century, when we were protected by the fact that we owned the majority of the world's factories, but which has no meaning or value for our time. Our statesmen

¹ *Evening Standard*, November 27, 1928. Report of an interview granted by Mr. Mellon to the Washington Correspondent of that paper.

THE WORLD, THE AIR AND THE FUTURE

make long speeches about the need of "rationalising" British industry, but hardly any of them have the courage to say straight out that rationalisation really means protection and reconstruction on an Imperial basis. Mr. Baldwin sees the issue clearly, but the election pledges forced on him by the party caucus prevent him from boldly advocating a policy likely to upset that large portion of the British public which clings with such strange infatuation to the fetish of free trade. The rest of our statesmen shirk the question, save only Mr. Amery whose prophetic zeal as an apostle of Empire is for ever getting him into hot water with his less imaginative colleagues in the Cabinet,¹ and who tells British Industry to its face that the basis of its rationalisation and reorganisation must not be confined to this little island with its limited markets, but must be extended to the trade markets of the British Empire with its infinite latent possibilities.²

To return now to the lessons to be drawn from our maritime history. How far can the study of our growth in sea power help us towards arriving at a solution of the air problem that now faces us? Is there any parallel between sea-development and air-development? Between sea-centrality and air-centrality? Does our commanding position as the trading centre of the world give us any advantage over our neighbours in the development of air-centrality, and if so how can we best use this advantage?

The first lesson that the story of our sea-development teaches us is this; we owe our one time maritime supremacy to our unique geographical situation rather than to any dazzling merits of our own. We are not forgetting the skill and daring of our seamen, the glory

¹ Since the above was written there has been a change of Government; but whether this will mean a change of policy remains to be seen.

² See for example Mr. Amery's speech at Annual Dinner of the London Iron and Steel Exchange. Nov. 27, 1928. *Times* report, Nov. 28.

AIR TRANSPORT

of our naval exploits unmatched in the annals of history, or the enterprise of our colonial explorers. But is not this very seafaring spirit on which this country justly prides herself, part of her geographical heritage? The point I want to insist on, however, is that our rise to Empire depended in very small degree on any conscious direction of our national policy. "The English," said Seeley a generation ago, "conquered and peopled half the world in a fit of absence of mind." Rarely has our statesmanship in the past visualised all the implications of sea power; and never in the unconscious process of Empire-building has the mind of one generation taken count of the problem of the next. We muddled through every crisis in our history and always we came out on top. We drifted into sea supremacy and into the greatest maritime Empire that the world has ever seen, because the flow of the tide was always with us. And to-day we are still drifting. But it is not a policy of drift that will lead us into the dominion of the air. For here, the flow of the tide helps us but little, and there are eddying currents working definitely against us. Our insular position and the configuration of our coast line count for much less in air development than in marine development. It is a field in which we must rely to a greater extent upon our own efforts. Moreover although our harbours may assist us to enjoy the air-centrality of the world by geographical favour so to speak, our position with regard to some aspects of it is no better than that of several other countries, and in others it is not nearly so good.¹ One or two initial advantages (to be specified

¹ Although as pointed out in the latter part of the book, it seems clear that the large aircraft of the future will operate from water, it must be remembered that deep harbours, such as marine vessels use, will not be essential owing to the very small draft of aircraft, and also that inland lakes are just as good for aircraft purposes as Coast Line harbours.

THE WORLD, THE AIR AND THE FUTURE

later) we do indeed possess; but we have several handicaps, such as an unfavourable climate for flying, an isolated position on the edge of the European system, and a small country where short distances make local flying of little practical utility, and so discourage enterprise and impede the development of the air sense.

Second lesson. In respect of sea-centrality, England reaped where she did not sow. That enlargement of the world's trading area which was so to enhance the value of this island corner was the work of others. It was the Mediterranean countries and not England who discovered the Americas and the sea-route to the Indies; and it was Spain, Portugal and Holland who first realised the enormous advantages of the sea-centrality that the new map of the world gave them. England as a nation, most emphatically did not. Our Elizabethan sea-dogs were daring and picturesque pirates and no more. The object of their adventures was to find treasure and incidently to "sing the beard" of His Majesty of Spain. . But while England was gaily buccaneering on the high seas and indulging in all the heady pranks of an adolescent nation that has suddenly found a new field for the display of her native genius, those other nations were building up an Overseas Dominion and engaging in a commercial activity on a scale hitherto undreamt of;¹ and by the time she woke up to the fact of her own sea-centrality she found the trading power of the world focussed in other countries. In the end, it gravitated into her hands for reasons already specified; but it took a century to do so, owing partly to her lack of vision at the start, and partly to her congenital incapacity for constructing a definite national policy on a rational and enduring basis. Here again, the lesson is obvious. The modern world moves more quickly than the world of the sixteenth and seventeenth

¹ cf. Bowles, *op. cit.*, page 42.

AIR TRANSPORT

centuries. To-day's watchwords are speed and efficiency. If we do not make a bid for air-centrality now, it will be lost to us for ever. Or do we expect the world to mark time and wait while England makes up her mind? It certainly will not; nor is it doing so now. Witness the rapid developments of air power in every great country but our own. Not all our blindness and blundering could do more than delay the inevitable advent of our supremacy at sea; but if we fall behind in air power, shall we ever catch up again?

Third lesson. It is not always realised that the re-orientation of trading power that has taken place at certain stages in the world's history, and has resulted in some hitherto unimportant area of the earth's surface acquiring a wholly new value, has as often as not been due to the inventions of science. Several instances may be adduced showing the revolutionary changes effected by science in the orientation of modern trade. Thus the development of synthetic dyes in Germany more or less killed the indigo trade of India; and the development of the German Beet Industry more or less killed the cane sugar trade of the West Indies. And if we turn to this country, we find that a re-orientation due to scientific causes is now actually taking place in our own economic situation. "For instance"—to quote from a speech of mine on the point—"the wealth and prosperity of this country were built up on coal and iron, but the value that the world is giving to these materials is altering. To-day oil is replacing coal. To-day cheap electrical power is supplying and controlling many of the industries which were formerly based on cheap coal power. One-third of our mercantile marine is running on oil and not on coal. I think that any statesman in this country has got to realise that we are to-day undergoing a real revolutionary change in the value

THE WORLD, THE AIR AND THE FUTURE

which this geographical region of England now has in relation to the world as a whole."¹

Looking back now to the dawn of the modern era, we find that the re-orientation of trading power that then took place was likewise due to the progress of technical science. About that time the mariner's compass was first introduced, and a type of sailing ship was devised capable of beating to windward; and it was the combination of these two inventions that gave Europe new worlds to trade with and enabled it to convert all the seas of the earth into highroads of commerce. As a result, the economic value of Great Britain's geographical position was at once changed, and from being a comparatively unimportant island on the edge of civilisation, she became the very nerve-centre of the world's trading system. Here surely is something for those who are grappling with the air problem to reflect on. Must we not try to find out what it is that will give us in regard to the air a position equivalent to that which the mariner's compass and the ability to beat to windward gave us in regard to the sea? Our course is clear. Only one thing can perform for us this office. It is the development of machines, whether they are lighter-than-air or heavier-than-air, which will give us a sufficient economic range of action to reach out to the outer Empire and the Americas.

Fourth lesson. It has been well said that "the reason why England was for centuries the mistress of the seas was because the English were always on the seas."² These are wise words, and we shall do well to give them heed. We are an island people and the sea is our natural element. Throughout our history the sea has been the inspiration of our national life and the guardian

¹ *Hausard*, vol. 171, page 695.

² The Earl of Halsbury, K.C., in the *Sunday Express* of August 19, 1928.



R.100 The Interior, facing passenger quarters, and showing corridor (uncovered) on right

AIR TRANSPORT

of our destinies; and over the broad plains of the sea we furrowed our way to Empire. But if it be true that it was only our genius for the sea that enabled us to reap the full value of our geographical position, the converse is equally true. For it was not until the era of our sea-centrality that we began to develop those sea-faring qualities that have been the envy and admiration of the world. The spirit was there, but it was the opportunity provided by the new order of things that gave us the inspiration. Henceforward sea power worked like a magnet on the life-force of the British nation. It became the term of all her endeavours. The vitalistic principle of her organic development together with the workings of all historical forces compelled her to be always on the seas; and being always on the seas, she not only assumed the dominion of the seas but at the same time developed a sea psychology which has made her the greatest maritime people in all history.

Now what is true of sea power is equally true of air power. If the English are to take their place in the air, they must always be in the air. Only so will they develop an air sense, an air psychology; nay, only so will they acquire this sense and this psychology. And here is where the difference comes in. Flying is not the national endowment, as is seamanship. The air is not the natural element of this country or of any other country. It is likely, of course, that a nation of born seamen will produce good airmen as well; still, as regards the acquisition of the air sense, we start at zero-point as does every other nation. Whereas, however, other nations are working hard to acquire it, we have not yet begun to think about doing so. We adopt the short-sighted and parochial attitude that because the narrow area of this country makes civil flying of little use as a means of internal communication, we can afford to neglect it altogether, and we give no heed to

THE WORLD, THE AIR AND THE FUTURE

all those Imperial, International and Defence issues that are crying aloud for its intensive development. Thus flying with us is still an adventure. In other countries it is becoming a habit. In Germany, for example, the air habit is now almost second nature. Germans are always in the air, and the more they fly the more they will fly. Already they have established themselves in the air-centrality of Europe, and they are making a determined bid for the air-centrality of the world. Their network of airways crosses the whole of Europe, and is extending to Asia; and they are taking advantage of our backwardness to put forward proposals for the development of air routes within the British Empire. So alive are they to the significance of air transport that they are now having the technical principles of aeronautical science taught in the schools. Nor is Germany the only country that is outdistancing us in air development. A comparison of figures shows that at the present time Great Britain does less flying than any other great nation. Germany flies nearly seven million miles a year; America flies five millions, and France three and a half million. The air miles flown by this country have dropped below a million, and are exceeded by both Italy and Russia. Again, the commercial air route mileage of Great Britain is roughly 2,000;¹ the United States has 13,000, France 12,000, Italy 3,000, and Germany 18,000. We do not even control our air routes to the Continent. In flights between this country and the Continent in 1927, foreign machines outnumbered British machines by nearly a thousand arrivals and departures. And what is the result of our apathy? Merely this: That while other countries are familiarising themselves with air travel, and taking it as a matter of course, our attitude towards

¹ The opening of the Indian route will increase our mileage by another 5,000 miles.

AIR TRANSPORT

it is still that of gaping provincials. It is an ignominious position, damaging to our prestige and of ill-omen for the future.

And the irony of it all is that we possess two initial advantages which, if we showed any of the grit, energy, foresight, and will-to-power that are to be looked for in a great people, would make us the natural centre of the air-world. One is our economic position, after three centuries of sea-centrality, as the ground landlords of the business centre of the world. What more natural, therefore, than that the centre of a new system of communications should be focussed at a point where the business centre of the world has been for so long established? The other is the existence of the Empire, which provides us with the ready framework for building up a comprehensive system of airways that would dominate the air routes of the world. The first of these advantages might be non-existent for all the use we have tried to make of it; and the second we are fumbling away in a sort of paralytic seizure at the thought of the tremendous effort needed to develop it, as it ought to be developed. As usual we are waiting on events, while other countries are anticipating them.

In the course of our brief historical excursus we have established the following conclusions:

1. That the possession of sea-centrality is a *sine qua non* of enduring Empire;
2. That the International importance of England dates from the time when the re-orientation of the trading world shifted this centrality into her hands;
3. That the possession of sea-centrality has been the energising force and sustaining power of her whole economic and Imperial development;
4. That whereas England's sea-supremacy was the result of her geographical situation, she will have to

THE WORLD, THE AIR AND THE FUTURE

rely entirely on her own efforts if she wishes to achieve anything like equality with other nations in the air.

Let us now try to answer the question how far British sea power can meet the challenge of air power. Can it, or can it not, meet this challenge? And if it can, how are we to establish an effective working relationship between the two powers?

§ 4

The relation between Sea Power and Air Power has formed the subject of much heated wrangling between Naval and Aviation experts; and I may say at once that the more extreme views put forward by both sides seem to me to be equally fallacious. I entirely disagree with the hidebound traditionalists of the Blue Water school who think that because the Navy has hitherto held sole responsibility for the defence of these islands and the Empire, it must always continue to do so, and whose jealousy of the new power causes them to underrate its significance; and I disagree equally with the advanced school of Air thought which takes the view that Navies are out of date, and that we should devote such expenditure as may be available for defence purposes almost exclusively to the Air Force. I think that both schools of thought are egregiously wrong. I criticise the first because it refuses to face facts; the second because it over-rides them.

None the less each school builds up its arguments on what is fundamentally a sound position—otherwise, of course, the problem would not present such immense difficulties. The Navy argues, and, I think rightly argues, that the greatest asset of Great Britain is her sea-centrality; that sea power is, has been, and always must be, the basis of her strength, the ultimate guarantee of her security; that any weakening in her control of

AIR TRANSPORT

the waters necessarily means the decline of her economic power and the dissolution of the Empire. So far so good. Where it seems to me to go wrong is in continuing to theorise as though the advent of aircraft had made no difference in the exercise of its functions; in refusing to face the fact that the days when the Navy could accept sole responsibility for the defence of these shores have gone forever, and that the development of aviation means, within limits, a gradual substitution of air power for water power and, as a consequence, the gradual transference of the functions and responsibilities of the fleet to the air service. It is right in its insistence on the paramount importance to us of sea power now and for all time; it is wrong in its evaluation of the instruments that are going to sustain it.

The error of the opposing school is that it claims far too much. It is right I think in its view that for the future, air power must be the ultimate criterion of a nation's belligerent strength. It is right when it argues that sea-centrality and sea-supremacy are henceforward of no account unless a large measure of air-centrality and air-supremacy be conjoined therewith. It is right, when it claims that many of the functions now performed by the Fleet could be better performed by the Air Force, and that every increase in the potentialities of aircraft means a corresponding diminution in the functions and responsibilities of the Navy. But surely it far outdistances any reasonable development that may be looked for in air power, at least in our time, when it pursues the Navy to its virtual extinction! The fact that aircraft are becoming increasingly able to do the work of naval craft does not necessarily mean that they will one day be able to replace the Navy altogether. We have still a long way to go before aircraft will have developed the carrying power, the range of action, or the reliability of movement to enable us to

THE WORLD, THE AIR AND THE FUTURE

dispense with a surface fleet. That day may one day come, but it is certainly not yet—though to hear some of our air enthusiasts talk, one would think that the aeroplane had already relegated the Navy to the scrap heap.

A point that undoubtedly complicates the issue between the two schools, is the fact that there is really no difference between the Navy and the Air Force in their several functions.¹ As compared with the Army which is a holding force, they are essentially carrier forces made up of self-contained machines which act independently and whose main function is transportation. The work of the Naval fleet is to secure the safety of our mercantile marine, to deny the seas to that of the enemy and to transport men and material from place to place. It can attack and cover, but it cannot hold a position. An air fleet performs the same functions. Consequently as our aircraft get bigger and bigger, and their transport capacity increases, the more they will become in essence like naval vessels.

For instance, a fleet can shell a coast town, but a fleet convoying, supplying and co-operating with giant flying boats can bomb a town 500 miles inland. It is sometimes argued that, since the merchandise of the world will always be carried in marine vessels navigating the surface of the seas, the type of craft which protects or attacks the mercantile marine must also travel on the surface of the sea. This is a fallacy. One might as well say the submarine that travels under the sea surface cannot be used either to attack or to protect a merchant vessel, as argue that the aircraft that travel over the surface of the sea cannot do so. If, in time to come, aircraft become so fast and powerful that they can destroy naval vessels more easily than naval

¹ See my speeches in the House of Commons on July 31st, 1924 (*Hansard*, Vol. 176, page 2346 et seq.) and on March 12th, 1925 (*Hansard*, Vol. 181, page 1604 et seq.).

AIR TRANSPORT

vessels can destroy them, we shall witness our mercantile marine being protected more certainly by aircraft than by sea craft. The important point to emphasise, however, is that the duty these aircraft will have to perform is identical with that of the navy to-day. We should merely be substituting a more modern vehicle than a warship as our instrument of attack.

This fact that the Navy and the Air Force perform similar functions adds not a little to the theoretical difficulties of our defence problem; and what is more, it seems to have raised questions of practical organisation which the heads of our fighting departments find it by no means easy to solve.

Perhaps the best way to avoid extravagance in this discussion is to ask ourselves exactly how far the reorientation of defensive power that is now going on has progressed up to date; and then to proceed cautiously on the lines of probable development from that point. It is as unprofitable in this specific matter of national defence to move faster than the times, as it is to lag behind them. What we have to do is to keep abreast of the times, and to move in the direction of the times, always trying to anticipate the next move in the changing situation. It is no good framing theories of the relationship between air power and sea power on a basis of what aircraft may perhaps be able to accomplish in the next generation. Speculations of this kind are interesting, no doubt, and we accorded them their full value in dealing with Empire development; but in matters of defence we cannot afford to look so far ahead. Here we have to proceed from certainties—present or immediately prospective. After all, the most important aspect of the defence problem is always its contemporary aspect. Our efficient strength at any moment is the actual potency of our fighting forces at that moment. Our conception of policy must be determined, not by what

THE WORLD, THE AIR AND THE FUTURE

we believe aircraft will be able to accomplish in the future, but by what we know they can accomplish today. In other words, we have to consider not only the direction of the new orientation but also its rate of progress; and this we must be careful not to exaggerate. We must look ahead of course; but in trying to anticipate future developments, ten years should be the limit of our vision. At the same time it is of vital importance that our organisation should be of such a character that it can expand and adapt itself on pre-conceived lines to administer the weapons we expect to have in the future, and not be so devised that a probable development will, when achieved, require a complete re-organisation of the control and administration of our fighting forces.

Leaving aside speculation, then, let us try to take the measure of contemporary happenings. What, in effect, is the actual relation between sea power and air power at the present time? Or better still—for this is the angle from which we, as the once predominant sea power have to envisage the problem—how far has the value of sea power been modified already by the challenge from the air? To what extent has the Navy had to surrender its traditional positions.

Speaking generally we may say that aircraft have definitely secured the upper hand over sea craft in narrow waters. So much is admitted by all sections of competent opinion. Continuing the work of the submarine and the mine, the bombing aeroplane is driving the surface ship further and further away from the coast on to the high seas; but not yet has it by any means driven it off the face of the waters. The control of narrow waters has indeed passed from naval craft to aircraft; but owing to the small range of action of existing aerial machines the Navy still remains supreme on the ocean spaces.

This is the unquestionable fact of the present situation.

AIR TRANSPORT

With regard to our own specific problem, it means that the defence of the Empire still remains in the hands of the Navy. In its continental aspects our defence problem is mainly a matter of troops and aeroplanes, the protection of our transports being provided by aircraft, or perhaps the transports themselves being eliminated by the construction of the Channel Tunnel. In its Imperial aspect which includes of course our relations with all countries outside Europe, it is still essentially a Naval problem.

Let us now see how the consequence of this fact must determine (1) the conduct of our Naval policy and (2) our conception of air power as a possible aid to the development of that policy.

In the first place, if we admit that the defence of these islands has now passed from the Navy to the Air Force, we must accept what this implies, and reorganise our Naval policy accordingly. It is no use our spending a great deal of money annually on the upkeep of Naval Dockyards at home if the centre of naval activity has shifted from home waters to the outer Empire. A re-orientation of Naval Power means a redistribution of Naval bases. We have to place our ships in the position that is most advantageous from a strategic point of view, and just as we have to redistribute our ships, so must we redistribute the bases on which those ships depend. As time goes on, we shall want very few bases in this country, and eventually one will be enough; but we shall want more and more in different parts of the Empire.

Here the issue is clear enough, but no Government has yet had the courage to face it. I quite upset the representatives of Dockyard Constituencies in the House of Commons in 1924,¹ by daring to suggest that we

¹Debate on the Navy Estimates, May 8th, 1924. *Harvard*, vol. 173, page 675.

THE WORLD, THE AIR AND THE FUTURE

ought to see about scrapping such hopelessly out-of-date dockyards as Chatham and Sheerness. If, I asked, these Dockyards were designed solely for the maintenance of light naval craft, what possible use could be served in spending money on their upkeep, now that light naval craft had ceased to be a factor of importance in the defence of this island. Such stations were now, I argued, a dead burden on the meagre Admiralty Vote, for which it got no adequate return in defensive power; and just as any private undertaking had to scrap its plant when out of date, so had a great fighting department like the Admiralty to scrap its plant, when it got out-of-date.

To point the absurdity of the situation at that time—and it has not changed since—I quoted figures to show that as compared with 1904 we were spending more than twice as much money on Dockyard accommodation for two-thirds of the number of ships. In 1924 we had only forty large vessels in commission as compared with 66 in 1904, yet our dockyard expenditure was £7,000,000 as compared with £3,000,000 in that year. Even allowing for the difference in purchasing value of the pound sterling the rise in cost was sufficient to merit inquiry.

As I suggested in the course of the Singapore controversy, the whole question of establishing a naval base at Singapore was merely an indication of what our future dockyard policy must be in view of the direction that the new orientation of naval power was taking. This, I contended, did not mean the spending of additional money on new bases. We must, I said, transfer Chatham to Singapore, and this could be done by a financial operation. In other words, we must scrap our useless dockyards at home, and as far as possible convert them into commercial ports—Chatham, for example, could be made an extension of the Port of London Authority; and the money so saved could

AIR TRANSPORT

be spent on building new bases at vital points in the Empire.¹

Of course, there is a limit to the commercial uses to which our superfluous dockyards can be put. They cannot as a rule be used for shipbuilding or ship repairing purposes, for the simple reason that their sites were chosen for strategic and not for economic considerations, and many of them are inconveniently placed as regards coal and iron, and all the other requirements of a shipbuilding area. On the other hand they could almost always be turned to profitable uses as ports for handling merchandise; and it so happens that what is now our most useless dockyard from the strategic point of view, is the one best adapted for conversion into a commercial port. Chatham, for example, is really a part of the manufacturing area of London, and by building a tunnel between Gravesend and Tilbury, it could be connected with the transport system of the Port of London.

So much is clear. If, as is admittedly the case, the new orientation of naval power means that our naval arm is going to operate less and less in home waters and more and more in the outer Empire, we shall have to reorganise and redistribute our naval bases to meet the changed situation. The next question we have to consider is this; what area on the world's waters will, in the future, demand the greatest concentration of our naval strength?

Now whatever view we may hold as regards the political wisdom of establishing a naval base at Singapore, there can be no doubt that from a naval point of view the conception is fundamentally sound. For if one thing is certain, it is that the focus of naval power is now situated in the Pacific. In any future world war, it is the Pacific Ocean which would be the centre

¹ *Hansard*, vol. 171, page 1209.

THE WORLD, THE AIR AND THE FUTURE

of big naval operations. And this for many reasons. The two great Sea Powers which share with us the sea-supremacy of the world are both situated in the Pacific; all the great nations of Europe have either possessions or vital interests in the Far East; and finally it is in the Pacific that the British Empire is most vulnerable to attack from the sea. A temporary loss of our Naval supremacy in the water zone of the Pacific, or in the Eastern seas of the Indian Ocean, which, for a naval vision, form with it a single strategic area, would mean the collapse of the whole Imperial fabric.

Let us consider closely what the concentration of our Naval strength in the Pacific means.

A glance at the map will show that the area of waters to be supervised in the Pacific Ocean and its adjacent seas is three times the area we formerly had to supervise in the Atlantic, the North Sea, and the Mediterranean. The new orientation means, therefore, that our Navy will now have the duty of patrolling three times the water surface that it had to patrol formerly. Now it is generally agreed that a Power which aims at predominating as a Naval Power must, in the event of war, have the same control of the large spaces of the sea as of the small spaces. Consequently, if Great Britain is to maintain a sea-strength adequate to the requirements of Imperial Defence, her Navy must be greater than ever before; not because other Navies are bigger, but because other Navies of the same size as before are operating over a much greater area, and therefore the number of auxiliary vessels and cruisers required by our Navy must necessarily become greater in proportion.

It is here, I think, that the Navy must look to air power to assist it. For it will be found that all those duties of patrol, reconnaissance, long-distance scouting, and so forth, which the Navy has to carry out on the great ocean spaces, can be performed more effectively

AIR TRANSPORT

and at a much lower cost by aircraft—and by airships, particularly—than by cruisers or sea-going ships of any kind. The number of battleships this country may build is restricted by the Washington Treaty, and the amount of naval power it can concentrate at any vital point is therefore limited to that extent. But the number of auxiliary craft that may be used in conjunction with capital ships is not limited. Here, however, the question of expense comes in. The cost of constructing and maintaining the large number of similar vessels that would be required to meet the needs of the new orientation would impose an intolerable burden on an already overtaxed country; so that if the Navy had still to rely on surface ships alone for the exercise of its functions, its fighting efficiency would be crippled to an alarming extent and the safety of the Empire would be by so much imperilled. Fortunately it need not. At this crisis in its history, it can enlist the services of a new power to which it can safely entrust precisely that large-scale surveillance work which imposes such impossible demands on its own resources.

Lest I be accused of claiming too much for airships in the sphere of naval strategy, I propose to consider in some detail their uses in this connection, and to enumerate what I conceive to be their chief advantages over surface craft in the work of Naval reconnaissance. First of all a few remarks on the importance of reconnaissance craft generally will not be out of place.

§ 5

“I am distressed for frigates, which are the eyes of the Fleet,” said Nelson over one hundred years ago; and throughout our Naval history this has been the continual cry of our Admirals at sea. But never have light cruisers—the modern counterpart of the 36-gun

THE WORLD, THE AIR AND THE FUTURE

frigate—been more necessary to the defence of our Empire than in the present century.

A comparison of Naval developments during the two greatest wars of our history is instructive.

At the end of the sea-phase of the Napoleonic War, we had doubled the number of our small frigates, and increased our small auxiliary craft from thirty-eight to 246 vessels. On the other hand there was no demand for large frigates, so that in 1810 we had only fifteen as compared with thirty at the beginning of the War in 1793.

We started the Great War with sixty-two light cruisers, and at the end of it we had eighty-two at sea, and twenty-one on the stocks. In 1914 we had 260 sloops and destroyers; in 1918 we had 558. Altogether, during the war our Naval strength was increased by the addition of some 3,000 small auxiliary craft. But here again there was no demand for armoured cruisers which are the equivalent of the old-time large frigates; so that at the end of the war we had only twenty-seven exclusive of those building, as compared with forty-six in 1914.

Both wars point the same lesson. That such a great increase in light cruisers and small craft was found necessary during the Great War, is the more remarkable seeing that we gained command of the sea quite early in the struggle, so that the area that had to be closely patrolled was relatively small. Clearly then, if the main theatre of Naval war were shifted to the Pacific, we should require more cruisers still, as well as scouts of greater tonnage and speed to cope with the greater distances involved. The small auxiliary craft that worked efficiently enough in the North Sea and the Mediterranean in the Great War, would be quite unequal to the task of patrolling the vast Pacific and Indian Oceans.

Yet our trade routes must be protected at all costs. They are our sea-railways, vital to our very existence,

AIR TRANSPORT

and vastly more important to us than is its great network of railroads to the North American continent. Our dependence on them is fundamental and absolute. No other country presents a parallel case. Certainly not the United States of America. In the event of war, the United States by means of her high-power wireless could recall her cruisers from all parts of the globe, and use them to protect her country by aggressive or defensive methods, living comfortably the while on her own produce. This, as all the world knows, England cannot do. At whatever cost, she must keep her trade routes open; for their destruction would mean the starvation of her people and the collapse of the Empire.

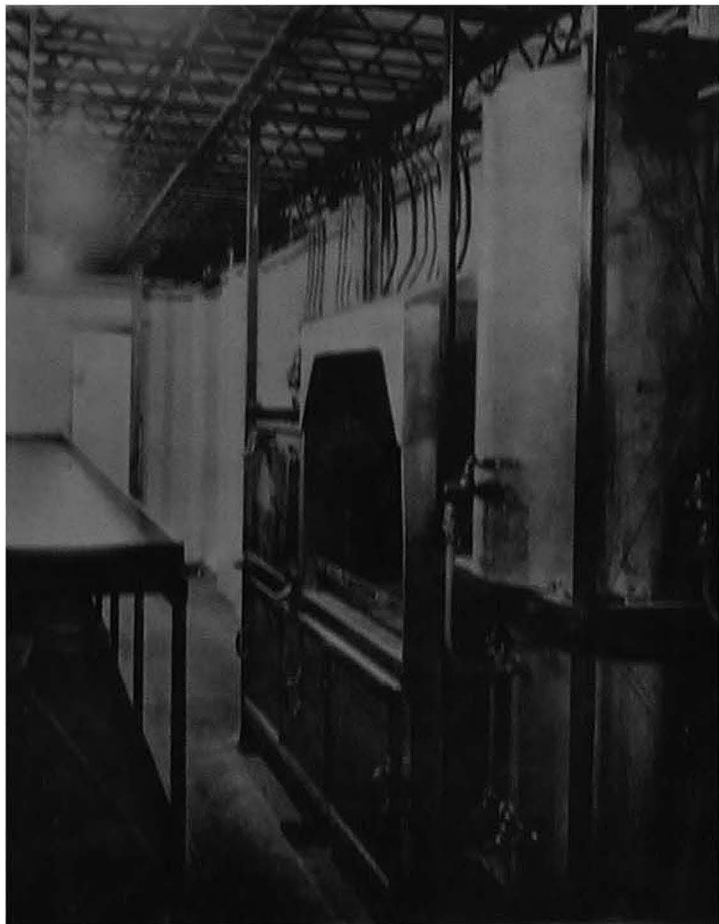
At the beginning of the Great War a few commerce destroyers escaped capture for a time. They were acting in direct contravention of International Law in destroying our ships on the high seas. In fact, they were pirates; and as pirates, they appealed to the popular imagination. But we must not be blind to the appalling harm they did to our trade, nor forget the invaluable tonnage they illegally sank. It is true that in time we exterminated them, but the cost of doing so was enormous, in fuel alone. According to a statement made by Mr. Bridgeman at Geneva (6th July, 1927), it took some seventy warships to track down the Emden, and at one period twenty-nine were actually in pursuit of her at the same time. This should bring home to us the all-importance of a good reconnaissance service. Yet such is our inability to learn from the lessons of the past, that if another war broke out tomorrow, which heaven forbid, we should once again find ourselves, in Nelson's phrase, "distressed for frigates."

For the first six years after the War we did not build a single cruiser or smaller vessel, and we were the only maritime power who did not. As a result we have, at

THE WORLD, THE AIR AND THE FUTURE

the present moment, to rely largely on old cruisers which are obsolete or nearly worn out. True enough, we now have thirteen ten-thousand-ton cruisers building to an excellent design for ocean work, considering the limitations set by the terms of the Washington Conference. Instead of the old fuel capacity of 1,000 to 1,200 tons which was considered sufficient for pre-war or war-built cruisers, when all eyes were directed to the North Sea, some of these new cruisers will carry three thousand four hundred tons of fuel. This gives a good radius of action, and it would seem that maximum speed has been sacrificed to obtain greater endurance, as nearly all the foreign cruisers of the same size are claimed to be faster. All the same, our cruiser programme is absurdly inadequate to our needs. Some forty-five cruisers cannot hope to cover 80,000 miles of trade routes or to give proper protection to the thousands of ships that arrive weekly in U.K. ports. We must remember, too, that as each cruiser costs about £2,000,000 the number we can hope to build is necessarily limited. It comes to this then. The Navy, within the limits of its own resources, can no longer do the work that is expected of it. That is to say, sea craft alone, limited in numbers by economic facts, cannot hope to grapple with the Naval problem as it exists to-day. We want far more light cruisers and small auxiliary craft of various kinds than we could ever think of building; and in default of the requisite number we must look to air power to supply the deficiency. I will endeavour to show that the airship provides us with a substitute that can perform many of the functions of the cruisers as well as, or better than, the cruiser itself.

It must be clearly understood that I am not suggesting for one moment that airships should attempt to usurp the fighting functions of cruisers any more than I would suggest that cruisers should fly. There



R.100. The Electric Kitchen



R.100. A Sleeping Berth

AIR TRANSPORT

is room for both. However much we develop airships, we shall for many years want as many light cruisers as we can reasonably afford; for there can be no question in this generation, at all events, of the Air Service being anything but ancillary to the Navy and Army—for Empire as opposed to Home Defence purposes. The rôle of aircraft, however, subordinate though it be, is important enough, as is shown in the following comparison between the relative effectiveness of cruisers and airships in naval reconnaissance. Hitherto, the disadvantages under which airships operate owing to their dependence upon mooring masts and land bases, and their inability to leave a shed except in fine weather have militated against their use by the Navy. The new developments which are outlined in a later chapter should remove these defects, and when they have been proved in practice, the arguments enumerated below should be capable of being substantiated.

1. First of all there is the question of visibility and speed.

The distance at which a vessel can be seen is dependent upon the height of the observer above the water line.

Roughly the horizon is distant:

| At | Sea Miles |
|---|-----------|
| 2,000 ft. useful cruising height for airships . | 50 |
| 1,000 ft. useful cruising height for airships . | 35 |
| 500 ft. useful cruising height for airships . | 25 |
| 150 ft. height of mast-head look out . | 14 |
| 50 ft. height of cruiser bridge or destroyer's masthead . | 8 |
| 25 ft. height of destroyer's bridge . | 5½ |

In the North Sea the average visibility in daylight is only about five sea-miles, which diminishes range of search for both cruiser and aircraft. The North Atlantic

THE WORLD, THE AIR AND THE FUTURE

also suffers from fog, mist, rain, blizzards, snow and sleet. However, in the vast Pacific and Indian Oceans, which German raiders, and in bygone wars, French privateers made their happiest hunting grounds, there is a very much greater degree of clarity.

Let us compare the radius of search of six cruisers and six airships, allowing the thirty knot cruiser a cruising speed of twenty knots (which is a generous speed) and the airship fifty knots (a decidedly low average). From the above table it will be seen that their range of visibility will be fifteen and fifty miles respectively. Thus, while six cruisers spread on a line would search 180 miles by 170 in twelve daylight hours, the six airships could search six hundred by seven hundred miles, or about three hundred and seventy thousand more square miles per day than the cruiser squadron.¹ Moreover, if we assume the complement of a cruiser to be seven hundred officers and men and that of an airship to be forty, it is seen, that whereas our air squadron would require a personnel of only two hundred and forty, the cruiser squadron would need over four thousand—a very big difference when man-power is in high demand.

It should be here stated that no allowance has been made for wind or sea currents, since both the air and the sea carry the vessel floating in them at exactly the same speed that they themselves travel. A thirty knot wind, with or against a fifty knot airship will either increase its speed to eighty or reduce it to twenty knots. The cruiser, however, has two elements to contend with; for while a thirty knot head wind will reduce her speed

¹ We must remember also that if credit be taken for the fact that light cruisers can carry scouting aeroplanes and thereby greatly extend their area of search, airships can do likewise, as experiments have proved the feasibility of aeroplanes being released from and re-embarked by airships. The quantitative value of either airships or cruisers can be increased in this way, but the relative value remains the same.

AIR TRANSPORT

appreciably by the rough sea it raises, a following wind and sea will hardly assist her at all. She has the advantage, however, that an adverse wind can never have so great an effect on her as on aircraft; though this is not a factor that affects the area covered by aircraft over a reasonable period.

2. A second point in which the airship can claim a decided advantage over the cruiser is in radius of action.

The radius of action of an old cruiser was small, and cannot bear comparison with that of airships. The Admiralty will probably keep secret the radius of the cruisers now building, but it is certain that this will be a great improvement on that of the old type. Even so, it cannot possibly hope to compete with the radius of action of an airship even as she exists to-day; and the airship, too, is always increasing her range. The R.100 described in a later chapter would have a still air radius of over seven thousand miles at fifty miles an hour, if the passenger quarters were eliminated, and this is a conservative figure. Future designs could more than treble this radius, whilst at the same time raising the speed. Commander Garland Fulton, U.S.N., in a lecture before the Society of Naval Architects in New York, in November, 1925, stated that if an airship of six million cubic feet were to carry fuel in place of passengers and cargo, she would have a still air radius of about 6,000 miles at sixty knots, and of 10,000 miles at forty knots.

In radius of action, therefore, the advantage is with the airship, and will be increasingly so with each new stage of airship development. There are the further facts that the distance from the patrol grounds to the base and back can be covered by an airship in about a third of the time required by a cruiser, and that an airship can re-fuel at a base, without having to run the

THE WORLD, THE AIR AND THE FUTURE

gauntlet of enemy submarines and minefields which will almost certainly be awaiting the returning cruiser.

3. In details of search and patrol, the advantages of aircraft over surface craft are many. Both airships and aeroplanes are invulnerable to mines and torpedoes, and by reason of their speed, they are immune from submarine attack. In fact, in the clear water of tropical and sub-tropical seas, an airship can keep a very useful watch on the activities of submarines, and if they should be forced to dive by surface craft, may possibly be able to bomb them effectively.

Of course, generally speaking, owing to their vulnerability to aeroplane attack, airships must avoid closely defended areas, and must be kept on the search of the vast ocean expanses. Similarly, a search by aircraft of rivers and arms of the sea which for navigational or other reasons cannot be penetrated with safety by the pursuing ships, may save a heavy useless expenditure of time and fuel.

4. Finally, there is the question of cost, and here the advantage is so overwhelmingly with the airship, that I think the Admiralty, in its own interest, should re-examine the whole position again, in view of the great possibilities opened out by the elliptical ship described in the Airship chapter. In an article I contributed to the *Fighting Forces* in June, 1924, I gave the result of an analysis that had been made of the cost for patrolling, sweeping, or searching out an area of a thousand square miles of ocean by means of airships, as compared with the cost of patrolling the same area with light cruisers. The cost of patrolling this area with airships would be 25s. and the cost of patrolling the same area with light cruisers would be £77 10s. These are only running costs, including fuel and crew, and take no account of depreciation, repairs, upkeep, bases, insurance, etc. If capital costs are considered, it is

AIR TRANSPORT

found that £55,000,000 would have to be spent on cruisers to give a power of reconnaissance and patrol that would be obtained by airships for the sum of £3,500,000, while the saving in annual upkeep effected by using airships in place of cruisers would amount to £11,000,000. These figures are, I believe, in the right relative proportions, if not quantitatively correct, and so far as I know they have never been challenged. I commend them to the notice of the powers that be.

From the foregoing it will be seen that we must concede to airships certain definite advantages over cruisers and destroyers for scouting and kindred purposes; but I must again insist that they can never take the place, or fulfil all the fighting functions, of the Fleet or of any portion of the Fleet, their rôle in relation thereto being always that of an auxiliary, albeit an indispensable auxiliary.

As has often been pointed out, the functions of the airship in Naval warfare will be strategic rather than tactical. It is too vulnerable to attack to be of use in the actual fighting; and here, of course, it cannot compare with the aeroplane. The distinguishing functions of the two air-arms in the strategy of the sea are well summed up by Rear-Admiral William A. Moffett, the Aeronautics Chief of the United States Navy.

“The airship is essentially a scout. It is not designed as a combat craft and its area of greatest usefulness is not fifty or sixty miles off the coast, but 1,000 miles or more at sea. It can travel at a speed of more than double the fastest surface ship; it can sustain itself in the air for several days or more, if the necessity arises, and it can carry moderate quantities of supplies, stores of ammunition, and, most important a reliable radio outfit for communication. . . . For services over land and over stretches of water of moderate

THE WORLD, THE AIR AND THE FUTURE

extent, and for military and naval operations not requiring voyages of great length, the airplane is daily proving itself ideally suited and reliable.

When oceans must be spanned with regularity, or when aircraft must be turned to naval employments requiring the constant surveillance over long periods of suspected areas, remote from friendly bases, the airplane is no longer capable of doing the work alone. Under these conditions it finds its necessary complement in the rigid airship. The large airship is essentially a long distance weight-carrying machine, having a longer range than the aeroplane, ability to keep the air for long periods, superior habitability, and is better adapted to night-flying. For high speed work at short range and for combat and spotting work the airplane has its field to itself.

No equitable conclusion can be reached by argument for or against airships as compared with heavier-than-air craft. Such arguments are similar to controversies which have taken place on subjects such as battleships versus submarines, and guns versus torpedoes. A correct solution in this case is clear, that both airships and airplanes are necessary components of a well-balanced fleet indeed, and as part of the nation's defence."¹

There is certainly no need for me to expatiate on the effectiveness of the aeroplane as a fighting machine. As I have already said, the war demonstrated it to such purpose that the dread of its destructive potency is now one of the strongest influences working in the cause of peace. Still the actual attacking value of the aeroplane in specifically naval warfare—in the ocean spaces as against the narrow seas—is I think apt to

¹ Article by Rear-Admiral Moffett, *New York Times*, October 14, 1928.

AIR TRANSPORT

be exaggerated. Let me give an example of what I mean.

One of the great drawbacks to the aeroplane as a naval fighting machine is its comparatively short range of action. This we are told can be got over by means of aircraft carriers. Now this is all very well in theory; but if we come down to facts, we find that the practical use of aircraft carriers is by no means so great as the reports about them that sometimes appear in the newspapers would have us believe. Apart from the difficulty of manœuvring them in conjunction with the fleet, it must be remembered that they are very vulnerable to attack from other naval craft, if they happen to be caught with their aircraft away upon other duties.

Again. Flying boats of large size and carrying capacity have not the endurance to accompany the fleet, and can only operate as independent units, on a definite programme within the limits of their range. On the other hand, the size of bomb or torpedo-carrying aeroplanes capable of taking off from, and alighting upon, an aircraft carrier, is at present strictly limited, so that their attacking power is comparatively small. To speak, therefore, as though the aircraft carrier has sounded the death-knell of the battleship is nonsense. The big torpedo and bomb-dropping planes of which we read in the American Press in regard to experiments carried out on the other side of the Atlantic, are all machines which have started from shore or from the enclosed waters of harbour. They have not been sent off carrier ships, and they have not proceeded into the air from the open sea.

Then there is the expense to consider. I once took the cost of one of the aircraft carriers which are attached to the Fleet. The carrier in question carried only some fourteen pilots and machines, and on working out the actual cost yearly of the carrier and its cargo of aircraft,

THE WORLD, THE AIR AND THE FUTURE

I found that the gross cost to the country for one year for one aeroplane and pilot came to the enormous sum of £35,000.¹ The very costliness, therefore, of this branch of the Naval Air Service must militate against its intensive development until it can achieve far more important results than can be fairly claimed for it at present.

To set against the disadvantages of the carrier, there are perhaps more favourable prospects in another direction, since the new type of elliptical airship described later will open out possibilities of giving airships a definite offensive value. I see no technical impossibility in constructing an airship capable of carrying, say, four torpedo-carrying planes and six fighting planes; the former to attack floating vessels and the latter to defend the airship herself from enemy planes. Not only should the airship be capable of carrying these planes but she should be able to release and embark them at will in any weather, and upon any course.² Now the argument I have elaborated has tended to show that as conditions are to-day the attacking value of aircraft is limited for naval purposes, by the difficulty of transporting the fighting aircraft to the position from which they can carry out their attack. If this difficulty could be overcome, the value of such aircraft would be greatly enhanced, and their effect would be felt far beyond the narrow waters. An airship capable of operating without reliance upon a previously prepared base and carrying the attacking aircraft could achieve this result. I do not wish to under-rate the technical difficulties involved, but within ten years a vessel of this character can, I think, be a proved and serviceable proposition, in which case, an action between a patrolling airship and a

¹ *Hansard*, vol. 173, page 680.

² Experiments of this kind were carried out with the R.33, and the aeroplanes were released from and re-embarked by that vessel when in flight. See Plate XVII.

AIR TRANSPORT

patrolling cruiser might more often than not result in a victory for the airship.

These facts all tend to support the contention, already elaborated, that whilst there is to-day a clear distinction between the value of aircraft in the narrow waters and upon the high seas, the power of aircraft is likely to increase from year to year, and that our policy should be governed by an acknowledgment of this situation.

§ 6

Our inquiry so far has led us to three main conclusions: firstly, that the best, in fact the only, way to solve the air defence problem is to force along the development of civil aviation; secondly, that the secret of Britain's greatness lies now, as always, in her possession of sea-centrality, and that though the invention of aircraft has completely transformed the problem of sea power and considerably curtailed the functions of the Navy, it has not altered the fact that the position of this country as a World Power must, as far as we can see into the future, depend on her maritime strength; thirdly that while the defence of this island is now mainly an aerial problem, the defence of the Empire is still and will be for many years to come, primarily a Naval problem.

It remains now to examine the defence problem in its Imperial and International aspects.

In discussing inter-Imperial relations we have to remember that the Dominions are of much greater value to Great Britain than Great Britain is to the Dominions.¹ This does not mean that if the Empire were involved in war to-morrow, the main burden of defence would not fall on Great Britain, or that the Dominions no longer rely on Britain's Naval power to defend them. It means, however, that if the Empire were suddenly

¹ See *Hansard*, Vols. 181, page 1608; 187, page 545.

THE WORLD, THE AIR AND THE FUTURE

dissolved, Great Britain would soon decline to a second-rate power, whereas Canada, South Africa, Australia, and even New Zealand, would still be able to work out their own salvation, even though their development might be less rapid. If, therefore, as time goes on, the Dominions remain inside the Empire, it will be because they wish to, not because they have to; and they will wish to only if Britain identifies her interests with theirs, and so strengthens the bond of Imperial unity that they cannot break it without injuring themselves and tearing at the roots of their own national life. On the other hand, a selfish or parochial economic and defence policy on the part of Great Britain, or a European as opposed to an Imperial outlook in her conduct of foreign affairs, will antagonise the Dominions, and might in time cause them to dissolve a partnership that implies certain definite obligations on their part, which it will be no longer worth their while to fulfil.

The Imperial problem is primarily an economic problem; that is to say, on the solution of the economic problem depends the solution of all the other problems, including that of defence. We are not a military Empire, but a commercial Empire. In the words of Mr. Bruce, the Prime Minister of the Commonwealth of Australia: "Our position in the world, our prestige, our authority in the Counsels of the Nations, has depended upon our commercial pre-eminence, not upon our armed forces, or our military strength."¹

Once the British Empire is welded into an economic unity, the difficulties of its defence organisation will be in great measure solved, as the Mother Country and the Dominions will then be able to act together in the development of a co-ordinated policy in a way that is not at present possible. Further, as no country can

¹ Report of Imperial Conference, 1926, page 57.

AIR TRANSPORT

take adequate means to defend itself, unless it has the money to do so, the ability of the Empire to keep open its trade routes and insure the flow of its commerce depends in the last resort on the financial situation. Thus, however we look at it, it is clear that the security of the Empire ultimately depends on its economic strength.

In one respect, therefore, the Naval problem of Empire defence offers a parallel to the air defence problem of this island, since the solution of both is to be found in methods that are in their nature pacific. We have seen that the best way to put the aerial defences of Britain on a sound basis is not to build up a gigantic Air Force, but to push ahead with the development of civil aviation. Similarly it is not by spending huge sums on Naval armaments and crippling our finances in doing so, that we shall solve the defence problem of the British Commonwealth, but by exploiting our Imperial resources and devoting ourselves to the work of Empire development.

In the first section of this chapter I said that British foreign policy had to take stock of two basic facts. As time goes on the focal strength of the Empire will shift more and more from Great Britain to the Dominions overseas; consequently the guiding principle of our foreign policy should be to cultivate the Empire and worry as little as possible about happenings in Europe. This covers one aspect of the Imperial problem. There is, however, another aspect to consider. So long as the strength of the British Commonwealth is centred in Great Britain, and until the Commonwealth itself achieves a position of economic importance equal to that of the continent of Europe, inter-Imperial relations will always be inextricably bound up with the workings of the European system; consequently the peaceful development of the Imperial organism must for some years to come depend considerably on the stabilisation of Europe

THE WORLD, THE AIR AND THE FUTURE

on a peace basis. Both these points seem to me to be fundamental, and it will be worth our while to consider each of them in some detail.

England's reluctance to orientate her policy away from Europe and towards the Empire is at the root of most of our Imperial difficulties. It irritates the Dominions and weakens their attachment to the Mother Country; it hinders the development of the economic unity of the Empire; and it materially increases the difficulties of the defence problem. In November, 1928, Sir Austen Chamberlain made the following statement to an audience at Ottawa: "Britain cannot get away from Europe. The problem of Dominion participation in foreign policy is still unsolved. In the meantime each is developing its own." This is deplorable. It is one thing to admit that, as things are at present, it is difficult for Great Britain to extricate herself altogether from the European tangle. It is another thing to announce to the Dominions that Britain, being an integral part of Europe, is tied forever to a Continental policy, and to give them to understand that as a consequence of this they must work out their own salvation in matters of foreign policy, as best they can, since the British Foreign Office is far too pre-occupied with solving political crossword puzzles in Europe, to attend to a matter of such minor importance as the solidarity of the British Commonwealth in its foreign relations; for this is what Sir Austen's declaration really amounted to. It is a wholly wrong attitude. A mischievous utterance of this kind from the Foreign Secretary of a Conservative Government which is usually supposed to stand for progressive Imperialism, and from the son of Joseph Chamberlain to boot, makes one despair for the future of the Empire.

Fortunately a different spirit animates our Dominion statesmen. Compare for example, Sir Austen's feeble

AIR TRANSPORT

effusion at Ottawa with the lofty Imperial faith and the profound grasp of the principles of Empire reconstruction that characterised the various utterances of the Dominion Premiers at the Imperial Conference of 1926.

The common theme of all the speeches was the fundamental unity of the Empire in purpose and ideals, and the paramount necessity of the closest co-operation in all matters of economic and foreign policy; and not one of them but was inspired by that larger Imperial outlook which is so sadly to seek in the utterances of our statesmen at home. "Our very presence here," said Mr. Mackenzie King, Prime Minister of Canada, in his opening address, "indicates that we share in common many great problems, many commanding opportunities, many proud memories . . . and, not least, common standards of public life and private conduct. In more senses than one, we speak the same language. In countless ways, in trade, in markets, in migration, one part needs and complements the other." General Hertzog, Prime Minister of the Union of South Africa, expressed himself to the same effect. He referred to the manifold relations "of blood, of friendship, of common interests and ideals, and of allegiance to a common Crown," that bind us all together, and he stated in unequivocal terms the whole-hearted determination of South Africa to work for the consolidation of these relations: "We are prepared," he said, "to co-operate to the fullest extent in laying as solidly as possible the foundations of our Commonwealth of nations so as to make it as durable as it can be." Not less emphatic was Mr. Coates, Prime Minister of New Zealand, who spoke with a moving sincerity of the intense Imperial patriotism that animated the "small country" he represented, whose hope it is, that "its earnestness, its goodwill, its ready recognition of the varying points of view of its sister nations, and its

THE WORLD, THE AIR AND THE FUTURE

willingness to fall in with any plans that will make for the common good of all, will to some extent compensate for its want of magnitude."

Of special interest was the appeal made by the Prime Minister of the Commonwealth of Australia for closer co-operation between the Mother Country and the Dominions in the work of economic development. The burden of Mr. Bruce's message was the building up of Empire unity on the basis of inter-Imperial trade. He expressed Australia's determination to go forward with her national development inside the British Empire, and to give every preference to British trade over that of every other country in the world; but he rightly insisted that "the whole economic strength of the Empire is vitally dependent upon the position of Britain" and that the commercial prosperity of Britain "is the key to the whole question of the future of the Empire and of the development of the different parts of the Empire." Everything in a word depends on Britain being able to keep pace with the tremendous expansion of the world's trade, and on her purchasing power bearing a proportionate increase to the increase in the production that the Dominions have to dispose of.

Dwelling on this point Mr. Bruce stressed two unpleasant facts of the present situation: (1) that the export trade of Great Britain is not expanding at anything like the rate of the export trade of the United States, and of most of the manufacturing countries of Europe; and (2) that Great Britain is not taking her full share in the expanding trade of the Empire.

It is undoubtedly true that of late years the increase in our trade with the Dominions has been greater in extent and considerably greater in proportion than the increase in our trade with foreign countries. This does not mean, however, that we have been taking our proper share in the increased trade of the Empire. Unfortun-

AIR TRANSPORT

ately the reverse is true. Trade statistics show that the proportionate increase of Great Britain's competitive imports into the Dominions cannot bear comparison with that of certain other countries, notably the United States of America; also, that the steady increase in the export trade of the different Dominions to foreign countries, has been accompanied by a serious reduction of the proportion that Great Britain is taking. This, as Mr. Bruce frankly told us, "is a most undesirable position," and the whole future of the British Empire depends on our taking effective measures to retrieve it. The initiative lies with Great Britain.

Now the only way to check this unfortunate tendency, is to do what no British Government has yet had the courage to do, that is, to get to grips with the issue of Imperial Preference, and to treat in a scientific spirit such questions as the marketing, distribution and standardisation of British and Empire manufactures and produce, instead of just playing with these questions or running away from them altogether. This is not the place for me to develop my own views on these matters. I have done so time and again in the House of Commons.¹ What I wish to drive home here, and what the statesmen of the Dominions seem to realise, and our own people do not, is, that the prosperity of the Empire depends on the prosperity of Great Britain, and that the prosperity of Great Britain depends upon the development of the Empire; in other words that the fundamental problem that faces us is the economic problem of the Empire. It is not a question of Great Britain sacrificing herself to the Empire, or of the Empire sacrificing herself for Great Britain. On the contrary,

¹ See especially my speech on Unemployment in 1925 wherein I argued that a deflecting tax in favour of Empire produce would go a long way towards solving the Dominion labour problem and our own unemployment problem. *Hansard*, vol. 184, page 1626 et seq.

THE WORLD, THE AIR AND THE FUTURE

what profits one profits the other. Britain and the Dominions must think and act together for the development of the British Commonwealth. There must be co-operation and reciprocity of effort. The Dominions must assist us in their markets, and we must assist them in ours. The decisive factor, however, is the position and policy of Britain. The Dominions are determined to push on with their national development at all costs, and they are prepared to do so within the British Empire rather than outside it. But they are certainly not going to slacken their stroke, merely because Great Britain refuses to pull her full weight in the Imperial boat. The Most Favoured Nation Treaty recently concluded between South Africa and Germany shows the way the wind is blowing. It was a perfectly justifiable though disappointing step on the part of South Africa, to which no exception can be taken by this country; but it indicates none the less that the Dominions are quite alive to the expediency of pursuing an independent line in the conduct of their foreign affairs, without any gratuitous promptings from the British Foreign Office.

The last word, therefore, rests with Britain. She can do one of two things. Either she can endorse the plea so ably set forth by Mr. Bruce in his statesmanlike address, and throw herself heart and soul into the work of building up the economic strength of the Empire; in which case her own economic problems and the problems of Imperial defence will solve themselves. Or she can persist in regarding herself as an integral part of the European system, and in subordinating her Imperial interests to her interests in Europe; in which case this generation or the next will see the dissolution of the Imperial Commonwealth and the reduction of this country to the rank of a second-rate Power.

When we come to the actual defence organisation of the Empire, we see at once that statements like that

AIR TRANSPORT

indulged in by Sir Austen Chamberlain at Ottawa cannot but aggravate what is already a very delicate problem. The chief difficulties here are (1) to fix the respective amounts that Great Britain and the several Dominions should contribute towards the upkeep of our Imperial defence forces, (2) to decide how the money voted for this purpose can best be spent in the interests of the Empire as a whole.

The first point is easily settled in theory. What we have to do is to work towards an Imperial Defence Budget. Hitherto England, being the reservoir of the Empire's wealth and white population, has had to bear the main burden of expenditure for the upkeep of our common defence forces, the Dominions contributing according to their means. To-day, to be quite frank, not one of the Dominions is bearing its fair share of this expenditure. The burden, however, is becoming too great for the Mother Country, and the time has clearly come for its more equitable distribution. It is essential, therefore, that we should frame our policy on Imperial lines so as to attract Dominion opinion. If we do this, we may rest assured that the peoples of the Dominions will shoulder their just burdens with the same fortitude as the inhabitants of Great Britain have done for the last two hundred years. If, on the other hand, we continue our misguided policy of divorcing our national interests from the interests of the British Commonwealth as a whole, and flatly tell the Dominions that in the eyes of the British Foreign Office Europe is more important than the Empire, we may be quite sure that the Dominions will take the hint, and that instead of raising their contributions to the Defence Budget, they will show an increasing reluctance to pay anything at all.¹

The second point is rather more complex owing to the fact that the defence of this island is mainly an

¹ See *supra* page 58—Note.

THE WORLD, THE AIR AND THE FUTURE

aerial problem, and that of the Empire a naval problem. Here, too, our European heresy aggravates our difficulties. This country, groaning as it is, under the burden of an excessive taxation, has to reduce its defence budget to a minimum. On the other hand the more we commit ourselves in Europe, the more we have to look at our defensive organisation from the point of view of a potential participant in any future European upheaval. This means that the actual defence of this island, as distinct from the defence of the Empire, imposes a bigger strain on the Annual Estimates than would otherwise be necessary. As I have repeatedly said, defence for us, in its continental aspect, is mainly a question of troops and aeroplanes; consequently there is a growing tendency to subordinate our Naval programme to the requirements of the air arm. This issue I have already dealt with at some length. What is important here is to note the disastrous psychological effect any weakening of our naval strength will have on the Dominions. The integrity of the British Commonwealth depends on the supremacy of the British Navy. It is on our Naval strength that the Dominions rely, as their first line of defence, and any seeming failure on our part to realise this fact would arouse the bitterest resentment. It will be remembered what a bad effect Mr. MacDonald's decision to abandon the naval base at Singapore had on Australian opinion in 1924, and how Mr. Baldwin's return to power in the November of that year was enthusiastically welcomed as heralding a reversal of that policy. "Here, in Australia," said the *Sydney Morning Herald* (November 1st, 1924)—to take one newspaper comment out of a chorus of such comments—"we look to the Conservatives to resume the work of the Singapore base without which the Empire in the Pacific is utterly defenceless, and Great Britain's influence for world peace must be gravely weakened."

AIR TRANSPORT

It will be readily understood that I am not accusing the British Government of consciously shirking its responsibilities in regard to the defence of the Empire. On the contrary, at the present time Great Britain is bearing more than her fair share of this burden, even relatively to her greater resources. I am merely pointing out that in saddling ourselves with so many obligations in Europe we are making it extremely difficult to fulfil our duties towards the Empire; and these duties, not the affairs of Europe, should be our first thought.

Let us now turn to the other basic fact of the foreign situation—the interdependence of Imperial and European affairs. So far, I have been criticising our Government for directing its policy towards Europe instead of away from Europe towards the Empire. Instead of trying to extricate ourselves from the European tangle, we have been busily tying ourselves up in every new knot that the muddled situation produces. This, I maintain, is a senseless policy, disastrous to ourselves, and fatal to the future prospects of the Empire.

In making this criticism, however, I am fully aware that as things are, it is not possible for Great Britain, or even for the Empire to ignore developments in Europe altogether, and I now propose to examine the Imperial problem against the background of the European situation.

Here, as has already been said, the point to be emphasised is, that stormy conditions in Europe are bound to cause atmospheric disturbances within the British Empire.

Perhaps the essence of the problem may be stated thus. The associated States that make up the British Commonwealth have each of them a two-fold orientation of policy, one an inward orientation, working in relation to the concerns of the Imperial family, the other an outward orientation, working in relation to forces

THE WORLD, THE AIR AND THE FUTURE

external to the Empire. The moral unity of the Empire depends on these two ends of policy being in constant accord. If, however, European politics, where the orbits of both cross and intercross at innumerable points, continues to present a shifting world of unstable and mutually conflicting forces, the work of harmonising the two will be no easy matter; and it will become increasingly difficult as the several Dominions expand in wealth and population.

This is the issue that has to be faced, and much will, of course, depend upon the orientation that Great Britain gives to her own Foreign policy. But what we have to remember is, that even if our Foreign Secretaries do at last wake up to the fact that the frontier of the British Empire is not on the Rhine, and that the consolidation of the British Commonwealth concerns us at least as much as does, say, the integrity of Poland, it will still be impossible for the Empire to keep altogether clear of European entanglements. In the course of the next generation or two, Canada, Australia and South Africa will become wealthy, thriving Powers of international importance; and it is not easy to see how, in view of their economic dependence on British and American capital, and their interests in European trade, and quite apart from the new political issues the process of their expansion will give rise to, they will be able to shut themselves up in their own continents, or behind the wall of British Imperialism, and ignore developments in the outside world. Neither as individual Powers nor as partners in the British Commonwealth will they be able to view the troubles of Europe with complacent indifference. Hence unless by that time Europe has abandoned its war mentality, and the European situation has become stabilised on the basis of the ideas implied in the League of Nations and the Kellogg Peace Pact, the rise of these three new Powers

AIR TRANSPORT

in different parts of the world will add considerably to the complexities of the International situation, since each of them will inevitably re-act to the national rivalries that divide Europe. But the more complicated the International tangle becomes, the greater will be the difficulty of the Imperial problem, as a moment's reflection will make clear.

For one thing, it is absurd to suppose that as the Dominions expand in power and influence, they will always see eye to eye with each other or with Great Britain on International questions. Differences are bound to arise, and these will be more or less frequent, more or less acute, according as the European atmosphere is troubled or peaceful. Or are we to suppose that, in a world given over to national hatreds and dissensions, and with war-clouds for ever hovering on the horizon, the British Empire, which is after all an international organisation, will be able to pursue its development in unruffled calm, with a psychology unaffected by the unsettling conditions? Let us make no mistake. Such a state of affairs must necessarily impose an enormous strain on the unity of the British Commonwealth, since each of the member States will look at the various issues from a different angle, and the possible points of disagreement will be infinite.

It must not be forgotten that the Dominions are free, autonomous States. Hence, in what I have called the outward orientation of their foreign policies—which depends upon geographical situation and local conditions—they will tend, more and more, as time goes on, to pursue an independent line. Each of the Dominions will form a personal relationship with the various Powers outside the British Commonwealth, and that relationship will be friendly or the reverse according as there is identity or conflict of interest. But it might easily happen that one of the Dominions formed a

THE WORLD, THE AIR AND THE FUTURE

rapprochement with some Power between whom and another Dominion there was a constant clashing of interests; so that it is quite conceivable that in a grouping of world Powers two of the Dominions might find themselves on opposite sides. A situation of this kind may, of course, never arise, and it is to be hoped that it will not; but it is theoretically possible, and it presents an aspect of the Imperial problem that has to be faced.

Again, if the nations of Europe continue to base their security on huge armaments and water-tight treaties of guarantee, instead of acting on the principles of the Kellogg Pact, or looking to the pacific machinery of the League of Nations for settlement of their differences, the outcome, sooner or later, is bound to be another world-war; and to imagine that the British Commonwealth will be able to keep out of it, is to cherish a foolish illusion. It will be drawn into the next world-war as inevitably as it was drawn into the last; and the chances of such an upheaval finding it united must depend on our success in building up the economic fabric of the Empire in the meanwhile, so as to make it strong enough to withstand any strain that may be put upon it by possible divergences of opinion between the Mother Country and the Dominions, or among the Dominions themselves in their outlook on foreign affairs.

Needless to say, I am not depreciating in any way the magnificent response the Dominions made in the Great War; nor do I forget their intense patriotism and the loyalty they have ever shown to the Crown and the Mother Country. I merely point out that as each Dominion becomes more self-sufficing, the more will material conditions tend to develop different interests. It is no service to the Empire to state categorically that it is unthinkable that any Dominion will ever break away from the British Commonwealth of Nations. It

AIR TRANSPORT

is but prudent to examine all contingencies, however unpleasant or unlikely, and prepare to meet and overcome all difficulties.

And there can be no doubt, I think, that the Imperial problem as affected by the unsettled state of Europe, does present difficulties of a very serious kind; and it is equally certain that we shall not solve them successfully unless we achieve a far greater co-ordination of Imperial and Foreign policy than is in evidence to-day. Every effort must be made to present a united front to the outside world. All differences of outlook within the Imperial family should be treated as a family concern, the ultimate decision upon any question being based on what is best for the Empire as a whole. This means that both the Mother Country and the several Dominions must, in their own interests, be prepared from time to time to sacrifice their individual points of view for the sake of the common good. In other words, each separate State of the Commonwealth must treat the special problem of its own foreign relations as of second importance to the larger problem of consolidating the unity of the Empire.

Unfortunately, at the present time, Great Britain, whose geographical position naturally makes her keenly alive to the dangers of the European situation, is inclined to forget this principle. Sir Austen's Ottawa speech was obviously dictated by his fear of the potential warlike capacity of a Europe in arms. But surely the best way of meeting any future danger from Europe is to strengthen and solidify the Imperial structure. If we must look ahead to future wars, let us always remember that, whereas Great Britain alone would have difficulty in withstanding a hostile European coalition against her, even the strongest combination of Powers would hesitate before challenging the united strength of the Empire to a struggle.

THE WORLD, THE AIR AND THE FUTURE

In determining our relations with Europe, we can learn, I think, a useful lesson from the United States of America.

Since the war, the United States has repeatedly declared a policy of non-intervention in European affairs, on the ground that happenings in Europe are no concern of hers. In practice this policy has not proved altogether workable, so that her attitude has seemed to Foreign Powers something of an affectation. She has far too many interests in Europe to ignore what Europe is doing; and even if she wished to, Europe would not let her. As is often pointed out, she has been the "big noise" at half the post-war Conferences of the Great Powers; and how acutely sensitive she is to the workings of inter-European relations, was shown by the outburst in Washington over the so-called Anglo-French Naval Compromise in September, 1928.¹ Events have proved, therefore, that, however she may define her policy, she cannot in actual fact hold herself aloof from European politics. On the contrary, owing to the economic and financial hegemony she now enjoys in the world, the tendency is, paradoxical though it be, for Washington to become more and more the centre of gravity of European diplomacy.

Still, all this notwithstanding, there can be no doubt, I think, that America's conception of policy is right in principle, even though she has been compelled to modify it in practice; and instead of passing strictures upon it we should be better advised to frame our own policy on similar lines.

This policy implies an ever-ready willingness to assist the countries of Europe in the solution of their problems, combined with a fixed determination not to

¹ For an interpretation of America's attitude see my speech in the Debate on the Address, November 13th, 1928. (*Hansard*, vol. 222, page 773 et seq.)

AIR TRANSPORT

be entangled in any of the issues that these problems raise. There is a world of difference between intervention and the assumption of definite military obligations. British and Imperial intervention in European affairs is inevitable; obligations are what we like to make them. By all means, let us take our place at European Conferences, give our whole-hearted support to the League of Nations, and play the part that the world expects of us, in raising the structure of European peace; but let us at the same time keep clear of all those dangerous commitments and treaties of guarantee, which bind us to military action in quarrels that concern neither ourselves nor the Empire.

As I have said, if the Empire is to hold together, there must be a close co-ordination of Imperial and Foreign policy. A programme must be formulated which has the approval of all the States of the Commonwealth. It is no use the Mother Country rashly committing herself in Europe on her own responsibility, and then expecting the Dominions to rally to her when the crisis comes, and she has to reap the fruits of her folly. She must tread the more warily in these matters owing to the loose political structure of the British Commonwealth.

And here it is pertinent to observe that the British Empire can never achieve an absolute political unity like that of the United States of America, whose federated States being contiguous countries were easily combined into a single economic and political entity. Upon Foreign policy all the various States that make up her body politic speak as one nation through Washington; and there can be no question of one or more States refusing to endorse the national policy. When, for example, the United States entered the Great War, she entered as a single nation, like Germany or France, or Great Britain herself; there was never any sugges-

THE WORLD, THE AIR AND THE FUTURE

tion of Maryland say, or Illinois, or any of the other States holding back, and declaring itself neutral. The British Commonwealth can never become one indivisible nation in quite the same way, owing to the wide distances that separate its various parts from each other; and so it is that the co-ordination of its foreign policy presents a problem of such enormous difficulty.

But though the British Empire cannot attain to the same absolute degree of unity as the United States has done, it can—and if it is to survive, it must—achieve a far greater political and economic cohesion than exists to-day. Its structure must, and I think can, be made sufficiently solid and enduring to withstand any strain that can be put upon it by disruptive political forces from without. Its economic resources must be so developed that, like the United States to-day, it can achieve a virtual independence of the outside world; and a degree of co-ordination must be reached in its foreign policy, such that, when Westminster speaks, it does, in actual fact, express the unanimous opinion of the whole Commonwealth. Speedy communication alone can make possible that close physical touch which will enable the statesmen of Great Britain and of the Dominions to formulate a united Imperial policy, and the more the future of the Empire is considered, the more patent does this fact become. And yet, in spite of the fact that it is by harnessing civil aviation to our need, and by that alone, that these speedy communications will be rendered possible, our civil aviation vote is not one-third of one per cent. of our annual expenditure on Defence! What a commentary upon our aerial policy! It would be laughable if it were not so serious.

From the analysis contained in these last two chapters, it will be seen that, in the three spheres of Economic

AIR TRANSPORT

Development, Defence Organisation, and Foreign Policy, the effects of air development on Great Britain must be considered under two aspects. On the one hand we have to consider its effects on her position as an independent unit; on the other hand we have to consider its effects on her as a partner in the British Commonwealth of Nations.

In the sphere of economic development, air transport will affect Great Britain, as an individual country, by helping her to conserve and extend the position given to her by sea-centrality, as the market-place of the world. At the same time, by making possible the practical transformation of the Empire into a single economic and political entity, it will make her part of a great trading continent, and thereby enable her to compete more easily with the United States in all her manufacturing enterprises; for, as we shall see later, modern industry demands continental home markets and an international foreign sales organisation. Happily, then, in this sphere, aviation is a providential gift from science, that has come at the critical time to revive and revitalise Great Britain's otherwise diminishing position in world industry.

In defence, whilst jeopardising Great Britain's individual position by making her more open to continental attack than she has ever been before, it will assist the Empire as a whole by making its Naval power, upon which alone the security of the Empire in time of war depends, more ubiquitous, cheaper, and more speedy in its application. Weighing one consideration with the other, one may say that upon the whole, the development of aviation has seriously weakened the fighting power of the whole Imperial organism.

In the sphere of foreign policy likewise, it has not proved an unmixed blessing; for by making Great Britain more open to attack from the continent of Europe,

THE WORLD, THE AIR AND THE FUTURE

it has tended to inveigle her more and more into the maelstrom of European politics. To set against this unfortunate tendency, however, is the fact that it will bring the Dominions close to the Mother Country, and thus make possible the speedier solution of inter-Imperial questions and the building up of a sound and stable foreign policy on an Imperial basis. It should also prepare the ground for a future Imperial Congress to sit in permanent session.

It is perhaps in this sphere that the most delicate and intricate problems will present themselves for solution, and it behoves us to grapple with them in a statesmanlike manner. Provided, however, that the Mother Country and the Dominions produce statesmen of sufficient calibre to deal with the new situation, there is every reason to think that aviation, besides helping to promote the internal unity of the Empire, will also prove an assistance rather than a hindrance to the maintenance of peace between the Empire and the outside world. And if we now turn our attention to the International implications of aircraft development, and examine the various ways in which it will tend to consolidate human society in the interests of peace, it will be seen that a reasonable optimism in this respect is fully justified. These considerations will form the subject of our next chapter.

CHAPTER IV

AIR TRANSPORT AND
INTERNATIONAL PEACE

Civil aviation postulates an International development:

- I. What do we mean by Internationalism? War the only alternative to an International as opposed to a National world order. What modern warfare means. Various forces working to-day in the direction of Internationalism
- II. The progress of civilisation on its material side, a matter of improved communications. The three means of communication: the Land, the Sea, and the Air, studied under their historico-metaphysical aspects. A synthetic, expanding, and universalising process always manifest. This process culminating in aviation. The air, the universal element, a symbol of the International principle
- III. Economic forces working towards Internationalism; Political forces still pulling in a contrary direction. The Economic position of the United States of America
- IV. Practical ways in which the development of civil aviation will help to build up an International World order.—A United States of Europe.—The establishing of closer relations between Europe and America.—The unification of the Atlantic peoples

Civil aviation, if it is to function properly, must be organised on an International basis. This is I think axiomatic. Most people who go up in an aeroplane—in Europe at all events, and in England especially—do so with the intention of crossing over foreign territory and coming down in a country other than

their own. Consequently it is absurd to conceive of air travel and air transport in terms of national boundaries and local systems of control. Indeed, air power practically demands a World-State for its free and systematic development, and from an airman's standpoint the national divisions of mankind are so many irritating obstacles in the path of progress.

However, a World-State is hardly a thinkable proposition at the present time; and in this book we are dealing with realities and not with the Utopian conditions of some dream-future. What we have to do, therefore, is to consider how far the trend of the world to-day favours the international development of civil aviation, and, conversely, how far the exploitation of the air will help to promote an international spirit among the nations of the earth.

As a preliminary to our inquiry, it will be well to clarify our notions of Internationalism. What do we mean by the International spirit? Is Internationalism a desirable end in itself? Or will it be wiser, more profitable for civilisation to adhere to the historic principle of territorial nationality, in spite of the recurrent wars that are its necessary concomitant?

§ I

Unfortunately the events of the past few years have given a sinister meaning to the word Internationalism. We are accustomed to associate it with the horrors and absurdities of Bolshevism; with class-war and class-hatreds; with that odious form of pacifism which regards loyalty to one's country as the one unpardonable sin against humanity; with atheism and materialism, and with the subversion of the whole ethical code on which the civilisation of Western Europe has been built up. This association of ideas, however, is purely

AIR TRANSPORT—INTERNATIONAL PEACE

fortuitous and has no logical basis. Internationalism, as such, is not a subversive doctrine at all, and has nothing whatever to do with any sort of perversity—political, spiritual, ethical or economic. One can be a firm believer in Internationalism without being a Bolshevik, or a Marxian economist, an atheist, an amoralist, or an anti-patriot. In broad terms, Internationalism means the clear conception of the civilised world as now, to all intents and purposes, an organic unity, and a readiness to accept a modified nationalism that will fit in with this conception. It means an intelligent realisation of the fact that with the close interdependence of States in the modern world, no nation can hope any longer to develop itself independently of, or at the expense of, its neighbours; that on the contrary, any Power whose conduct and policy inspire fear and mistrust in the outside world, cripples its own development in proportion—as we see in the case of Soviet Russia. It means broader, longer horizons in politics and economics; a profound conviction that collaboration of endeavour must take the place of national self-centredness, that there must be a general breaking down of economic barriers between nations, that all countries, great and small, must try to forget their racial antipathies and national enmities, and that the Great Powers especially must make an organised attempt to work harmoniously together, since they can each of them advance their own ends better by concerted effort than by thwarting each other. It means, in short, that co-operation must take the place of competition as the first word in the vocabulary of nations.

So conceived, Internationalism has nothing sinister about it. Nor does it negate patriotism of the right sort. It does not exclude love of one's native land and pride in its achievements, attachment to local traditions and customs, devotion to national interests and national

THE WORLD, THE AIR AND THE FUTURE

ideals, and a constant endeavour to increase by all legitimate means the influence of one's own state in the comity of civilised Powers. What it does negate, however, is a narrow and aggressive Chauvinism, militarism, and any manifestation of the will-to-power spirit which ignores the rights and legitimate aspirations of other nations; the sort of patriotism, for example, that says "my country right or wrong" and putting the nation above the moral law, is prepared to justify any policy however unscrupulous, that serves some selfish national end.

In the world to-day there are two great political communities which present many of the features of an International State, and in which the spirit of nationalism manages to harmonise the claims of a smaller and a larger patriotism. There is the British Commonwealth of Nations, and there is the United States of America. Either of these may well serve as a model for some World-State of the future. The United States of America, especially, presents an admirable ideal for Western Europe to aim at. Here we have a number of autonomous States, each possessing its laws and developing, up to a point, its own economic system, and all federated into a single political and economic unity. State patriotism is strong in each. A citizen of the United States, whether he hail from San Francisco, Boston, or Chicago, always remains devotedly attached to the State of his origin; he is none the less a good American and a loyal citizen of the Republic. On a smaller scale we have the same thing in Great Britain and Germany. Wherever he be, the Scotsman, for example, lets the foreigner know that he is a Scotsman and not an Englishman; and in the same way no Englishman would consent to be labelled a Scotsman; yet both are equally loyal sons of Britain. Similarly in Germany, Bavarians, Saxons, and Prussians, all possess a distinct



R.100. The Upper Part of the Gallery in
the passenger quarters



R.100. The Dining Saloon

AIR TRANSPORT—INTERNATIONAL PEACE

nationality to which they cling with an intense patriotism; but they are none the less all equally devoted to their German Fatherland.

The creation of a United States of Europe, whether in the pattern of the British Commonwealth or in that of the U.S.A., seems hardly perhaps a question of practical politics at the present time. Economic forces are certainly pulling in that direction; but the political consciousness of Europe lags far behind. In the new Europe, dotted about as it is with newly-formed democracies born of struggle and revolution, and each of them the product of the national self-consciousness of some long-oppressed racial minority, the spirit of nationality burns more fiercely than ever, so that everywhere we find strong political forces running counter to the synthetic pressure that is being exercised by economic forces; while the many repellent features of Internationalist propaganda make the very principle of Internationalism suspect in the eyes of responsible statesmen. Yet there can be no doubt I think that if the fabric of Western civilisation is to survive, it can only be on the basis of the International principle. We may never actually achieve the European Commonwealth our Utopians dream of; but unless the statesmanship of Europe accepts the conception of such a Commonwealth as an ideal to work for, and unless national policies are made to conform in some measure to what such an ideal implies, the tension of national rivalries, political, racial and economic, must inevitably bring about the catastrophe of another world-war.

The question then to be considered is not whether Internationalism as such is a finer ideal than Nationalism—though, as I have tried to show, Internationalism properly understood provides plenty of room for the saner elements of Nationalism—but whether our civilisa-

THE WORLD, THE AIR AND THE FUTURE

tion can develop without it; and if, what no intelligent student of foreign affairs will deny, war is the only alternative to a loyal acceptance of the International principle, the answer will be that it cannot. Anyone who disputes this must be strangely blind to the character of modern warfare.

I have already alluded to the fact that now for the first time in history, intelligent opinion throughout the world is unanimous in repudiating the whole idea of war as in any way a desirable thing, or as a proper means of settling disputes between nations. Less than eighty years ago we had a poet of such high ethical standards as Tennyson celebrating in verse the cleansing power of war and looking to some stern national struggle to brace England up and save her from the selfish, soulless materialism into which her unexampled economic prosperity had plunged her. Such an attitude towards war is no longer tenable. No poet who lived through the Great War has sung the praises of war; and no future poet of our civilisation ever will. To-day the conscience of civilisation looks upon war as a crime against humanity, and any state which like the France of Louis XIV or Hohenzollern Germany, did actually use war, or the threat of war as an instrument of national policy would soon find the important civilised nations of the world lined up against it. There are two reasons for this change of heart. One is fear of the horror and destructiveness of modern warfare, the other is the realisation that war no longer pays.

Modern warfare differs in a number of ways from the warfare our ancestors knew. In the first place war has become completely mechanized, with the result that little room is now left for the personal prowess or that chivalrous exchange of courtesies between combatants that lent a certain romance to warfare in ages past. The glamour that surrounded fighting

AIR TRANSPORT—INTERNATIONAL PEACE

in the old days is now gone. One cannot talk of the glory of battle in an age of shells, mines, long-range field guns and poison gas, when war is conducted from a laboratory, and armies are mown down by an enemy they do not even see. There is room indeed for heroism as never perhaps before; but there is little scope for personal glory, nothing of the adventurous thrill that attracted men to arms in the old days. Secondly, war is now no longer confined to the armies in the field; the whole nation is involved. It is the whole adult population, wealth, and resources of one nation pitted against the population, wealth and resources of another, and the old distinction between combatant and non-combatant has ceased to have meaning. Thirdly, owing to the deadliness of the instruments used, the vast field of operation, and the enormous increase in every direction of the belligerent capacity of nations, war is now infinitely more ruthless, more destructive, and more fundamentally ruinous than ever before.

These changes are due to the progress of science. Unfortunately the growth of science has vastly increased man's capacity to destroy his fellow creatures, without at the same time raising his mental and moral stature. It has not succeeded in transforming his nature or in giving him the moral strength to refrain from turning to ill uses the power it has put into his hands. If any proof were needed that science alone cannot bring salvation to mankind, we have it in the character and conception of modern warfare, which shows a reversion to the character and conception of warfare in primitive times.

In the warfare of primitive times, the whole nation, or if you will, the whole tribe, was engaged in hostilities. It was an affair of one tribe setting out to exterminate another. All were combatants and there

THE WORLD, THE AIR AND THE FUTURE

were no laws of war or reasons of political or economic expediency limiting the field of belligerent activity. The men were either slaughtered or captured, and the women were the prize of the victors, who also carried off such belongings of the beaten tribe as they could lay hands on. As nations grew larger, and states of more extended area were formed, a nation in arms became an impossible idea, owing to transport difficulties, the food question, and the need of carrying on the normal functions of an organised community. Hence trained men were chosen to do the fighting. This led to the laws and conventions of war, and to the carefully formulated distinction between combatants and non-combatants.

At a later date, during the Middle Ages, for example, and in early modern times, national sentiment had little to do with the waging of wars. Wars were waged for a religious principle or to settle dynastic rivalries, or to gratify the territorial ambition of a restless monarch. So little did war mean a national effort, that armies were largely composed of foreign mercenaries who sold their swords to the highest bidder for a specified term, and not infrequently changed sides during the same war. The fighting usually ended when both sides had done enough to satisfy their honour, or when the money gave out. It was rarely a case of a struggle *à outrance*, of a set determination to fight for a knock-out blow.

The growth of the modern state, and the development of the European system on the basis of national units of power, necessitated the keeping up of large standing armies, and soldiering became a recognised profession. This meant that the distinction between the fighting and the civilian population became more clearly marked than ever, and as a consequence the field of belligerent activity was narrowed down by

AIR TRANSPORT—INTERNATIONAL PEACE

International agreement to certain well-defined limits. On the whole, the laws and conventions of war were honourably kept by belligerent nations, for the reason that the military science of the times did not make their infringement a virtual necessity; or put differently, for the reason that the carrying on of war did not involve the active participation of the whole nation and thereby make the distinction between soldiers and civilians on which the limiting conventions were based, a dead letter.

To-day we have returned to the conditions of tribal warfare. It is the whole strength of one nation set against the whole strength of another. There is no sense in talking about confining hostilities to the armies in the field, when the whole country is one huge arsenal, and every man, woman, and child is enrolled for "war work", and doing something or other to keep the fighting machine working at high pressure. Logically, the extermination of the civilian population is a legitimate object of modern warfare; for every belligerent country is virtually in a state of siege, and it is as legitimate to employ the usages of war to reduce a besieged nation to submission, as it is to employ them to reduce a beleaguered fortress.

In a word, through the agency of science, the modern world has now to face war in its primitive beastliness, and the thousand year attempts of European civilisation to circumscribe its horrors and in a sense to humanise its character have ended in failure.

We who read of past wars affect horror at their tale of savagery and destructiveness. But why should our conscience be so nice on the point? Not the worst of past wars, not even the 'Thirty Years' War, nor the Napoleonic Wars can vie with the Great War either in inhumanity or in destructiveness. Old wars were waged savagely enough as we know; but it was a savagery

THE WORLD, THE AIR AND THE FUTURE

of a different order from ours, more specifically brutal no doubt, but less positively inhuman, and how infinitely less thorough! It was the savagery of a rude soldiery in the heat of battle, in the intoxication of victory; ours is the calculated "frightfulness" of policy, conceived in the Council Chamber, prepared in the laboratory, and worked by the inhuman agency of mechanical invention. Then, too, the destructiveness of the old wars was intermittent and piecemeal; that of ours is constant and wholesale. Not only are our engines of destruction beyond comparison more deadly, but the area of conflict is out of all proportion greater. Whereas in former wars it was confined to the field of battle, the line of march, the fortified town; to-day it embraces the whole territory of the enemy nation, and the heavens that overarch it.

A further fact about modern war is that it does not pay. It is as ruinous for the victors as for the vanquished. And here the analogy of primitive warfare no longer holds good. The primitive tribes did not trade with one another. When one tribe crushed its enemy in battle, its triumph was pure gain; it rid itself of a troublesome neighbour, and enriched itself at the latter's expense, and there the matter ended. The more complete the triumph, the more profitable to the victor. There was no devastating back-shock to the momentum of victory, and no economic considerations to minimise its assets. To-day when the nations of the world make up an International system of trade and finance, the damage inflicted by one great nation on a powerful rival ultimately reacts on itself. Besides, when two great Powers fight each other to a standstill, it means the exhaustion of both, and the victory can only be a barren affair. What profits victory when the plight of the victors is almost as bad as that of the vanquished? The triumph of the Allies in the Great War was complete;

AIR TRANSPORT—INTERNATIONAL PEACE

but once the bells of victory had stopped pealing what had they to show for it? Was their material and moral exhaustion appreciably less than that of the defeated enemy? On both sides there was the same appalling sacrifice of human life, the same wastage of the national substance, the same nerve-shattering strain. And the aftermath showed that the victors could not cure their own wounds without rendering first-aid to the vanquished.

The spectre of war as it is carried on to-day haunts civilisation like a nightmare, and the nations are vainly trying to devise schemes for lessening its frightfulness. All such schemes are futile, and merely show that we are not prepared to face the logic of facts. Throughout the ages, nations at war have invariably made full use of every destructive invention known to them. And so it will be always. It is no use calling conferences to discuss the question of prohibiting the use of poison gas, abolishing submarines, limiting the functions of aircraft, and so forth. Whether such agreements are signed or not, a nation with its back to the wall will not pay the slightest heed to any of them. As well expect a man who is fighting for his life to keep the rules of the prize ring. In the first few days of the war the agreements will be kept by both sides, to gain the goodwill of neutral opinion; but this will not last. The slightest infringement of any of them, or even the rumour of such infringement, by one of the belligerents, will draw from the other a fury of protest, and at the same time give it the excuse it wanted for acting in a like manner. Each side will begin by repudiating the convention that seems to cripple its own efforts more than it cripples the efforts of the enemy, and before long every restrictive check will be thrown over by both. Nor must we forget that the poison gas of the printing press is just as deadly an instrument

THE WORLD, THE AIR AND THE FUTURE

in modern war as the poison gas of the laboratory. Truth is at a discount in wartime. The true is the expedient—anything which helps, justifies, or improves the morale of one's own country, or serves to increase hatred and contempt for the enemy, and to put him in an odious light. By an ably conducted propaganda a belligerent state can make out a good case for anything it chooses to do. Its own people will always, and in fact must, believe everything it tells them, and the neutral world will choose to believe or not, according to where its sympathies and interests lie.

We are not being cynical: we are facing the stern logic of the situation. There can be no half measures in war. There is no half-way house between its complete abolition and the maximum utilisation of all the means of destructiveness that modern scientific invention has put into the hands of any and every belligerent country.

It may well be that war will never be abolished until we arrive at a world-state of civilised powers; and that is a far distant dream of the future. The abolition of war implies universal disarmament; and it is quite clear from the niggardly policy pursued by every Government without exception on the preliminary question of limiting armaments, that civilisation is prepared to risk the catastrophe of another world-war rather than take the only steps that can remove the danger of such a contingency. It is something ironical that though all the Great Powers made the grand gesture of signing the Kellogg Pact for the renunciation of war as an instrument of national policy, the only one to put forward a definite proposal at Geneva for immediate and universal disarmament has been Soviet Russia, herself a greater danger to world peace than all the others put together; whilst the United States, who initiated the Pact, authorises fifteen new ten thousand ton cruisers before

AIR TRANSPORT—INTERNATIONAL PEACE

the ink is yet dry on her President's signature! Yet unless the nations disarm, all agreements for the renunciation of war are not worth the paper they are written on. It is sheer sophistry to argue that nations must continue to keep up their armaments in order to be in a position to enforce peace on their neighbours. Let us not confuse the issue. Granted that the total abolition of armaments is not a practicable proposition, this is not to say that individual nations cannot disarm and regulate their affairs by contributing to the upkeep of an international naval, air, and military police force. Some armed forces must always continue to exist; the point at issue is, who is to control them?

It is an undoubted fact that the fear of war, engendered in all nations by the experience of the Great War, is working in two contrary directions. On the one hand it is causing the nations to meet together in frequent conference for the purpose of removing the causes of war and reconstructing the world on a peace basis; and, on the other hand, it has created a scare among them which effectively paralyses the whole peace effort. Never have the European States been more pre-occupied with the question of national defence. Realising that in the event of war a weakened defence means immediate and irretrievable ruin, States are less prepared than ever to risk anything in the cause of peace.

A striking instance of the extent to which, even in Great Britain—which is more advanced politically than most countries—the fear of war cripples the economic and other influences that are working towards its elimination, is afforded by the attitude adopted by the British Government towards the project of the Channel Tunnel. Manifestly the construction of the tunnel is desirable from every point of view save that of the Admiralty and War Office. Yet the slight danger that, in some

THE WORLD, THE AIR AND THE FUTURE

war of the future, the existence of such a tunnel might conceivably jeopardise our safety outweighs in the eyes of the Government all the economic advantages the scheme indubitably holds out to us. The point is not so much that the military objections to the tunnel are now out of date and that, instead of prejudicing our strategic position, it would strengthen it by helping to ensure our food supply, but that we should reject the scheme for purely military reasons, and leave the last word to our military authorities. It all goes to show that our political psychology is as war-ridden as ever.

However, in spite of the manifold forces working against it, the cause of universal disarmament presents a sufficiently concrete ideal to justify the hope of its ultimate realisation. It does not, that is to say, seem altogether outside the range of practical politics. Clearly if war to-day can be to the ultimate profit of nobody, it is a clear contradiction in terms to pretend that it can be to anybody's interests to wage it. Political logic, therefore, is wholly on the side of a general disarmament. But the idea implies a wholly new conception of political realities. It is not enough for the nations to sign an agreement to renounce war. They must show by their policies that they believe such an agreement to be workable, and that they are prepared to accept its implications. This means that the individual nations must develop an international consciousness, that they must learn both to think and to function internationally. In the framework of the modern world there is no place for a purely selfish state. When no national development is possible outside the international relationship, it is idle for any single nation to claim absolute autonomy and freedom for its own selfhood. On the contrary, each nation must submit to a diminished sovereignty, a restricted freedom; and an enlightened self-interest demands from each a certain

AIR TRANSPORT—INTERNATIONAL PEACE

measure of self-sacrifice. A profound recognition of this fact must be the basis of the new outlook on world-politics; and it implies a general, whole-hearted, and unqualified acceptance of the principle that, in the words of the late Lord Haldane, "it is not brute force, but moral power, that commands predominance in the world."

To-day the will-to-peace is sincere and manifest. But it is too timid, too negative, not dynamic enough, too little constructive. Owing perhaps to the persistence of a war psychology, we view the issue of peace and war too much in its negative aspect. We think so much about eliminating the causes of war, that we are apt to forget that the best way to do this is to develop and consolidate all the positive forces working for peace. We must launch a Peace offensive. Our efforts for peace must be as dynamic, as ruthless, as comprehensive, as our war efforts have been in the past.¹ The forces of Peace must get such a grip on the nations that war will become far too difficult and complicated an operation for any nation to embark upon. Strictly speaking we cannot, I think, remove the causes of war. Clashings of interest and policy between States there will always be; and these we cannot prevent. But we can do much to prevent such disputes from leading to an open rupture. It is the sword-rattlings, the veiled ultimatums, the fears and threats of war, the hints at mobilisation, and war preparations generally, that aggravate national differences and create that inflammable atmosphere in which any chance spark can cause a conflagration. What is needed then is a freer, healthier political psychology. We must try to rid ourselves of our war-obsession, and the best way to do this is to concentrate our attention on building up the machinery of peace. We must so strengthen

¹ See my speech on the Air Estimates, March 7th, 1929. (*Hansard*, vol. 226, page 664 et seq.)

THE WORLD, THE AIR AND THE FUTURE

the international framework of society, and so consolidate the International idea, that all wars will become virtually civil wars, which means that they will be too disastrous from an economic point of view, and too abhorrent to our moral sense, to be thinkable as a means of settling disputes between nations. In other words, it is in our power to make the preservation of peace an economic necessity and a principle of international morality.

It must be remembered that never at any time has the cause of Peace had so many assets to draw from as to-day. One of the chief of these is the financial and economic pull towards Internationalism of which I have already spoken, and to which I shall have to refer again. But there are others. There is, for example, the intense and growing feeling of solidarity among the working classes of all nations; and however much we may deplore the class-war and subversive propaganda that accompanies it at the moment, only blind prejudice will refuse to recognise its far-reaching significance as a synthetic force in International affairs. Then there is the steady progress of education with its broadening influence and the humaner, more enlightened outlook on life, that it portends in the rising generation. Again, there are inventions like wireless, the cinematograph, and the gramophone, all of which are powerful assets of peace, in that they are international both in their appeal and in their educative influence.

Finally, there is the revolution that is being brought about in our methods of communication by the invention of aircraft; and this may well prove to be the most fundamental and far-reaching of all the factors that are working for unity and peace in the world. In the first place, a system of communications which demands in some sort an international world-order for its effective development must necessarily tend to bring nations

AIR TRANSPORT—INTERNATIONAL PEACE

together and promote a good understanding between them. In the second place, every invention that speeds up communication acts as a big stimulus to trade and industry, so that the swift method of transport and travel provided by aircraft will be a potent instrument of economic development; and it is precisely the pressure of economic forces, as we shall presently see, that is slowly but surely breaking down the barriers of national separatism all over the world and preparing the way for a United States of Europe, and ultimately perhaps for a World State that shall embrace all civilised peoples.

§ 2

It is true to say, I think, that on its material side the progress of civilisation has been a synthetic process directed and implemented by the progressive annihilation of distance. It has been essentially a speeding up process in the means of communication between the various parts of the world. One might measure the advance of human progress by the increasing rapidity with which man has been enabled to get from one place to another. The more civilised man becomes, the more the question of distance irks him, and the more he endeavours to overcome it; and as each successive improvement in the means of communication brings with it new needs, new hopes, new desires, which the relative success over distance can only partially satisfy, he is for ever impelled to redouble his efforts to overcome the unconquerable enemy. In a word, speed becomes an ever greater necessity to him in proportion as he achieves it; and his desire to achieve it is one of the driving forces of civilisation itself.

A century ago it took four days to get from London to Edinburgh. Everything was done in the way of improving the state of the roads, ensuring a swift ex-

THE WORLD, THE AIR AND THE FUTURE

change of horses at the various halting stations, and so forth, to make the journey as speedy as possible under the existing conditions. And man, always in a hurry to get to his destination with the least possible delay, organised his time according to the maximum speed afforded him by the prevailing means of locomotion. Then railways were invented, and it became possible to reach, say, Edinburgh from London in one day instead of four. The possibility of covering distance three or four times more quickly than heretofore soon established itself as a positive necessity even for the most conservative citizen, and railway travelling became a habit and a need.

The part played by railways in the development of civilisation is too well known to require emphasis here. They virtually made modern Germany and the United States of America, and in alliance with coal they created the industrial greatness of nineteenth-century England. And in railway travelling, too, the demand has always been for quicker and quicker trains and more and more of them, to ensure the completest possible triumph over distance that this means of locomotion can achieve.

Now that aircraft have appeared on the scenes we shall witness a similar process. At the moment air-travel is a rich man's luxury, and sparingly used. It does not yet compete with the railway, as confidence in its safety and stability is not yet established; nor have we had time to familiarise ourselves with the idea. In this country, especially, the idea permeates slowly, as, owing to our short distances and excellent system of rail and road transport, a quicker method of locomotion is not of immediate urgency. Sooner or later, however, as flying becomes everywhere more general, it will become even with us a matter of commercial necessity. We shall find ourselves speeding up the tempo of our

AIR TRANSPORT—INTERNATIONAL PEACE

lives, and organising our needs and requirements on the basis of the rapid means of communication and transport provided by aircraft. We shall grudge the waste of a whole day on the journey to Edinburgh, when we can do it comfortably between breakfast and lunch, and return again in time for dinner the same evening.

We see a speeding up process of the same kind at work in another branch of communications. In the old days, the letter post offered the only means of transmitting news or sending messages from one place to another. The method seems slow to us; but the expectations and requirements of people were regulated accordingly, and it completely satisfied the needs of society. Provided that it was carried out with the maximum of efficiency, no one regarded the delay involved with any impatience. Once the telegraph was introduced, telegraphic communication became a constant and urgent necessity; and not to be within telegraphic reach of anybody was soon accounted an intolerable hardship. To-day not even the telegraph satisfies our need of prompt communication. We are at a loss without the telephone at our elbow.

Every improvement, therefore, in our method of communication means a speeding-up in the tempo of life, and thus creates a demand for its own intensive development. We are, as it were, in the grip of our own inventions, and each great technical triumph gained over the obstacle of distance exercises a dynamic influence over the whole movement of civilisation.

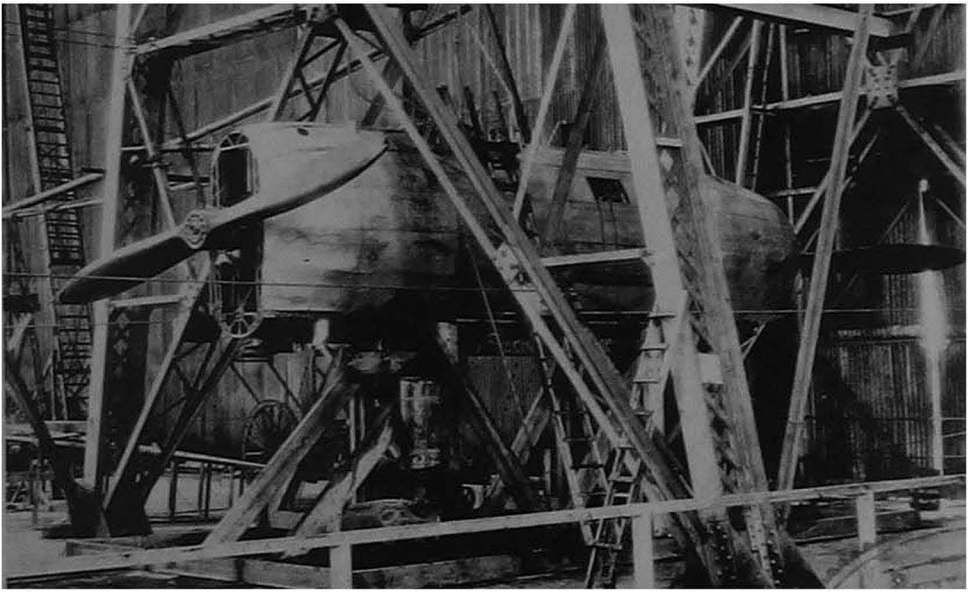
Now if, as is manifest, the aeroplane and the airship provide the quickest mode of covering distance that has yet been devised, it means that they are going to be a dominating factor in determining the trend of the contemporary world. It means that they are going to create the conditions of their own development. Indirectly and without our altogether realising it, they will dictate

THE WORLD, THE AIR AND THE FUTURE

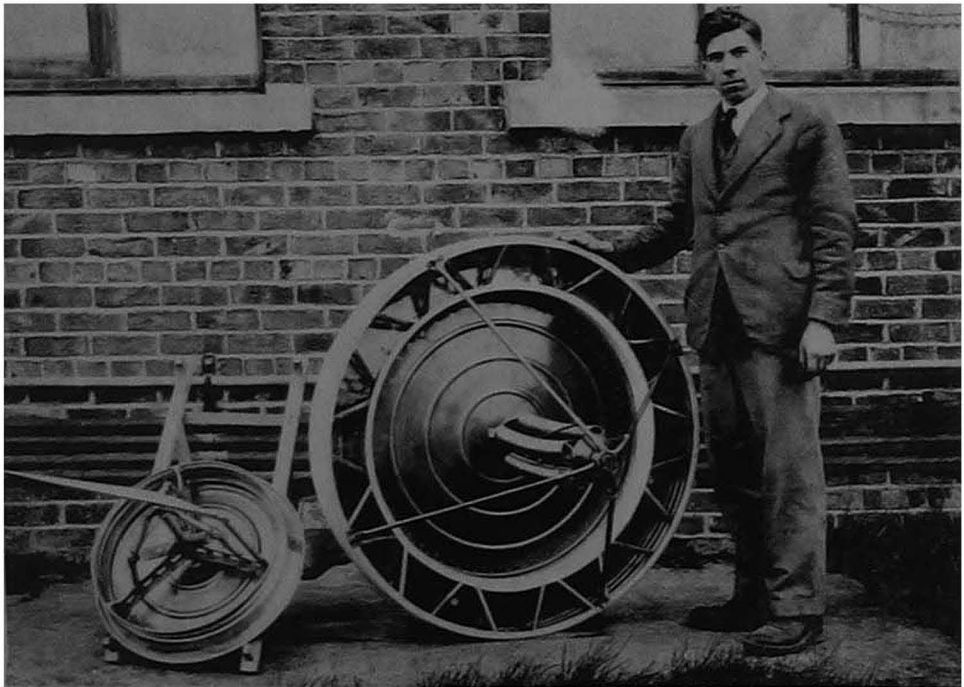
policies, transform issues, solve old problems in a new way, and bring important new changes into the psychological structure of human society. Once mankind becomes acclimatised to the thought of air-travel and accepts it as part of the scheme of things, flying will impose itself on civilisation as a necessity. The public in all lands will insist on its intensive development, and any obstacle that stands in the way of its maximum exploitation will be overborne by the general insistence. In an age whose god is speed, nothing is going to stop man from reaping the full fruits of the greatest triumph he has yet scored over his two enemies, time and space.

The question now presents itself: how soon is the driving force of air power going to make itself felt? As has already been pointed out, civil aviation, if it is to function properly, must be developed internationally. Hence an elaborate system of air communications throughout the world implies at least a partial victory of the international principle. This means that, apart from technical difficulties, the greatest obstacle to the development of the air is the spirit of nationalism. The more we cultivate the international outlook, the more we shall be able to utilise the splendid advantages of air power; and, conversely, the more we insist on pushing ahead with air development, the further we shall advance along the road to Internationalism. To-day, as we know, the forces of nationalism are cramping the functions of civil as opposed to military aviation, in every direction. In doing so, however, they are fighting a losing battle; for not only are they opposing the common interests of mankind, but they are running counter to the spirit of the age.

We have to remember that however loudly it may continue to assert its claims, nationalism in its narrow sense is an anachronism in the modern world. Economic forces are over-ruling it everywhere; while the



R.100. One of the Engine Cars, comprising two Rolls Royce engines



R.100. One of the automatic and manoeuvring Gas-valves

AIR TRANSPORT—INTERNATIONAL PEACE

whole moral and cultured trend of the times is towards an opposite ideal. I look to see, therefore, a gradual wearing down of the difficulties that State separatism puts in the way of aircraft development. The struggle may be protracted; but it can only have one issue, for the simple reason that in impelling the world towards Internationalism air power is working with the spirit of the age, not against it.

Again, it is, I think, a point of deep significance for our argument that it is precisely in air power that we find the symbolical expression of what I conceive to be the trend of the age towards Internationalism.

The air, unlike the land and the sea, cannot be parcelled out among the nations. It does not admit of propertyed possession, national frontiers, administrative zones of control, etc. It is indivisible and universal, the common property of all. It reflects, therefore, the International principle. We see then that an almost metaphysical interest attaches to the science of aviation; for it is not by a mere chance that man has found the means of exploiting this international medium for travel and transport purposes, at the precise period of history when a cosmopolitan outlook is being forced on the world and all the deeper currents of civilisation are flowing in the direction of Internationalism. On the contrary, the symbolic relation we find between the Air and Internationalism accords with a parallel development of a similar kind that can be traced throughout the process of historical evolution. This is a point of sufficient interest to detain us for a moment.

I have described the history of civilisation on its material side as largely a history of the development of communications. Now of the three roads of communication open to man, the land, the sea, and the air, the land is the one that fits in best with the needs and principle of territorial nationality. The land is sus-

THE WORLD, THE AIR AND THE FUTURE

ceptible to quantitative division in any measure. It can be cut up into small or large pieces. It admits of private property, and of various forms of particularism in its exploitation. It provides "natural" boundaries in the way of mountains and rivers for the setting up of local systems of control and self-contained units of national life; and by affording each of these territorial divisions the means of pursuing an exclusive development, it promotes a separatist outlook, and encourages each to concentrate on the needs and interests of its own entity. Clearly a system of land-communications will tend to be local and national. It will be intensively developed within the borders of each separate State; but the frontiers of each will present sundry barriers both natural and artificial to the freedom of international intercourse.

The sea presents a very different proposition. It can be made to serve the national principle, but it does not create it. Water cannot be pieced out like the land; it does not form natural divisions in itself; and, not itself producing the necessaries of life, it does not invite national exploitation in the same way. Its great use to man is as a road of communication; and as such it is free to all. The seas and oceans of the world have different names, but they are all of a piece—one vast, uniform, unobstructed surface for all peoples of the earth to use at will. You can get into a ship on the Thames and visit all the open seas of the universe in a single voyage.

Still, even the use of the water can be restricted. Inland waters are, of course, subject to the land Powers that encompass them; but restrictions can be placed on the use of the open seas as well. Coastal waters are the property of the nations whose coast line they bound, and definite limits are set to their free use by others. Again, a strong naval and mercantile Power

AIR TRANSPORT—INTERNATIONAL PEACE

can bring whole stretches of the ocean's surface within the sphere of its control, and virtually dictate the conditions of their usage by others; and it is possible for such a Power, when at war, to prevent its enemy from showing itself on the face of the waters at all. Not even the sea then functions internationally. It ought to do so of course; but the national principle has been too strong for it. A wholly free system of sea communications has never existed. Though the sea has served a unifying purpose in history, it has always been exploited on national lines. It does not, like the air, impose Internationalism as a condition of its development; otherwise, of course, the two great maritime nations of the world would not now be arguing so strenuously about "the Freedom of the Seas."

When we come to the air we have to do with the element that is free, cosmopolitan, universal, in absolute degree. It does not admit of quantitative division, and cannot be conceived of in parts. It provides no natural frontiers, and, unlike the waters of the earth, its area is not interfered with by land formations and projections; so that tracts of it cannot be partitioned off into zones of control, spheres of influence, and so forth. To illustrate the greater intrinsic freedom of air as compared with water, we may say that while you can put a tax on the water we use, you cannot tax the air we breathe.

As a means of communication the path of the air is everywhere. It embraces the whole universe. Anyone who gets into a flying machine at any point of the earth, can fly (subject to the technical efficiency of the machine), anywhere he pleases without obstacle or interruption. It is, of course, possible for a nation to forbid flights over its own territory, but difficult if not impossible to prevent them. To that extent only can the area of air travel be restricted. It is hardly conceivable that a nation at war would be able to conduct an effectual air

THE WORLD, THE AIR AND THE FUTURE

blockade against an enemy state; and it is certainly quite inconceivable that any nation would be able to patrol the aerial expanse of the globe and prohibit the use of the atmosphere to any but friendly or neutral aircraft.

All restrictions, therefore, to a free world-system of air communications will be wholly arbitrary and artificial; and what is more, it will not be possible to enforce such restrictions save over a comparatively small area, and then only to a limited extent.¹

It is hardly necessary to point out that in the history of the development of communications, the road of the land was the first to be exploited. The early centres of civilisation used water transport of course; but this water-transport was inland or coastal, and always ancillary to a system of land communications. The Empires of the ancient world were each of them territorial units of power. True enough, as we saw in the last chapter, only those which possessed sea-centrality were able to consolidate their supremacy over a long period; but this does not alter the fact that their strength was built up on a territorial and not on a maritime basis. They extended their frontiers to the sea, but not beyond it. The lands they owned or dominated were contiguous, not scattered. The seas they controlled were frontier seas, seas adjacent to their dominions, or within the sphere of their territorial influence.² We shall not find then an International

¹ It will always be easier for an aeroplane to elude a patrol of aircraft than for a ship to run a blockade at sea.

² The only purely maritime Empire of the ancient world was Athens, and her power was short-lived. She was worsted by militarist Sparta in the Peloponnesian war, and finally succumbed to the military power of Macedonia. The reasons are not far to seek. Apart from the fact that sea-communication in those days was difficult, the area open to the exercise of sea power was narrowly circumscribed. It was, as it were,

AIR TRANSPORT—INTERNATIONAL PEACE

world outlook in any of these ancient Empires. Each was a complete cosmopolis unto itself. Its life revolved wholly within the circle of its own attraction, and thus remained always circumscribed and parochial. The spacious vision, the cosmopolitan, international outlook which are the concomitants of a maritime power that plants off-shoots of itself in distant parts and develops contacts with centres of civilisation far removed from its own centre of life, were lacking in all of them. Often we speak of the universality of the Roman Empire; but it was a universality wholly relative to the area of its own administration. The Roman conception of civilisation was summed up in the idea of the Imperium Romanum. The great concern of the Romans was to develop their Imperial system and to consolidate their frontiers. The movements of nations beyond meant nothing to them, save as a possible menace to the integrity of their power. Land communication was far too slow and difficult to bring them into close relations with the vast contemporary civilisations of the Far East, and sea communication was still too venturesome and undeveloped. Thus the world of the Romans ended at the frontiers of the Empire; and this was because their dominions were territorially compact and formed a single land unit. Save that he would have had to cross the Hellespont or the Straits of Gibraltar by boat, a Roman citizen could have made a circular tour of the Empire on foot, visiting every part of it with the exception of Great Britain, which was, after all, merely an Imperial annex, and never became a vital part of the Roman system. Sea power, of course, the Romans possessed, otherwise their Empire would not

^a Continental basin, so that maritime supremacy alone was not sufficient for the maintenance of an Empire; it needed to be supported by territorial strength on the mainland, and this Athens did not possess.

THE WORLD, THE AIR AND THE FUTURE

have held together.¹ But the seas they controlled—the Mediterranean, the Adriatic, the Aegean—were inland seas, that is to say, Roman lakes.

The development of sea communications began with the enlargement of the map of the world in the fifteenth century; and as always in the history of communications, cause and effect closely interacted. The means of exploiting the road of the sea were discovered at the precise moment when civilisation was expanding its horizons on every level. Henceforth the sea was no longer subservient to the land, it became itself the sole basis of a new kind of power. And just as the sea is a more universal element than the land, so was the new kind of Power built up on sea communications, wider in its area of control, freer in its movement and outlook, and more international in all the implications of its development, than any land power known to history. The commercial and maritime Empires that grew up in the fifteenth and sixteenth centuries had no territorial basis of power whatever. Portugal and Holland were tiny fragments of Europe, but they controlled the new trade routes to the East, and their influence was world-wide. The extent of their dominion is to be estimated, not by the area of their colonial possessions but by the length and importance of the sea-routes reaching out to them which they controlled and exploited. These new high-roads of civilisation were diameters of a larger world than acknowledged the sway of Imperial Rome, so that their control brought with it a sphere of influence that extended over a greater area than was embraced by the Roman Empire.

The supreme example of a world-wide power built up entirely on sea communication is Great Britain. All the advantages and possibilities of this form of communication are exhibited in a pre-eminent degree in the

¹ Vide supra p. 86

AIR TRANSPORT—INTERNATIONAL PEACE

story of her Imperial development. She has planted her foot in every corner of the earth, and founded what are virtually new Empires in every continent. The sea can produce no bigger result than the British Commonwealth of Nations. A larger, more widespread, more comprehensive Empire, or one of freer, more cosmopolitan outlook, is not, I think, conceivable, except on an International basis.

After the sea, the air. It has been the function of sea communications to enlarge the confines of the world; to make civilisation co-extensive with the whole habitable universe; and by the synthetic agency of trade and commerce, to bring all the families of mankind into interdependent relations. It will be the function of the air to intensify and complete this synthetic process.

The road of the air is a free and universal thoroughfare for all mankind. As wide as the world, and almost everywhere navigable,¹ it is unhampered by any barrier, obstacle, or limitation whatsoever. Any restriction to its usage will be an arbitrary restriction imposed by the will of man. By its nature, its freedom is absolute. All points within it are at the minimum distance from each other, they can be crossed as the "crow flies." And as though to accentuate the untrammelled freedom of this road of communications, the means devised for exploiting it have a velocity with which no other method of locomotion can compare. An aeroplane can cover a distance three times as fast as any method of land travel. A flying boat can move through the air five times as fast as any ship can move through the water. The new elliptical type of airship will be three times as speedy as the fastest ocean liner.

¹ We abstract, of course, meteorological considerations, which are not pertinent to this side of our argument.

THE WORLD, THE AIR AND THE FUTURE

What system of power, what kind of Empire does this universal road of communication postulate? It will be exploited everywhere, and ever more extensively; that is certain. But how are we to conceive a dominating Power whose supremacy lies in its control of aerial communications? Such a Power, I repeat, could not be developed on a national basis. No nation can establish in the air a supremacy like that so long exercised by Great Britain over the seas. In the old days England at need could close any sea to any nation. It was practically within her power to close all the seas of the world to almost any combination of Powers that could be brought against her. And this was so, because the sea as a road of communications has gates and channels and other limiting features, which make it possible for a single nation with a big enough fleet, to control its whole navigable surface. But the air has no such limiting features. The command of the air that should correspond with the old idea of the command of the sea is clearly not thinkable in terms of national power. It would demand a measure of ubiquity in the controlling air fleet, such as renders the whole idea farcical. In a word, no single nation will ever be in a position to write "No Thoroughfare" across the whole road of the air. Insofar as that road is to be barred for general usage, and the traffic of the skies curtailed, all such control must be an international operation.

And further, as no nation can build up an elaborate system of air ways, and exploit the roads of the sky for its economic development, save in collaboration with all other nations, we are forced to the conclusion that if air communication is to be the basis of some great Empire of the future, this Empire will be as much vaster, more comprehensive, more cosmopolitan and more universal than the sea Empire of Great Britain, as was that Empire than any of the land Empires that

AIR TRANSPORT—INTERNATIONAL PEACE

preceded it. In other words, it will be an International concern.

We can establish then an historico-metaphysical parallel between the development of communications and the psychological evolution of organised society, this parallelism having its roots in the specific character of each medium of communication that has successively dominated the progress of civilisation. We had a world-order based on communication by land, and this world-order was separatist and static, exhibiting a number of territorial units each involving an exclusive, self-centred, localised national life such as is postulated by the limiting principle of that medium. The next world-order grew up on the water—a free uniform medium not static or separable into parts like the land, but one that finds its way everywhere and contains no restrictive principle in itself; and so a greater fluidity is to be seen in the new units of Power: horizons expand, and state organisms develop themselves on a wider basis; nations and races meet each other in the intercourse of international commerce; their interests interconnect, common ideas circulate, the separatist principle is gradually weakened, and the progress of civilisation pursues a more synthetic and cosmopolitan development. And now to-day when this synthetic and cosmopolitan process has reached a point when all parts of the earth are being forcibly drawn together by the magnet of economic necessity, as so to form what is virtually the fabric of an international world-order, a new medium of communication offers itself for development, in which the essential characters of this new world-order find symbolic expression. Free, indivisible, and all-embracing, without barrier or restriction, or any form of distinction in its own essence, always self-identical and distributing itself equally over the whole universe, the air affirms the International principle;

THE WORLD, THE AIR AND THE FUTURE

and so it is that when we come to consider it as a road of communication, we find that it postulates a world-state for its effective functioning.

Before we deal with the practical ways in which air development will accelerate the international process let us see to what extent the economic forces of our time are working in the same direction.

§ 3

States are still intent on developing their internal economies on a national basis. Each nation still affects to regard its small territorial unit as a self-contained economic whole, and strives to build up its economic strength by protecting its own industries and putting prohibitive tariffs on the goods of the foreigner. As things are at present, of course, a certain measure of "safe-guarding" is everywhere necessary; it is as necessary as the guarding of frontiers and the upkeep of armaments. None the less except among politicians, these national barriers to free trade are generally felt to be a nuisance, and a severe handicap to real economic progress.

We live in an age of mass production, when by the agency of mechanical processes, goods of every description are being produced and manufactured on a scale such as no previous age has witnessed. At the same time, side by side with this enormous increase in output there has been a corresponding development in mechanical transport, which provides a world market for its distribution. Supply and demand have, as it were, both become international. The complex needs of modern civilisation together with rapidly increasing populations, have created a universal demand for more and cheaper goods of all kinds, which rises progressively with every year that passes; and this demand cannot

AIR TRANSPORT—INTERNATIONAL PEACE

be met on a national basis. No single nation, save the United States of America, which is, after all, a continent in itself, can supply even the most elementary wants of its own nationals; these have to be met by producers and manufacturers from other parts of the world. Accordingly everywhere we find the producer producing for a world market, and the consumer depending on a world output for the satisfaction of his needs.

Clearly, the economic basis of modern life is an International basis; and if we look closely into certain implications of the mechanisation of industry, we shall find several factors at work, each of which is forcibly breaking down the economic barriers with which an out-of-date political nationalism still strives to maintain itself against the spirit of the times.

One of the main results of the mechanisation of industry and transport is the development of bigger units of control both in production and in distribution. Machinery-plant is expensive and requires constant renewal; and this, together with the high rates of wages, overhead charges, advertisements, and so forth, makes the cost of production exceedingly heavy for the small man, and renders it impossible for him to turn out goods at competitive prices. Costs of production, however, are in inverse proportion to the size of an undertaking. Consequently there is a growing tendency for firms engaged in the same industry to reduce costs by pooling their resources and forming themselves into combines. Much wasteful competition is thereby eliminated, a bigger output is achieved at a lower cost, and prices can be fixed at an economic level. The same tendency towards co-operation and amalgamation is showing itself in every department of trade, industry, and finance. Two results of this are to standardise qualities and to give uniformity to model and design; and though these results like many other results of the growing mechanisa-

THE WORLD, THE AIR AND THE FUTURE

tion of the universe are to be deplored from other points of view, there can be no doubt that they help on the unifying process of our civilisation.

It is clear, then, that the day of the small independent concern is over. The small shopkeeper is being bought up or turned out of business by the multiple stores with branches everywhere. Small private banks are either forming themselves into a single group, or are being absorbed by the larger banks with bigger capital; and the great banks themselves find co-operation more profitable than competition—witness the co-operation in policy among the Big Five in England.

It is to be noted that this movement towards amalgamation and trustification ignores national boundaries. Thus, in the producing industries we have the great Steel Cartel on the Continent comprising the steel industries of half a dozen European States, the recent amalgamation of the Dutch-British and Anglo-Persian Oil Companies, and the amalgamation of Mond Nickel and International Nickel Corporation, which again brings both into close relationship with the great organisation of Imperial Chemicals; in transport we have the Wagon Lit Company which covers all Europe, and has lately taken over the equally international undertaking of Thomas Cook & Son, Limited; while in the distributive field there are such international establishments as Woolworths, Appenrodt, etc. Further, there are trusts being formed which are designed to achieve world monopoly and dictation in a particular commercial product; such as for example the Corporation with £120,000,000 capital which has just been formed in the United States with a view to the holding of motor-car shares in various companies all over the world.

But if the economic future lies with the Trust and the Amalgamated Combine, if there is a universal tendency in every department of trade, industry, and

AIR TRANSPORT—INTERNATIONAL PEACE

finance for the separate units of control to group themselves together under single management, so as to form one vast organisation with sufficient capital to wield dictatorial power over the markets and financial operations of the world—how is this going to affect the political situation of Europe, divided as it is into a number of small States, each trying hard to work out its economic salvation in the old time-honoured way, by promoting home industries at all costs and raising tariff wars to keep out the goods of the foreigner?

Here we find ourselves up against the same kind of problem that faced us with regard to armaments. There can be no doubt that the removal of all tariff barriers that prevent Europe from being a single economic entity is greatly to be desired, whether we look at the matter from an economic or from a political point of view. But here as in the case of disarmament no country can afford to move alone. We in England who embraced a policy of Free Trade a century ago, now find it necessary to qualify it by the process of "safe-guarding," in view of the refusal of the rest of the world to follow suit. Yet it must be admitted that logically there is as little to be said for the imposition of tariffs as for the upkeep of armaments. Both are due to a narrow national outlook which refuses to adjust its vision to the changed conditions of the modern world.

Just as a number of small independent businesses cannot hold their own against the big amalgamated combine, neither can the separate States of Europe hold their own as independent economic units against a continental combine like the United States of America or against a world-wide Imperial combine like the British Commonwealth of Nations, supposing, that is to say, the British Empire does in fact achieve an economic unity. When a small State interferes with the free play of economic

THE WORLD, THE AIR AND THE FUTURE

forces by putting prohibitive tariffs on foreign foods, either to raise revenue or to bolster up such of its local industries as cannot compete in world markets, what it does is to force up prices to an uneconomic level, to raise the cost of living, to restrict the productive use of capital, and to impoverish its own money market, thereby drying up its legitimate sources of taxation, and creating all the conditions of financial disaster and social unrest. Of course I am stating the case theoretically; in practice, there are always other factors at work which counter the evil effects of such a policy, and can even cause them to take on a healthful appearance. Many European States have prospered and do prosper under a high protective system, but such prosperity is due to peculiar conditions and temporary causes: and it is not equal to the prosperity that each would experience as part of a great area of continental extent like the United States of America, operating on one uniform external protective tariff, but internally free of all barriers. The economic power of the United States is equal to that of a combined Europe with Russia excluded; and my point is that it is as unprofitable for the several European States, not even excepting Germany, to enter singly into industrial and commercial competition with America, as it is for the small business concern to try to cope with the amalgamated combine. The only European State that could hope to do so successfully, were she properly organised, is Russia; but her time is not yet. At present a divided Europe is striving to hold her economic position against America with overhead charges of from 25 to 30 per cent. higher. The effort is vain, and so we find her rapidly becoming an economic appendage of the United States. The fact that most British and Continental securities are being marketed on the New York Exchange, and that such an all-British concern

AIR TRANSPORT—INTERNATIONAL PEACE

as the Marconi Company is largely in fee to American investors shows clearly what the situation is coming to.

Bearing in mind that one of the objects of imposing Customs duties is to provide funds for the upkeep of armaments, we may say, I think, that while economic forces are working progressively towards Internationalism, political forces are still pulling in an opposite direction. Consequently it is on economic necessity rather than on political vision that we must build our hopes of a United States of Europe. This view finds eloquent support from post-war happenings in Central Europe.

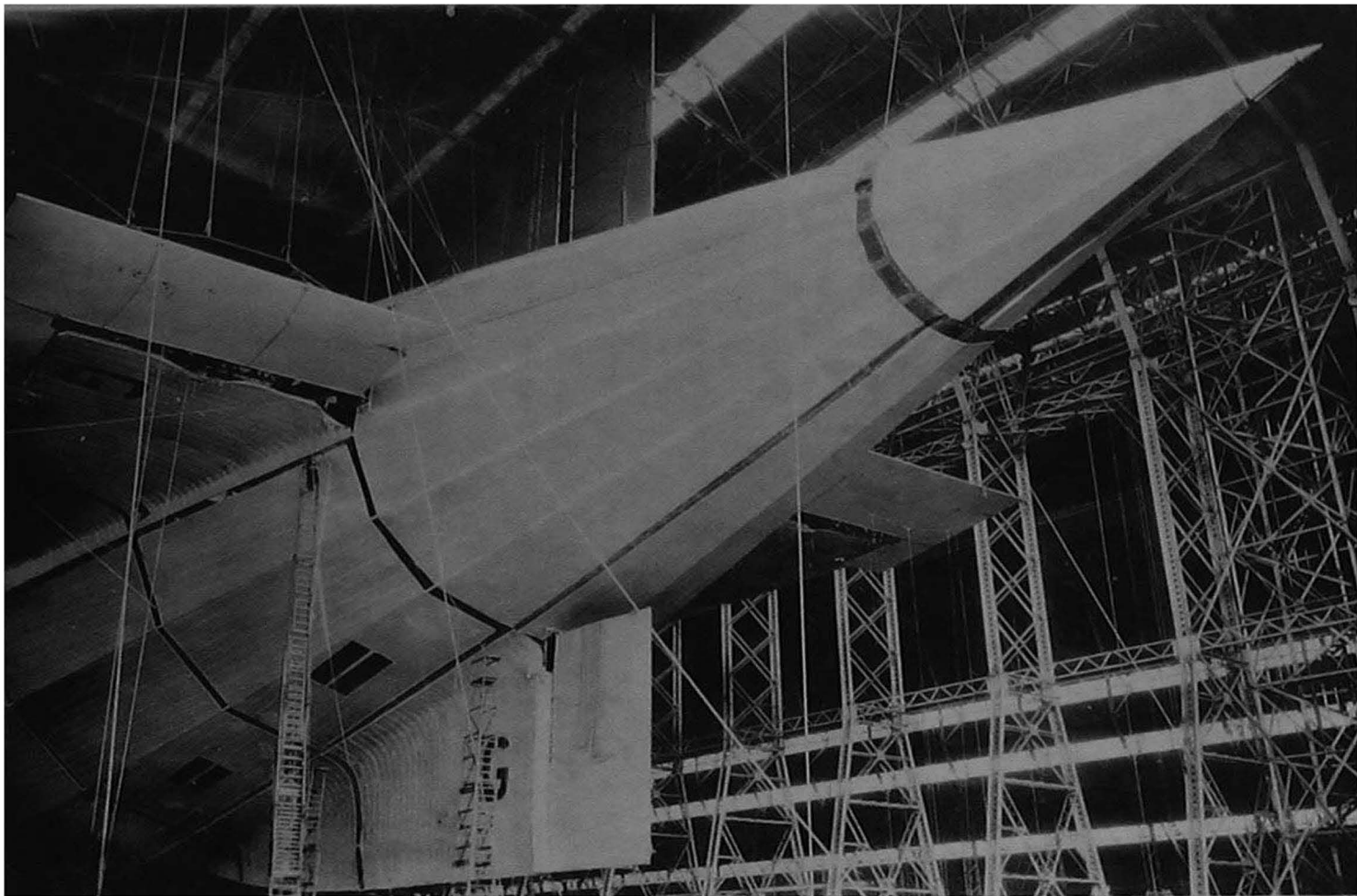
The collapse of the Austro-Hungarian Empire gave birth to two new States, Czecho-Slovakia and Yugoslavia, and increased the territory of the Kingdom of Roumania by more than a third. At the same time it reduced Hungary to a third of its former size, and left Austria a mere suburb of Vienna. The result was that the political relations between the new States and Roumania on the one hand, and Austria and Hungary on the other, were of unexampled bitterness. Austria, it is true, was too impotent to give active expression to her resentment. In Hungary, however, the thought that her fairest provinces were now in the hands of those whom she regarded as her racial inferiors, rankled like an open wound, and she took up an attitude of defiant hostility from the first; while Czecho-Slovakia, Yugoslavia and Roumania, mindful of past wrongs, and in constant fear of aggression, returned her hatred with interest.

All these countries, however, form really a single economic unit. The Danube is their high road of trade; they use the same outlets to the sea; and their network of railways centres around Vienna, the age-long capital of the system. Geographically and economically, though not ethnically they are one

THE WORLD, THE AIR AND THE FUTURE

Danubian State. Here, then, was a clear issue between economic necessity and political nationalism in its extreme form; and economic necessity proved the stronger. Thus, though the virtual extinction of Austria was a pleasing sight to the patriotic citizens of Czecho-Slovakia, they found it necessary, in their own interests, to help restore her economic life; consequently close commercial ties were formed between the two countries, to the benefit of both, at a time when Prague and Vienna were diplomatically hardly on speaking terms. Again, Czecho-Slovakia is an over-industrialised country, while Hungary is almost entirely agricultural. Accordingly, in spite of their mutual antipathy, each was driven out of sheer necessity to exploit the market of the other; so that active economic relations were established between them long before the inflamed state of national feeling on either side would allow reason to raise its voice in the settlement of racial and political problems. And the history of post-war relations between Hungary and Roumania, and between Austria and Yugoslavia, points exactly the same lesson.

Equally significant has been the triumph of economic forces over national animosities in the post-war relations of the Great Powers. It is economic considerations that have had most to do with putting Franco-German relations on a tolerable footing; and the excellent understanding that now exists between England and Germany is largely based on a mutual realisation that the two greatest commercial and industrial powers of Western Europe have everything to gain from working together in a close economic relation. Similarly, it has been her financial and industrial necessities that have compelled Soviet Russia to modify her programme of World Revolution, and to cultivate more neighbourly relations with Capitalist Europe, in the hope of attracting into the country the money and material



R.100. View of Ship, showing fins, rudders, and elevators

AIR TRANSPORT—INTERNATIONAL PEACE

she so badly needs for the up-building of her economic structure.

Needless to say, I must not be understood as meaning that economic factors are going to over-ride the national principle altogether. A nation does not live by bread alone, and not all the material advantages in the world will reconcile a people to the loss of their independence as a nation; had we in England kept sight of this fact, we should not have blundered so in our dealings with Ireland. What I do contend, however, is, that the stress of their economic necessities is gradually forcing individual states to group themselves together into great continental and imperial economic systems; and that this trend, though it does not necessitate the sacrifice of the right to self-determination, does most emphatically mean a giving up of national rivalries and racial animosities among the members of the group, and the definite sacrifice on the part of each, of all such rights of separate statehood as interfere with the workings of the larger organism in which it has to function.

It is safe then to prophesy that if we are going to have a United States of Europe, it will be brought about by economic necessity rather than by political understanding. A general abandonment of tariffs seems a more thinkable proposition than universal disarmament. A time will come, though perhaps we shall not see it, when the nations of Europe will at last wake up to the advantages that will accrue to them from organising their economic life on a continental basis; and grouping themselves into an economic Federation of European States, they will achieve simultaneously and at one stroke the elimination of both war and tariffs. Accordingly European statesmen should, I think, approach the problem of peace on its economic rather than on its political side, and try to clear the ground for the free

THE WORLD, THE AIR AND THE FUTURE

play of economic forces. With the League of Nations firmly established at Geneva, the formation of an economic federation of Europe might well be achieved within the next two generations, in spite of all the hostile forces working against it. But concentrated effort will be required and many thorny problems will have to be tackled. One important step towards preparing the foundations of a United States of Europe would be the establishing of a common currency for all Europe. This should not prove an insuperable difficulty. Just as the United States of America has standardised her currency and established a Federal Reserve Bank at New York, it ought to be possible, I think, as time goes on, to create a common currency for the whole of Europe with a Federal Reserve Bank at, say, Geneva under the jurisdiction of the League of Nations. A practical development of this kind initiated and organised by the League would, I believe, be of more value than any Kellogg Pact. At the same time there are many other ways of accelerating the economic unification of Europe, and among the chief is the development of air-communications.

§ 4

In the chapter on Air Transport and Empire Development, I dealt at length with the various ways in which aviation, if properly developed can be made to help on the cause of Imperial unity. The problem of establishing a United States of Europe is, of course, a very different problem from that of consolidating the structural unity of the British Commonwealth. It is immensely more difficult, and is complicated by a number of political issues that are absent from the latter problem. In both cases, however, aircraft will operate towards the same end. In either case we may

AIR TRANSPORT—INTERNATIONAL PEACE

expect them to be a potent instrument of unity, solidarity, and peace.

It will be objected, perhaps, that speedier means of communication and increased facilities for trade and intercourse do not necessarily bring with them an improvement in inter-state relations. Railways, it will be argued, have built up the economic strength of nations; but it cannot be said that they have done much to promote friendly relations between them, and a good case could be made out for the contrary view.

This is true enough. On the other hand we must not forget that if economic forces now require an international framework of Society for their free development, this is mainly due to the rapid intensification of the commercial and industrial life of nations that everywhere followed the introduction of railways. The point is, however, that rail transport and air transport postulate entirely different conditions for their exploitation. Railways, being a form of land communication, must operate territorially; they are the exclusive property of the state through whose territory they run, and they are laid down and exploited by that state independently of all outside interference and control; though even this exclusively national method of communication has had to be internationalised to a certain extent, and we now have through-train services from one end of Europe to the other. Air communication, however, postulates a totally different conception. The main advantages it has over other modes of communication are speed and range; and these are wasted over short distances. Thus there is no sense in a country (unless it be the size of a continent like Russia or the U.S.A.) building up a system of airways for its internal use only. People will want to fly not for the fun of the thing, or to save an hour or so on a train journey, but solely because aircraft will enable them to accomplish long distance

THE WORLD, THE AIR AND THE FUTURE

journeys in about half or a third of the time that any other mode of travel would take to accomplish the same journey; that is to say, if they fly, in nine cases out of ten, it will be to get to a destination in foreign parts. But the whole purpose of air travel will be stultified if aircraft are to be victimised by the obstructive paraphernalia that the territorial divisions of mankind have put in the way of free travel and intercourse between peoples; if, in other words, they are to be held up at every frontier, so that the air traveller may be subjected to the usual routine of passport revision, luggage inspection, purse-prying, and all the other delays and inconveniences that waste the time and patience of the train passenger and motor tourist, and make the passage from one State to another such a difficult business at the present time.

To make air travel worth while, all these petty obstacles must be done away with. Direct non-stop air-routes must be established all over Europe, whereby the speed and range of aircraft can be exploited to the full; otherwise we shall not create an air public or get sufficient air traffic to make civil aviation a commercial proposition.

A system of European airways, however, can only be established by International agreement; and it will require, moreover, close inter-state co-operation in organisation and control. As Mr. Wells truly says: "It is as sensible to hope for an air transport system developed on national lines, as it would be to hope for an interoceanic railway system through the coalescence of mile and half-mile of bits of line built, each at its own sweet will, to its own design and gauge, by every village and township *en route*."¹

Apart from its general effect on economic conditions, and on the psychology of the European situation, a

¹ *The Way the World is Going*, page 130.

AIR TRANSPORT—INTERNATIONAL PEACE

proper system of European airways will have three important results.

In the first place, the partial abolition of customs and frontier regulations in favour of air-passengers will sooner or later have to be extended to other travellers as well; and so it will be the thin end of the wedge towards the total removal of all those restrictive barriers that now interfere with free inter-state communications, and a step forward will be taken along the road to the economic and political unification of Europe.

Secondly, the collaboration of various Governments in developing such an important matter as air communication is bound to have a unifying effect on policy generally. Communications are a vital part of every State economy, and co-operation in this field will lead to co-operation in other fields as well, and so advance us still further along the road to unity.

Thirdly. If any invention of international importance economically, like aircraft, were to be exploited on purely national lines, we may be quite sure that the rivalries between competing States would soon give rise to International complications. Each State would pursue what is known as a "forward" policy, trying to push its way here and there at the expense of the others, and not looking too closely at any means that enabled it to best its most dangerous competitors. Any State, which by its foresight and enterprise, managed to steal a march on its rivals, and to secure a partial monopoly of the new development, would be eyed with jealous hostility by all the late starters, who would be tempted to resort to unfair methods of competition in the endeavour to make up for lost time. There is little need to fear competition in the development of air communications, since the exploitation of the air cannot be left to the free play of national competition,

THE WORLD, THE AIR AND THE FUTURE

but necessitates a communal effort on the part of the combined States of Europe.

To come now to the general unifying effects which the development of air communications will be likely to have on the European situation, these fall under three main headings—economic, political, and cultural; though each of these headings really represents a different aspect of one and the same problem. We are conceiving of Europe as a potential unity, and, needless to say, what facilitates the approach to solidarity in one direction, will facilitate the approach in other directions as well. We saw this clearly in the chapter on Empire Development.

In that chapter I tried to show how a complete system of Imperial airways, by linking up the distant parts of the Empire, would enable us to convert an agglomeration of separate units into a single economic organism; how it will help to establish close political relations between the Mother Country and the Dominions, and so give unity to our Imperial foreign policy; and how by facilitating inter-Imperial travel, and encouraging a more frequent intercourse between the component parts of the Empire, it will tend to intensify the Imperial consciousness, and bring about that unity of feeling and outlook on which the future of the British Commonwealth so greatly depends. A system of European airways may be expected to achieve unifying results of a similar kind in Europe. Its workings will be less immediately effective no doubt; for a United States of Europe is certainly a rather more mythical ideal than the consolidation of our Imperial unity; but, *mutatis mutandis*, the arguments that hold good in one case can be applied with equal force to the other.

There is no need, therefore, for us to elaborate at any great length the case for air development in Europe. A brief summary of arguments similar to

AIR TRANSPORT—INTERNATIONAL PEACE

those used in the Imperial connection, is all that is necessary.

Firstly, the economic argument. The two watch-words of modern economic life are speed and efficiency; and these depend on communications. Now the train is immeasurably faster than the old mail-coach; and the motor-vehicle is a far quicker and more efficient means of transport than the horse-and-cart. Yet, in spite of the elaborate net-work of railways that has grown up in Europe and the general improvement in road transport, no one can pretend that the present system of communications is nearly equal to the demands put upon it by the intensification of modern economic life. This applies especially to passenger travel and the delivery of mails. I have already alluded to the delays and petty annoyances that the present day traveller has everywhere to put up with.¹ What with the overcrowded trains, the frequent stoppings and changings, the inevitable hold-up at every frontier, the risk of missing a junction connection and the interminable delays and manifold discomforts that face anyone whose destination happens to be off the main lines, travelling in Europe is by no means a pleasurable occupation, quite apart from the unconscionable waste of time it involves. Consequently only the leisured and the adventurous travel more than they absolutely must. The busy man reduces his travelling to a minimum. He cannot spare the time, and he shirks the bother of it all. Yet if communications were quicker and easier, he would be encouraged to make frequent journeys abroad with a view to exploring new markets and establishing closer relations with his foreign clients. And his affairs would

¹ In England as much as anywhere. The Customs arrangements and the waiting-room accommodation on our Southern Railway are a disgrace to a civilised country, and the amazement of every foreigner that visits this Island.

THE WORLD, THE AIR AND THE FUTURE

prosper accordingly. Moreover he would get to understand the business psychology of other peoples, which, especially if he is English, he only too often lacks, and to his great disadvantage.

But this side of our argument requires no further emphasis. It will be patent to everybody that a method of locomotion which reduces the time spent in travelling by a half or two-thirds, will start a new era in the economic development of Europe. The map of Europe will shrink to half its present size; which means that the practical business area of the merchant, the banker, the industrialist, will be doubled. It means that the producer and the manufacturer will find themselves within easy reach of important new markets that previously it would hardly have been worth their while to compete in; and that the trader will be brought into profitable connection with flourishing firms in distant parts, that have hitherto been outside the range of his business vision. It means, in a word, that the loose threads that hold together the economic life of Europe will be increased, and tightened and strengthened, and that the economic unification of Europe, to which we look forward, will fast become an accomplished fact.

The political argument for air development is closely bound up with the economic argument, and need not detain us long. To-day almost all political issues both in domestic and foreign politics ultimately resolve themselves into economic issues;¹ and as we saw in the last section, it is on an economic foundation that the reconstruction of European politics will be based. Insofar, therefore, as the development of air communications will help to promote the economic unification of Europe it

¹ Even Governments are slowly waking up to the fact that diplomacy has now to concern itself closely with economic problems.—Hence the practice now generally adopted by the leading states of attaching Commercial Secretariats to their Embassies and Legations.

AIR TRANSPORT—INTERNATIONAL PEACE

will likewise be helping to consolidate the political situation.

But independently of this, it will also serve the cause of political unity in other more direct ways. For example, it will smooth the path of diplomacy by making it very much easier for statesmen who have a delicate problem to settle, to thrash the matter out in a heart to heart talk, instead of leaving it to become more and more complicated during months of protracted negotiations. Often a brief conversation will settle to the mutual satisfaction of both parties a point that has given rise to masses of acrimonious correspondence.

Again, the development of the air will render necessary the working out of an elaborate system of laws embracing the whole field of aerial navigation. This code of laws will be established by international agreement, as has been the case with the Law of the Sea, but with an important difference. The Law of the Sea has been the creation of those nations which at various periods of history have enjoyed sea power. Other nations have from time to time insisted on certain modifications of this Law, and there has always been a serious conflict of opinion on the subject between Continental Powers and the predominant Sea Powers of the age, and even between the Sea Powers themselves, as we see to-day in the difficulty Great Britain and the United States are experiencing in coming to an agreement on the question of the Freedom of the Seas. Still, in the main, the principle has never been disputed that it is the sea-faring peoples—those to whom the exercise of sea power is a vital concern, and who practically hold a monopoly of the world's carrying trade—who should have first say in all matters of maritime legislation; and the laws and regulations of the sea, as defined by them, have been generally accepted by the rest of mankind. Air power, however, concerns all nations equally. Con-

THE WORLD, THE AIR AND THE FUTURE

sequently the Law of the Air must have an international basis of agreement in a far more radical sense than has ever been the case with the Law of the Sea. Every nation is entitled to an equal say in its drafting, seeing that its provisions will affect all equally, and cannot be carried out without the active co-operation of them all. Hence in this great co-operative organisation of the air, an organisation which will be established by international agreement, which will be controlled by all nations in common, and whose machinery will be worked by all of them together and for the benefit of all equally, lies an instrument of the most far-reaching importance for the unification of European politics. It remains to be seen how soon contemporary statesmanship will succeed in bringing this organisation into being. At the moment it looks as though the complete anarchy that now prevails in the air world will continue for some time to come.

Thirdly, there is the argument for air development to be drawn from the broadening influence it will have on the mentality of the European peoples. In this connection it is important to bear in mind that, when all allowance is made for considerable variations in temperament and outlook, the peoples of Europe represent one civilisation, a single cultural system. The divisions that mark off one European nation from another—I am speaking here of course, of Western, i.e., of Latin and Teutonic Europe, between which and Eastern, or Slav Europe there is a more strongly defined line of demarcation—are superficial in character and due to secondary and arbitrary causes. In other words they are rather the outcome of historico-political accidents, than due to fundamental differences in racial psychology and spiritual origins, or to extreme variations of climate. We Western Europeans all belong to the same family of the human race. We are born into a civilisation that has been built up on Roman Law, Greek Culture and

AIR TRANSPORT—INTERNATIONAL PEACE

the Christian Religion. Our spiritual values, our ethical standards, are everywhere essentially the same, being rooted in the principles of our common Christianity. There are no vital differences in world outlook between us, or in our psychological reactions to life and its problems; and our æsthetic consciousness responds to the same emotional rhythms. Thus we all use and appreciate the same idioms in art and music, and our picture galleries and concert halls, and even our theatres are in the truest sense of the word International. In the world of Letters, too, the peoples of Europe have always formed a single Republic. We all speak different languages it is true; but we use the same alphabet, and our various groups of languages having been developed in the same civilisation, have tended to approximate to each other both in idiom and structure, so that an educated European of to-day can acquire a working knowledge of European languages other than his own, with comparative ease.

The basic unity of our Western culture is a fact of the first importance; for it provides a natural framework for a United States of Europe. It means that the differences that divide us off from our neighbours are in no sense fundamental. They concern, as it were, the externals of life only; such matters as dress, diet, style of living, details of administration, and sundry minor conventions in the ordinary routine of existence.

Now people who travel little and rarely leave their own country are too apt to raise these minor points of difference into national prejudices, and to establish on them quite unjustified claims of national superiority. Knowing only their own mode of living, their own social and administrative conventions, their own outlook on things in general, they accept these as the final standards of a civilised community, and any deviation from the national code in such matters they regard as

THE WORLD, THE AIR AND THE FUTURE

necessarily the mark of a lower order of civilisation. Take, for example, the average untravelled Englishman's contempt for the mere "foreigner." Because the "foreigner" has his clothes cut in a different way, or relishes a kind of dish which revolts our unaccustomed palates, or does not play our games, or regulates his habits by other social standards, or does not enjoy all the manifold blessings of Parliamentary Government, he is *ipso facto* an inferior being! Silly prejudices of this kind which are not by any means confined to the people of this country—they are part of the make-up of all nations, and the French are probably worse offenders than we are, since their contempt for the "foreigner" is not nearly so good-humoured as ours—do much to intensify national animosities, and are among the chief disintegrating factors in European politics. The best, in fact the only, way to cure all this provincial narrowness is to travel. In this respect, too, therefore, aircraft will render Europe a most useful service. By inducing business and professional men to travel more, and by making it easier for all classes of the community to pay frequent visits abroad, they will help to educate nations in the habits and outlook of their neighbours. The barriers set up by ignorant prejudice will fall away. Nations will get to know and understand each other better, and the people of one country will gradually begin to realise that though "foreigners" may be different, they are not necessarily inferior, and may even be in some points superior to themselves.¹

¹It is common knowledge that however galling to her national pride the quartering of the British Army of Occupation in Germany may have been, the fraternisation that has ensued between the British troops and the German population has done much to make the two peoples appreciate each other better, and to dissipate the cloud of prejudice engendered by the war and by the years of political tension that preceded it.

AIR TRANSPORT—INTERNATIONAL PEACE

It goes without saying, too, that the essential unity of our European culture, which, as I have suggested, forms a ready-made foundation on which to raise the superstructure of a United States of Europe, will be strengthened in a multitude of ways by the easier circulation of ideas, and the closer intellectual and artistic communion that must result from such a speedy means of travel as will be provided by a system of European airways.

So far we have been considering Western Europe as a single self-contained system. This is only one side of the picture. The European system is one among many such; and a word must now be said about its relations with the other big economic and political entities that are shaping themselves or are already in being in different parts of the world. Broadly speaking there are five such. There are the British Commonwealth of Nations and the United States of America. There are the States of Latin America, destined almost certainly, I think, to become welded into a single economic unit. There is Russia, who, with her vast territory and population, and great natural resources must inevitably develop into a world centre of economic power when once she settles down into a rational polity; though how soon that will be, and whether she will consolidate herself as a European or an Asiatic Power, are matters on which it is impossible to form an opinion. Finally there is China. At present even her existence is something of a geographical myth, but her economic potentialities are immense—greater perhaps than those of any of the other units we have mentioned with the exception of the British Empire—and so soon as her various people achieve an organised statehood, and become thoroughly westernised, her rise to material greatness will be even more rapid than was Japan's. A progressive Chinese Republic, with a fully awakened national

THE WORLD, THE AIR AND THE FUTURE

consciousness, will dominate the Far East as effectually as the United States of America dominates the Far West.

Including Western Europe, there are then six great, or potentially great, economic systems in the world. Of these six, only Europe, the British Empire, and the United States of America concern us here. For it is these three who have the financial and economic, and therefore the political ordering of the world at the present time; and it is on their money, enterprise and goodwill that the other three depend for their development.

On the other hand it is pertinent to observe that though Russia, China, and Latin South America are at the moment hardly more than in a rudimentary stage of development as continental organisations, their economic progress is likely to be very much quicker than some people imagine, and for three reasons. In the first place, the world to-day moves very much faster than at any previous time; secondly they form a magnificent field of exploitation for the Big Three, who are vitally interested in forcing ahead their development; and thirdly this speeding up process will be greatly accelerated by aerial communications. We saw in a former chapter what an important part aircraft have already begun to play in opening out the backward portions of the British Empire; and they are destined to play an equally important part in the commercial and industrial exploitation of China and Russia and Latin America. So soon, therefore, as Russia recovers from her Bolshevik fever, and China becomes organised as a modern state, and the Republics of South America wake up to the wisdom of forming themselves into an economic federation, we may expect each of these three systems to develop with unexampled rapidity—a rapidity which may well outdistance that of any of our Dominions, owing in the case of Russia and China, to their vast populations and greater natural resources,

AIR TRANSPORT—INTERNATIONAL PEACE

and in the case of South America, to the fact that its development, besides presenting a more international complexion, is already in many respects more highly rationalised. As, however, their day is of the future, we may profitably confine ourselves here to the mutual relations of the Big Three, in whose keeping lies the immediate security and welfare of civilisation.

In treating of the relations between the British Empire, Western Europe, and the United States of America, a point that strikes us at once is the vital position occupied by Great Britain with regard to each of them. She is, as it were, the nerve-centre of the triangular relationship. Thus, owing to her wealth and power, she is the head State of the British Commonwealth of Nations. At the same time she is a vital part of the European system, whether we consider that system on its political or its economic side. Her economic importance to Europe needs no emphasis; her political importance lies in her moral position as in some sort the keeper of Europe's conscience; having no particular axe to grind in European politics, she can bring a disinterested judgment to bear upon them, a fact which, together with her prestige as the head of a great world Empire, gives immense weight to her counsels at every European conference. Finally, she is the connecting link between Europe and the great English-speaking nation across the Atlantic—a people sprung from her own stock, and between whom and herself the sense of the family relationship still holds strong, being kept alive as it is by the use of a common language and by the legitimate pride that each feels in the common achievements of the Anglo-Saxon race.

Great Britain may be said, therefore, to occupy a pivotal position in regard to the inter-relations of the three great entities who between them have the ordering

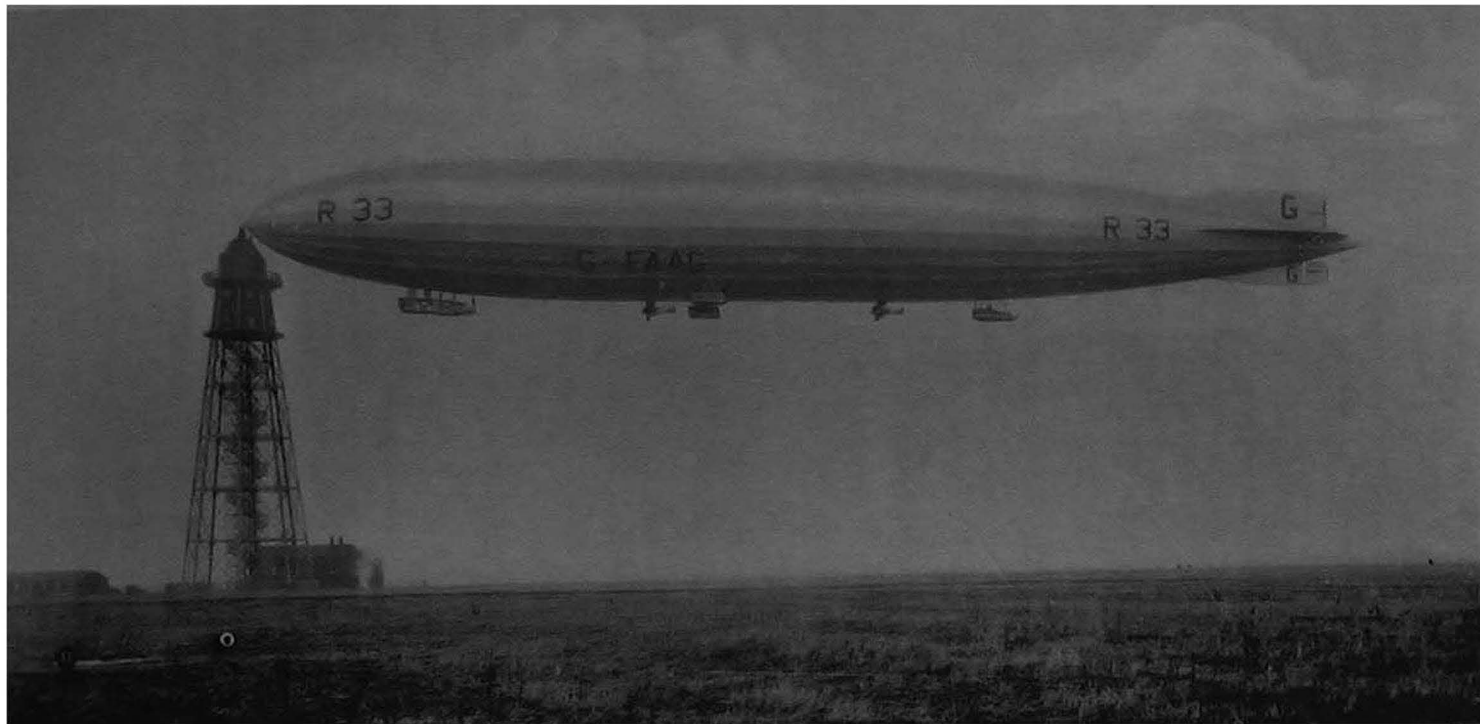
THE WORLD, THE AIR AND THE FUTURE

of our present day world; and the burden of responsibility that rests on her shoulders is correspondingly grave. It is the burden of a three-fold kind, such as perhaps no country before her has ever been called upon to bear. Of this responsibility in its Imperial and European aspects we have already spoken. There remains for brief consideration its American aspect, a matter of the first importance, since it is generally admitted that the harmonious development of Anglo-American relations is the corner-stone of World Peace.

There are two ways of looking at Anglo-American relations. One is to regard them in the light of differences of opinion on contemporary issues; the other is to regard them in the light of ultimate questions of State policy and National intention. Viewed under the first aspect they seem at the moment somewhat troublesome and unsettled; viewed under the second aspect they are wholly reassuring.

What I mean is this. At the present time, the friendly relations of the two peoples are being upset by disagreements on Naval matters.¹ They do not see eye to eye on the question of Naval disarmament; and they adopt opposite standpoints with regard to the Law of the Seas. Now this would be a serious matter if the two countries were historical enemies, or if they were openly competing against each other for world power, or if they were at loggerheads on other important issues, and each could reasonably regard the Naval programme of the other as a gesture against herself; but the facts are just the reverse. Britain and the United States are not hereditary foes, but kindred nations bound together by the consciousness of their common origin,

¹ It is to be hoped that the meeting between General Dawes and Mr. Ramsay MacDonald, which took place in Scotland in the June of this year (1929), will be the prelude to a final settlement of all these points of difference.



(Photo by courtesy of the Air Ministry.)

The R.33 riding the new Mooring Mast at Cardington

The Mooring Mast is 200 feet high, with a covered way connecting the landing stage and airship. Lifts are provided for passengers and cargo, and mains carrying water, gas and fuel are constructed right to the masthead. It will be seen that the Airship has two small aeroplanes suspended from her.

AIR TRANSPORT—INTERNATIONAL PEACE

and a fundamental similarity of world outlook. They are not rivals for world power, but two peace-loving nations, with no desire whatever for further territorial expansion, and each eager to co-operate with the other in stabilising a warring world on a basis of permanent peace. Nor do their various national interests in any way conflict. On the contrary, they closely inter-connect. England's great interest—the one that dwarfs everything else—centres in the development of the Empire, and her natural ally in this mighty work is surely the great Transatlantic branch of the Anglo-Saxon race which, though during its growth it has inter-married with and absorbed so many millions of the different races of Europe, until the proportion of British stock is but 20 per cent. of the whole population, has nevertheless built up its greatness on the solid qualities of the British character, and still presents a national psychology that is unmistakably British in all essential features. The United States is a business community, and, as such, the economic development of the British Empire concerns her nearly; at the same time, there is a pronounced strain of idealism in her people which is an important factor in determining Anglo-American relations. Justly proud of the supreme place she has made for herself among the Nations, she is yet not unmindful of her own early struggles and difficulties so similar in character to those which the peoples of our self-governing Dominions are now having to face, and the efforts of these kindred nations to emulate her own magnificent achievement, cannot but command the full measure of her imaginative sympathy.

If we bear these facts in mind, we shall not take Anglo-American naval differences too seriously. It is both narrow and foolish for this country to regard America's claim to share with her the naval supremacy

THE WORLD, THE AIR AND THE FUTURE

of the world on an equal footing as a hostile challenge. If America were building up her naval strength against Great Britain, she could soon knock the bottom out of our supremacy, by at once laying down a two-power standard; and we should have to suffer it in silence. This she does not do; and the fact that she does not is in itself a gesture of amity. Again, though our views in regard to the Freedom of the Seas are diametrically opposed, this is a problem which can only become a vital issue in the event of another world war; and if Britain and America hold firmly together, such a war will not take place; or, if it does, they will be on the same side, and the problem will solve itself. Let the two great English-speaking peoples, therefore, cease their naval bickering. Let them stop looking askance at each other's Naval programme. Between them they control the finances and the seas of the world, and each shares her power with a kindred people of similar world outlook, and animated by the same motives and ideals. Why talk inflammatory nonsense about competition and rivalry, when the power exercised by one is in some sort the ultimate measure of the other's security?

I am not saying here that war between England and the United States is unthinkable; so long as war is a possible contingency in any part of the world, it cannot be unthinkable between any two nations; but what I do say is that such a war is not a contingency that the statesmen of the two countries need take into account in their mutual dealings, or in the orientation of their respective policies. And the clear symbol of this fact is the unguarded American-Canadian frontier, a magnificent example to the world of two mighty Empires who can live side by side without having to regulate their mutual relations on the basis of armed force.

The promotion of a good understanding with the United States is then the third of Great Britain's three

AIR TRANSPORT—INTERNATIONAL PEACE

great responsibilities at the present time; and there can be no doubt that the successful solution of this problem will materially assist her in the solution of her other two great problems. For not only will the consolidation of Anglo-American friendship aid her in the work of Empire development, but it will also greatly add to her stature as a European Power.

Further, and this is the point I want to emphasise here, if the British Empire and the United States hold firmly together, the stabilisation of Europe is ultimately assured. Even separately, each exercises an enormous influence on the affairs of Europe; together they can effectually guide her destinies into the harbour of permanent peace.

America, as we know, has turned her back on European politics. But this is only one, and not by any means the chief aspect of the situation. In the structure of her economic life, she is closely bound up with the economy of Europe, so that the two systems are, as it were, organic correlatives. Culturally, too, her ideals, outlook, and affiliations are quite definitely European; and what is more, the intellectual and spiritual vitality of her people is such, that she is now one of the chief centres of our European culture. Indeed, there are already signs that the cultural centrality of the Western World may one day shift across the Atlantic, just as the financial centrality is now doing.

However that may be, Europe and the United States must now be regarded as two great inter-dependent entities of one Atlantic civilisation, with Great Britain's Imperial system as the third co-ordinate factor in a triangular relationship.

But between Europe and America lies the vast stretch of the Atlantic seas; and this it is that prevents the consolidation of their relations, and causes that mutual lack of understanding which is the constant lament

THE WORLD, THE AIR AND THE FUTURE

not only of statesmen, but also of professional and business men on both sides.

Speaking on this very matter in November, 1928, Mr. Baldwin put the case in a nutshell:

"American statesmen do not know European statesmen, European statesmen do not know American statesmen. There is no personal intercourse. The only intercourse that takes place is the written dispatch that goes across three thousand miles of water. A far more difficult thing to get a mutual understanding under these circumstances!"

Clearly the one way of overcoming this difficulty is to shorten the distance between Europe and America and this can only be done by so speeding up communications between the two continents that the journey can be reckoned in hours instead of days.

Once again then we must look to air transport for the solution of our problems. For here we have a method of locomotion which, in theory at least, can effect a reduction of distance such as will enable the Atlantic peoples to unify their relations and thereby consolidate the structure of our Western civilisation. In theory yes, but can it in practice? I think that it can, and the building of the R.100 bears witness to the strength of my conviction. Certainly, the performance of the Graf Zeppelin goes far to justify a reasoned optimism on the point. But I need not enter here into the technical grounds on which my belief is based. These are fully stated in a subsequent chapter of this book, where I also give my reasons for thinking that, so far as one can gauge future possibilities, it is airships, and airships alone, that offer us a reasonable prospect of covering oceanic distances by air.

Leaving such matters then for later discussion, and

AIR TRANSPORT—INTERNATIONAL PEACE

assuming for the moment that at no distant date airships will be able to make the Atlantic crossing on a commercial basis, shall we not be justified in regarding such a development as the beginning of a new epoch in Atlantic history? When a regular service of Atlantic air-liners has reduced the distance between Europe and America to a matter of fifty hours, may we not confidently hope for a far more intimate and productive relationship between the two continents, based on the closer economic and cultural ties that such increased facilities of Transatlantic travel will establish between them? How much more easily will diplomatic differences be adjusted, and economic issues settled, when European and American statesmen can meet in frequent conference and establish personal relations with each other, instead of having to rely so much on the impersonal medium of the official dispatch!

And may we not hope also to see a gradual breaking-down of the psychological barriers that the Atlantic distance has set up between the Old World and the New? If, to-day, Europe and America are too little appreciative of each other's finer points of character and civilisation, if a feeling of mutual antagonism—antipathy would hardly be too strong a word—has grown up between them, and a fair estimate of the other's problems, standards, aims, motives and mental outlook, is sadly to seek on either side, this is largely because the peoples of the two continents have had such scant opportunities of getting to know each other. Distance has made them strangers. But will not these prejudices and causes of irritation—based mainly on ignorance—that now keep them apart, give place to more cordial feelings when airships make possible a more fluid intercourse? Europeans and Americans will then have greater opportunities of familiarising themselves with the root-conditions that underlie the differ-

THE WORLD, THE AIR AND THE FUTURE

ences between their two civilisations. They will be able to judge of one another's qualities, difficulties, and aspirations in the home atmosphere and psychological environment peculiar to each, and we shall then no longer have to complain of the lack of mutual understanding which at present vitiates their relations.

And our vision need not end here. A means of transport that will help to unify the Atlantic peoples will also help to unify the human race. By the agency of the airship, the flying boat and the supplementary aeroplane, the globe will shrink to the compass of a single continent. The furthest outposts of civilisation, the units of Power that are growing up in the outer portions of the British Empire, and those that are growing up in other distant parts, will all be linked up with the Atlantic system—destined, one must think, to be the political, economic, and cultural centre of the universe for many generations to come; and the nations of the earth will gradually achieve that organic unity out of which will evolve the World-State of the future.

I foresee then a magnificent prospect for mankind from the development of civil aviation. But it depends on two conditions. One is, that the nations develop it and organise it as it should be developed and organised,—that is to say on an international and not on a national basis. The other is, that the several types of aircraft are, or will become, technically capable of fulfilling in practice the various functions we have assigned to them. Having dealt exhaustively with the first condition, it now behoves us to examine the second in equal detail.

CHAPTER V

AIRSHIPS: THEIR DEVELOPMENT AND PROSPECTS

1. The Evolution of the Airship
2. Description of the R.100
3. Facing Facts
4. Solutions to the Three Main Problems
5. Possibilities of the Future
6. Justification of Airship Development

THE evolution of aeronautical science has proceeded along two distinct lines of development, each having an independent origin, and being based on a different theory of mechanical flying. On one side, effort has been directed to achieving human flight by means of a machine that is heavier than air, on the other, the effort has been directed to achieving it by means of a machine that is lighter than air. The two movements are in no wise related, and it is important to differentiate clearly between them. The method of application of mechanical and aerodynamic laws governing the development of heavier-than-air craft—of aeroplanes and flying boats—is not the same as that which govern the development of lighter-than-air craft or airships. Indeed, except that in both cases the machines are propelled by engines or motors, the specific technical problems of the aeroplane and flying boat are of an entirely different character from those of the airship; consequently, conclusions that may be drawn as to the limitations or possibilities of the one branch of aerial activity, in no way apply to those of the other. Leaving,

THE WORLD, THE AIR AND THE FUTURE

then, heavier-than-air craft for separate discussion in the next chapter, we will confine ourselves in this chapter to a consideration of the problems connected with the construction and navigation of airships.

§ 1

The Evolution of the Airship

Airship is the name given to a flying machine that is sustained in the air by a gas which is lighter than air. It is a development of the spherical free balloon which was invented at the end of the 18th century; and the story of how the huge dirigible airship that navigates the air to-day was evolved from such a primitive beginning is both technically instructive and interesting as a record of man's courage and indomitable will. A brief sketch is all that is possible here.

The first balloon was the contrivance of two Frenchmen, Joseph and Étienne Montgolfier, sons of a paper manufacturer in Annonay. Here, towards the end of 1782, the two brothers, who were students of the physical sciences, began successful experiments with small paper balloons consisting of envelopes open at the bottom. Under the aperture they burnt more paper, until the air inside becoming hotter than the air outside, the envelope rose. Delighted with their success, the brothers repeated their experiments throughout the winter of 1783, each time on a larger scale, and in the April of that year, they built a spherical balloon with a capacity of 23,000 cubic feet. In the following June, this balloon made a public ascent from Annonay to the amazement of a crowd of excited spectators.

A strange feature of these experiments was that the brothers did not know that the balloon rose because hot air is lighter than cold air, but thought that it was

AIRSHIPS: DEVELOPMENT AND PROSPECTS

on account of some special property of the paper they burnt. Yet their compatriot of an earlier century, Cyrano de Bergerac, seems to have known this elementary fact, and it is recorded that he made an attempt to fly by tying air bags to his body and allowing them to heat in the sun.

The Montgolfiers and their hot-air balloon were now the talk of the hour, and the brothers were invited to Versailles to give a demonstration before King Louis XVI and his Queen, Marie Antoinette. On this occasion the balloon ascended with three passengers, consisting of a sheep, a duck and a cockerel, whom it landed quite safely two miles away, after carrying them to a height of 1,500 feet.

The next step was a human ascent. At first the King would not hear of his subjects risking their necks in such a hazardous adventure as flying suspended from a balloon. But at length he relented so far as to allow two convicts to try their luck, on the understanding that they should receive a free pardon if they came down alive. However, the honour of being the first aeronauts was snatched from them by an enthusiastic young nobleman, Pilâtre de Rozier, who prevailed upon Louis to let him make an ascent, and to take with him his companion and friend the Marquis d'Arlandes.

On November 21st, 1783, at 1.54 p.m., after one false start, this historic flight was made before a vast crowd in the Bois de Boulogne. The balloon, which was 74 feet high and 58 feet in diameter, rose to a height of 3,000 feet, remaining visible to all Paris for some twenty minutes, and eventually landing $1\frac{1}{2}$ miles from the point of departure. The fuel used was straw, put into a brazier slung by iron chains from a large opening underneath the balloon; and the Marquis d'Arlandes, whose function it was to

THE WORLD, THE AIR AND THE FUTURE

stir the straw, is referred to in contemporary accounts as the chauffeur!

Thus, within the space of a few months, experiments with paper balloons led to a successful human flight—an achievement which will make the year 1783, and the names of Montgolfier and Rozier for ever famous in the history of aeronautics.

As with other inventions and discoveries, once a beginning was made, progress up to a point was very rapid. Only ten days after Rozier's flight, Professor Charles, a physicist of Paris, flew from Paris to Nesle, a distance of 25 miles, in a somewhat different type of balloon. It must be remembered that the Montgolfière, as the balloon invented by the two brothers came to be called, was not filled with gas, but simply lifted by ordinary heated air. Unlike its inventors, however, Professor Charles realised that it rose because hot air is lighter than cold air. He was also familiar with hydrogen (which Cavendish had discovered in 1776), and knew that it was even lighter than heated air. Accordingly he was able to improve on the Montgolfier idea. Fortunately, about this time, two mechanics named Robert had discovered that rubber was soluble; so, finding by experiment how easily hydrogen will escape through the pores of paper or linen, he covered the fabric with a solution of rubber, and then filled the balloon with hydrogen laboriously prepared from iron filings and sulphuric acid. In the August previous to his own ascent, he released his "inflammable air" balloon in drenching rain before an enthusiastic crowd estimated at 300,000 persons on the Champs de Mars. The sequel was somewhat unfortunate, for the balloon disappeared out of sight and came to earth in the country, where the peasants, terrified at the sight of such an un wonted phenomenon, attacked it with anything they could lay hands on, and finally tied it to the

AIRSHIPS: DEVELOPMENT AND PROSPECTS

tail of a horse—a rapid descent from the sublime to the ridiculous.

Though further successful ascents were made by both types of balloon—especially by the Charlière, or hydrogen balloon, which soon established itself as a more efficient type than the Montgolfière—the utter inability of the pilot to control direction prevented the balloon from ever becoming a practical means of transport, and since the place of descent might be the sea, it had more than its fair share of danger as a speculative amusement.

A first step towards overcoming this difficulty was taken as early as 1784, when another Frenchman, named Guyot, built a balloon egg-shaped, the length being greater than the height, in order to lessen air resistance. The most important pioneer work in this direction, however, was accomplished by General Meusnier, who made a scientific study of the whole problem, and by introducing air bags and other improvements calculated to give balance to the egg-shaped balloon, and to help it to keep its shape and direction under pressure, may be said to have been the real inventor of the dirigible airship. Unfortunately he was killed in action early in the Revolutionary wars in 1793, so that his design was never developed.

In view of the rapid progress made in so short a time, the nineteenth century was singularly barren of achievement in this branch of aviation. From 1850 onwards, spasmodic efforts—mostly in France—were made to construct a dirigible, the usual motive power being a steam engine. But that these were by no means satisfactory is illustrated by the fact that as late as 1870 it was proposed to drive an airship built in Paris, by a hand propeller worked by eight men. However, the close of the century saw the invention of the internal combustion engine, with its more reasonable proportion

THE WORLD, THE AIR AND THE FUTURE

of weight to horse-power, and now for the first time the construction of a really efficient dirigible became a practical proposition. A steam engine, with its necessary adjuncts of boiler and boiler water, was always too heavy; besides which, the boiler itself, with its tendency to throw out smouldering sparks, was not the best possible companion to an inflammable gas like hydrogen.

The year 1898 may be considered the birth year of the modern airship. This year saw two men of widely different character, and with different ends in view, commence a series of interesting trials with dirigibles. One was Santos Dumont, a young Brazilian in France; and the other Count von Zeppelin, a retired Army officer in Germany. Santos Dumont may not have done much to advance the science of aviation, but by his daring and enthusiasm, and his spectacular exploits, he did more than anyone else to show the world the possibilities that lay in dirigibles, and to arouse interest in their development.

But with Dumont, flying was merely a sport, and while he was thrilling the world with his dazzling exploits, Count Zeppelin had conceived the idea of converting the dirigible balloon into a rigid airship, and was steadily at work on the construction of his first model. This was completed in 1900, and on the 2nd of July of that year the first Zeppelin was launched from its hangar on Lake Constance. This vessel had a cubic capacity of 400,000 cubic feet, and weighed 9 tons. Like its successors, it was cigar shaped, being 420 feet long, with a maximum diameter of 38 feet. The framework was aluminium covered with specially treated linen and silk. The hydrogen was contained in special compartments arranged along the length of the hull. The ship was propelled by two 16 h.p. Daimler motors, each placed on a separate car hung close beneath the keel. Zeppelin adopted Dumont's idea of having

AIRSHIPS: DEVELOPMENT AND PROSPECTS

a sliding weight with which to raise or lower the nose. On the first trial this caused trouble; the winch working it broke and the dirigible suffered damage. A second trial flight made in the following October was more successful, no mishap of any kind occurring, and the ship attaining a speed of over 20 miles an hour.

Zeppelin, at first, found considerable difficulty in raising funds. However, by 1905, he had collected enough to build an improved model very slightly smaller than No. 1, but with 85 h.p. motors which were actually lighter than the 16 h.p. motors of that vessel—the whole airship weighing a ton less than her predecessor. The two trials of this ship were unfortunate. On her first flight, the tow rope fouled a propeller, and in the process of landing a gasbag was seriously damaged. Her second trial was even more disastrous. After a short flight she had to make a forced landing, and while lying at anchor, she was so badly battered by a strong wind that rose during the night, that she had to be destroyed.

Undaunted by these failures, Zeppelin immediately started on a third airship which reached completion in October, 1907. At last his faith was justified, for this vessel made a successful trial flight of 67 miles at a speed of nearly 30 miles an hour. German patriotism and enthusiasm were now roused. Subscriptions were started, and the Government came forward with a grant. This resulted in the building of Zeppelin IV, a huge structure 446 feet long and having a gross lift of 16 tons. She was the largest airship yet built, and her performance easily surpassed that of any of her predecessors. She proved entirely airworthy, and in one of her trials she remained in the air 12 hours, covering a distance of 270 miles. Soon afterwards she was destroyed by fire. But belief in the airship as an efficient means of transport was now firmly established in Germany, and the building of Zeppelins

THE WORLD, THE AIR AND THE FUTURE

became henceforward a part of the German national programme.

It may be said that the period prior to 1909 was occupied by the pioneers in groping towards the type of airship that contained within its fundamental design those characteristics that enabled a real airship, as distinguished from a gas-bag with an engine suspended from it, to be evolved; and furthermore, that the Zeppelin type of rigid airship was the first really serviceable vessel. A fact that became increasingly clear during these experimental years was, that the line of development lay in the direction of larger vessels and higher speeds. Starting as a gas-bag with a small metal framework suspended beneath and carrying a motor, the airship has gradually developed into a complicated structure demanding the highest mechanical and engineering knowledge in its design.

There have been in reality four stages in the development. Firstly, the free balloon; secondly, what is now termed the non-rigid airship, which is really an elongated free balloon with a car and engine suspended beneath; thirdly, the "semi-rigid," in which a rigid keel is put into the elongated balloon, the cars and engines being suspended therefrom; and fourthly, the rigid airship in which a number of balloons are placed inside a metal framework, all parts of the airship being affixed to this framework. It is generally agreed, I think, that the non-rigid and semi-rigid types of airship, although forming necessary steps in the development of the rigid airship, are now out of date. Whatever functions they may have had in the past can to-day be more efficiently performed by the aeroplane or seaplane, when only a limited endurance is required, or by the rigid airship when great radius of action is desired.

Great Britain cannot be said to have contributed in any degree to the development of airships prior to the

AIRSHIPS: DEVELOPMENT AND PROSPECTS

war, so that her first experimental efforts in airship building are not of sufficient importance to detain us here.

During the war, however, Zeppelin bombing activities naturally brought the airship question into the forefront of aerial politics, and a certain impetus was given to airship construction. In 1916 the German Zeppelin L.33 was brought down in good condition at Colchester, and served as a model from which the R.33 and R.34 were built. These vessels, which were not completed until after the war, were a marked improvement on any vessel that had previously been built in England.

But our somewhat spasmodic activities in airship building during the war culminated in the construction of the ill-fated R.38, which was begun at the Government Airship Works at Cardington in 1918. This ship which was designed on an ambitious scale, had a capacity of 2,700,000 cubic feet, and took nearly three years to build. Her trials began in June, 1921, the first flight revealing defects in rudders, elevators and controls. Further defects were discovered in a second flight a few days later, and a third flight revealed structural weakness in the girders. The fourth flight, which took place on August 23rd, ended disastrously, the ship breaking into two portions and 44 persons being killed. As a result of this catastrophe the airship department of the Air Ministry was closed down, and all airships, airship bases and material were turned over to the Disposals Board for sale.

The history of airship development in the United States is not unlike that of their development in Great Britain. In 1908 the War Department purchased a small 20,000 cubic feet non-rigid, and in 1911 a 50,000 cubic feet non-rigid, from the French Zodiac Company. No further development took place until 1916 when, in view of possible intervention in the Great War, the Navy Department produced five types of sea scout

THE WORLD, THE AIR AND THE FUTURE

non-rigids ranging from 18,000 cubic feet to 84,000 cubic feet, the largest having a maximum speed of 60 miles an hour and an endurance at moderate speed of 1,800 miles. About 60 of these vessels were built by the Goodyear Company. After the United States entered the war, British experience of rigid airships was placed at her disposal, and in 1918 work was started by the United States Naval authorities upon the design of a rigid vessel, about the same size as the British R.33. This vessel subsequently called the "Shenandoah" (2,148,000 cubic feet) was completed in 1923, and made her first flight in September of that year. Two developments were made in this vessel; first, she was designed to be made about 30 per cent. stronger than contemporary vessels of the same size, and second, helium was employed as a lifting gas instead of hydrogen. After carrying out a large number of flights and experimental trials at mooring masts, the Shenandoah was destroyed in September, 1925, on encountering a line squall when over Ohio. The violent vertical gusts generated in this line squall broke the ship into three portions, and the captain and several of the crew were unfortunately killed. In 1928 the American Government placed an order with the Goodyear Zeppelin Company for two new rigid vessels of 6,500,000 cubic feet at a price reported to be £850,000 each. These vessels are due for completion in 1931.¹

§ 2

Description of R. 100

In spite of this somewhat gloomy record of disaster, it was clear that the performance and efficiency of the rigid airship were increasing slowly but persistently.

¹ A considerable portion of this section has been abstracted in modified form from an article I wrote on Airships for the *Encyclopædia Britannica*.



(Photo by courtesy of the Central News Ltd. London.)

The Government Airship R.33 at the Pulham Mooring Mast

The experiment of an aeroplane being released while the R.33 was in flight was carried out at Pulham, and the photograph shows the aeroplane attached to the airship at the Mooring Mast before being released.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

For instance, in 1917 the German L.57 left Jamboli, in Bulgaria, for Central Africa, and returned without alighting, having covered a distance of 4,200 miles in 96 hours; while, in 1919, the British R.34 crossed the Atlantic from Great Britain to the United States carrying some 30 persons, and returned successfully. On the other hand, it was equally clear, that technical development in airship construction had been marked by a steady improvement in the internal combustion engine, coupled with an increase in size, rather than by fundamental advance in design, and when in 1924 the British Government ordered two 5,000,000 cubic foot airships, it was decided to make a fresh start. Shortly after this decision was taken the Los Angeles, a ship of 2½ million feet displacement built in Germany, on behalf of the United States Government, flew from Germany to the United States via the Azores—a distance of 5,000 miles—carrying a full crew and a few official passengers. So spectacular a demonstration of the extent to which airships had developed, appeared to afford an ample justification of the British programme.

The two ships ordered by the British Government have been christened the R.100 and the R.101, and both vessels have been designed to fulfil the same overall conditions, namely to have a speed of 70 m.p.h. and a carrying capacity of 100 passengers in addition to the crew. The R.100 has been built and designed by a company which I organised with Messrs. Vickers Limited, called the Airship Guarantee Company Limited, while the R.101 has been built and designed by the Air Ministry at the Royal Airship Works at Cardington. Both ships are a logical development of the Zeppelin type, in that they consist of a rigid structure, divided into some fifteen compartments, in each of which is a gas-bag.¹ Attached to this rigid

¹ See Plates III and IV

THE WORLD, THE AIR AND THE FUTURE

structure are the engines, fuel, tanks, passenger quarters, and the outer cover. The two ships, therefore, are built on the same basic principle, and though they differ greatly in the details of their construction, such differences in detail are not in themselves of much interest save to those intimately connected with their designs; they can have but little meaning for the outside world, except insofar as some detail may touch on a matter of sufficient importance to affect the general policy of development. This being so, I will confine myself here to a description of the R.100, as not only can I write with greater knowledge of this ship, but, as I have said, the differences between the two reside solely in technical details, and these details will be analysed and compared with meticulous care, when the trial results of both ships are available. The overall dimensions, displacement, designed speed, and designed carrying capacity, are almost identical. If one has a higher speed than the other, or a greater useful lift, or girders of cheaper construction, then investigation will show what combination of detail design gives the advantage.

The measurements and general characteristics of the R.100 are as follows:

1. Length: 709 feet.
2. Diameter: 133 feet.
3. Actual displacement: 156 tons.
4. Engine power: 4,200 h.p.
5. Maximum speed: 80 m.p.h.
6. Cruising speed: 71.5 m.p.h.
7. Carrying capacity: 100 passengers and mails.
8. Range: 3,600 miles at 71.5 m.p.h. with full load.
9. Engines: 6 Rolls-Royce petrol engines.

It was originally intended to equip the vessel with either Diesel engines or hydrogen kerosene engines,

AIRSHIPS: DEVELOPMENT AND PROSPECTS

out neither type of engine is as yet sufficiently developed for the purpose. The Diesel engines are progressing, but have turned out so much heavier than anticipated that the performance of the ship would be reduced by their installation.

Turning now to the structural arrangements of the ship itself, and commencing at the bow, we have, first of all, the attachment fittings for the mooring mast, and an observation station, with windows, for the use of the crew. Passing down the ship by an enclosed corridor designed for the use of passengers,¹ and lit electrically, we come to the passenger coach, about 190 feet from the bow. This structure is slung inside the hull of the ship, and consists of three floors, the lowest of which is allocated to the crew, and the two upper ones to the passengers. This coach is surrounded entirely by a double wall, through which air is circulated to obviate the danger of any inflammable gas or vapour penetrating to the living quarters. Cooking is carried out here in an electric kitchen.² The passengers are quartered in two and three berth cabins³ very similar to those on board ship. Windows in the sides of the ship provide the light and the view, and these are faced by a small promenade which adjoins the dining saloon.⁴

Below the crew quarters of the passenger coach is slung the control car, an excrescence on the hull. Aft of the passenger coach the corridor narrows and becomes more Spartan, being designed for the use of the crew only. A hundred and thirty feet aft of the coach we come to two engine cars suspended outside the hull.⁵ Each car contains two Rolls-Royce engines of 700 horse-power and one A.C. motor car engine, whose function is to drive a dynamo to provide the electric

¹ See Plate VIII

² See Plates X and XI

³ " IX

⁴ " XII

⁵ See Plate XIII

THE WORLD, THE AIR AND THE FUTURE

current necessary for lighting, heating, cooking, and wireless. Ninety feet aft of these engine cars, a third car similar to the other two is situated. Aft again, we come to the fins and rudders of the ship,¹ these serving the same purpose as the feathers on an arrow in ensuring stability of flight. There the corridor ends, and ninety feet aft again, the ship comes to an end in a fine run tail.

The ship carries fuel for 3,600 miles in still air at 70 miles per hour. This amount of fuel enables her to carry a paying load of one hundred passengers, with one hundred pounds of luggage for each passenger, together with a small quantity of freight. Allowing for head winds and adverse conditions of lift, her safe operating range will be about half the designed range, or 1,800 miles. In still air, she will cover this distance in under 30 hours, and she can operate as well, and with equal reliability by night or in fog, as in normal visibility.

The accommodation made for the passengers is intermediate in comfort between a Pullman train and an ocean liner. Noise is practically eliminated owing to the great distance of the engines from the passenger coach. Proper washing and lavatory arrangements are provided. To give some idea of the space available, it may be fairly said that the sense of restriction which the passenger will experience in a ship that is carrying a full load will be similar to that experienced in one of the smaller hotels.

So much for the ship's arrangements and capacity. Next comes the question of operating her, and this at once brings us to a consideration of certain difficulties and dangers which have always been connected with the manipulation of dirigibles, and have hitherto prevented the airship from taking its place as an efficient commercial vehicle.

¹ See Plate XV

AIRSHIPS: DEVELOPMENT AND PROSPECTS

The difficulties of operating an airship may be said to increase in proportion to her size. The R.100 is 710 feet long and 130 feet in diameter. That is to say, she would very nearly fill Northumberland Avenue if she were laid in it; she could not be housed in Olympia. She is, in fact, about as big as the *Mauretania*. Her great size then is her outstanding characteristic.

Size in itself is no detriment to a vehicle of transport. For a sea passage we do not choose a small vessel because we are frightened of the size of the large one. In each case, with increase of size the paying load that can be carried is increased in a greater ratio than the power required to drive the vessel. A big ship is a better commercial proposition than a small one, judging from a performance basis alone.

The real objection to size in an airship, as things are at present, is that the larger the airship the more difficult becomes the operation of landing and housing her at the completion of a voyage. Hitherto airships have been handled by man power, but although the size of the airship may be increased, the size and strength of the men remain the same. Obviously, if airships exceed a certain size they become too unwieldy to be man-handled. If this difficulty could be overcome there would be no objection to an increase in size. A marine vessel, floating on the water, can always anchor and remain riding at her anchor indefinitely. An airship however, although floating in the air, is totally immersed in it, and there is no equivalent to a waterline. In addition, therefore, to having to be held in the horizontal plane like a marine vessel, she must also be held in the vertical plane, and it is this double requirement that makes the difficulty.

An attempt at providing the equivalent of an anchor of a marine vessel, is the mooring mast.

THE WORLD, THE AIR AND, THE FUTURE

The mooring mast is a tower not unlike a lighthouse in appearance, and its height is about two hundred feet. To this mast the bow of the airship is attached in such a manner that the ship can swing freely to the wind as a maritime ship at anchor swings to the tide. Attachment of the airship to the mast is made by dropping a cable from the ship on to the aerodrome; this cable is linked to a similar cable laid out upon the ground from the mast head. The ship can then be hauled in to the mast and moored, floating on the air with her own buoyancy. Fuel and gas are taken in through the bow of the ship from the masthead, while passengers are brought up the mast by a lift, and embarked by a covered gangway leading through a door in the nose of the ship.¹

The problem of handling is admittedly the vital or key point of the whole development, and the future of the airship largely, if not entirely, depends upon its successful solution. So long as man power remains the only aid available for handling a vessel, her size must necessarily be limited.

Another objection often advanced against an increase in size of the airship is that because she is so large she must necessarily be weak. To support this contention, it is pointed out that in the past several airships have broken in the air. In this country, the R.38 broke her back over the Humber in 1921, because, in the words of the official report, "during design, no calculations were made of the aero-dynamic forces to which the ship would be subjected." A less avoidable cause of failure was experienced by the Shenandoah in America, which flew into a line squall and broke. The loss of the Dixmude, a Zeppelin handed over to the French as reparations, was due to the same cause in all proba-

¹ See Plate XV

AIRSHIPS: DEVELOPMENT AND PROSPECTS

bility. In all cases structural weakness was the cause of failure.

What of the R.100? It means little to state that this ship can well withstand conditions five times as severe as those which broke the Shenandoah, unless it can be stated that she can never encounter aero-dynamic conditions that will break her. We have little knowledge of the magnitude of the disturbances high above the earth in a tropical cyclone, a storm which endangers the largest ships, and which is very naturally avoided by all vessels—maritime or aerial. We can assume that any aeroplane or airship that runs at full speed into such a disturbance as a waterspout is extremely likely to break up. The surest criterion of the strength of the R.100 is to say that she is fully equal in strength against air disturbances, to the standard set by the present day passenger-carrying aeroplane.

One further point before we leave the question of strength. Mere wind velocity puts no force upon an airship in flight. Just as a swimmer in a current feels no force upon his body, so an airship flying in a 90 m.p.h. gale, suffers no greater force than if she were flying in still air, provided that the gale is steady. She may be blown from her course, but she will not be injured. In the neighbourhood of thunderstorms and in line squalls, however, she may encounter vertical currents of air, often of high velocity. These are the disturbances known in the aeroplane world as "bumps." The Shenandoah hit a sudden vertical current with an upwards velocity of about 15 m.p.h. and broke. The R.100 would be safe when running at full speed into a similar gust with an upwards velocity of 50 m.p.h.

But there is one other serious danger connected with the airship in its present stage of development, and that is the danger of fire.

THE WORLD, THE AIR AND THE FUTURE

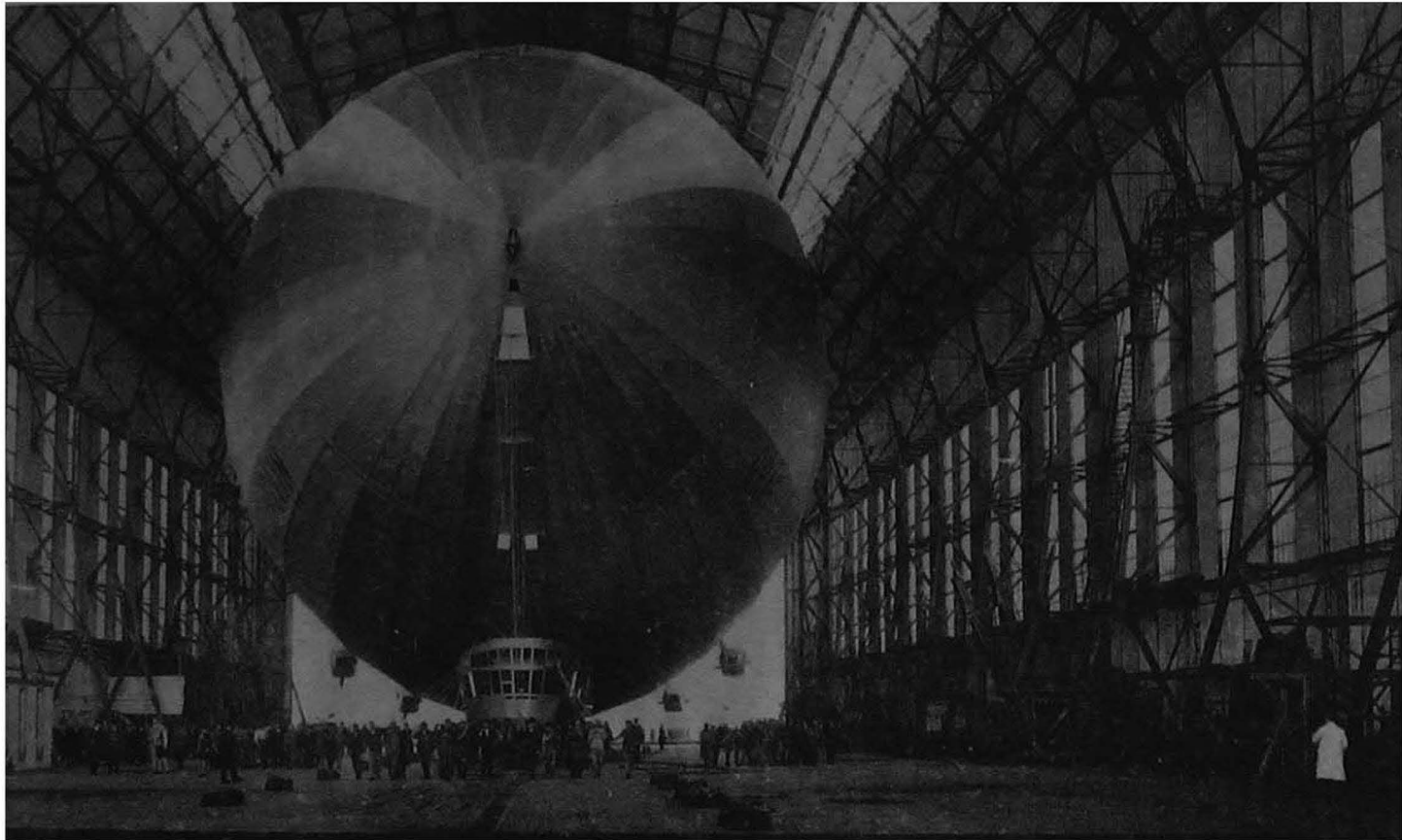
An airship carries large quantities of two inflammable substances—hydrogen and petrol. Of these two the petrol is probably the more dangerous.

The reason for this may easily be seen. Hydrogen is a gas very much lighter than air. The engines, passage-ways, passenger quarters, etc., are all located in the bottom of an airship. Consequently if a tear should be made in one of the gas-bags of the ship, the escaping hydrogen at once flows upwards away from the possible sources of fire, and escapes out of vents provided at the top of the ship. Further, in normal flight the gas-bags are only partially full. Owing to the weight of the bottom of the bags, the gas in a partially full bag is less than atmospheric pressure. If then a hole should be made in the bottom of the bag, the tendency is rather for air to leak in than for gas to leak out.

Helium gas, which has a "lift" comparable with that of hydrogen and is non-inflammable, is not commercially obtainable except in the United States, where its export is prohibited unless specifically released by the responsible Secretary of State. The cost of helium is very high in comparison with hydrogen, and its "lift" is less, so that a six-and-a-half million cubic foot ship inflated with helium is necessary to do the work of a five million ship inflated with hydrogen. For these and for other reasons it is doubtful whether we can make use of helium until we alter the design of our vessels, so as to obviate having to valve gas for manœuvring purposes.¹

Petrol, however, can be eliminated in the near future. The motorist of to-day has become so accustomed to the use of this explosive vapour, that it is rarely that the thought of danger from it enters his head. His petrol tank is usually in a well-ventilated position and

¹ See Plate XIV



(Photo by courtesy of the Luftschiffbau Zeppelin G.m.b.H.)

The GRAF ZEPPELIN inside her shed

AIRSHIPS: DEVELOPMENT AND PROSPECTS

the designer of his car has taken a great deal of unobtrusive care that there shall be no danger of fire. Equal care must be taken by the designer of the airship. The R.100 carries thirty tons of petrol in tanks disposed over a great part of the length of the ship. These tanks are necessarily inside the outer cover of the ship, and although in temperate climates petrol is not sufficiently volatile to render this a source of danger, adequate ventilation has to be provided to disperse the small amount of vapour that may be generated from the inevitable small oozing and weeping of petrol at some one of the many joints of the system.

Petrol can be eliminated in two ways. Either Diesel engines can be installed, or a system of gas fuel and kerosene or diesel oil can be utilised. Both systems are almost ready for installation, and it is probable that one or the other will be substituted for the petrol engines at an early date.

Meanwhile, in view of the special precautions taken against fire during the construction of the R.100, very little danger is to be apprehended from this source. And as, too, the structural strength of the ship is five times greater than that of any airship built in Great Britain prior to 1924, it may be fairly claimed that in her case, the two great sources of danger in airship flying have been reduced to a minimum.

In conclusion, then, we may say, that when the R.100 is in the air and flying, she is a reliable and safe vehicle of transport, and that the real and vital difficulties are solely connected with problems of anchoring, docking and handling on the ground. She is, I believe, the first airship that has been constructed of a strength equivalent to a passenger-carrying aeroplane, but no attempt has been made to incorporate ideas of handling her other than those that will enable her to operate to and from a mooring mast. In short, every

thing in her design has given way to a strong hull structure.

§ 3

Facing Facts

Since the R.100 and the R.101 were put in hand, America and Germany have been obtaining considerable experience with the Los Angeles and the Graf Zeppelin, and it would not be too much to say that one of the principal lessons has been that the cruising speed of all airships is far too low for commercial purposes, and should be increased to not less than 90 m.p.h.¹ The experience gained in the building of the R.100 and the R.101 shows that in order to obtain the requisite strength, the fixed weights have had to be increased, and the useful load reduced, as compared with the ratio anticipated when the ships were ordered. To increase the speed of either vessel to 90 m.p.h. would entail a further considerable increase of weight in the form of more powerful engines, more fuel, and a stronger hull structure to withstand the higher speed. This increase of weight must necessarily entail a corresponding increase in size, and thus will emphasise the handling difficulties. It will, therefore, be instructive to analyse the performance of both vessels and then to state what the effect would be of increasing the speed to 90 m.p.h. This increase of speed is required for two reasons. Firstly to enable a reasonable time-table to be maintained, and secondly upon the score of safety.

The increase of safety given by higher speed is due in a large measure to the development of a passenger-carrying ship of adequate strength; and to see why this

¹ It must be remembered that the Graf Zeppelin upon her world flight travelled always from West to East, and thus had upon the average a following wind over the whole voyage. This is the explanation of her fast travelling.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

is so, we have only to compare the passenger airship of to-day with the old type of Zeppelin used during the war. With the war-time Zeppelin, approximately half the total weight of the vessel, when prepared for flying could be divided equally between structure and operating crew in one part, and the fuel, ballast and bombs in the other. These earlier vessels could, therefore in case of necessity, jettison weight equal to half their displacement; and since these ships were comparatively slow, their control, in difficult circumstances, depended to a greater extent upon ballast conditions than upon dynamic lift. With the R.100 or R.101, however, conditions are quite different. The structure weights, when elaborate passenger accommodation is included, are up to 60 per cent. of the total weight, and a great portion of the remaining load being carried in the form of passengers and mails, cannot be jettisoned. Consequently the effect that could be produced upon the vessel by dropping ballast is very much smaller than in the earlier ships.

The conclusion to be drawn from this is, that a modern passenger ship must depend to a much greater degree upon dynamic lift for altitude control, than did previous vessels. Dynamic lift is a function of speed, and safety for operational conditions is enhanced by an increase of the speed to as high a degree as possible. These considerations are fundamental to the passenger type of vessel strengthened to present conceptions of airworthiness, and are quite independent of the route upon which the vessel may be flown.

Upon the score of safety alone, the speed of the passenger ship should be raised, if possible to not less than 90 miles per hour.¹ Consequently the R.100, the R.101, and the Graf Zeppelin, must be looked upon

¹The Graf Zeppelin, on her first return flight from America, was driven down to within 450 feet of the sea. Higher speed would have enabled her more nearly to retain her safe flying height.

THE WORLD, THE AIR AND THE FUTURE

as merely preliminary steps in the evolution of a practical commercial vessel.

This does not imply that on account of their low cruising speed, the R.100 and the Graf Zeppelin are not safe for carrying passengers upon demonstration flights, since, when a demonstration flight is undertaken, selected weather can be chosen for the voyage. But if an airship has to operate upon a regular schedule, it is obvious that she will at all times be liable to encounter bad weather, and it is low speed in bad weather that exposes airships to undue risks that would be minimised by higher speed.

If we want to grasp the magnitude of the advance that must be made before a ship can carry a reasonable pay load at this increased speed of 90 m.p.h., we have only to analyse the existing performance of the R.100 and the R.101 upon the route to Egypt.¹

The nearest mooring mast base in Egypt, is some 2,100 sea miles or say 2,400 land miles away. It is pointed out in a later chapter that the commercial range of an airship is only half the still air range; but in order to put the matter in a favourable light, we will assume that only a 50 per cent. increase upon the geographical range is necessary to give us the fuel allowance, and that an airship proceeding to Egypt need carry fuel for only 3,600 miles. At 70 m.p.h. the consumption of the R.100 will be 1,375 lbs. per hour, and that of the R.101 approximately half a ton, and as we require fuel for 51 hours, this means that the R.100 wants 32 tons, and the R.101 25½ tons.

The amount available for pay load at 70 m.p.h. for each ship can be calculated from the following table:

¹I am purposely omitting any analysis of, or comparison with, the Graf Zeppelin or the Los Angeles, as I believe the performance of both these vessels has only been obtained by accepting a much weaker hull than British Airworthiness authorities would allow, and moreover, their speed is less than that of the R. 100.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

| | Weight of ship. Tons. | Lift to 2,000 ft. Tons. | Ballast. Tons. | Crew stores and food. Tons. | Fuel. Tons. | Total weight Tons. |
|-------|--------------------------|----------------------------|-------------------|--------------------------------|----------------|-----------------------|
| R.100 | 92 | 8 | 7½ | 4 | 32 | 143.5 |
| R.101 | 103 | 8 | 7½ | 4 | 25.5 | 148 |

Now the total lift under standard conditions is 156 tons for the R.100 and 148 tons for the R.101. Accordingly the R.100 has 12.5 tons of payload and the R.101 none at all.¹

The accommodation in the R.100 provides for 100 passengers, and if we take the average weight of a passenger at 160 lbs. or 11½ stones, and allow 100 lbs. of luggage for each person, this works out at roughly 11½ tons for passenger freight, leaving about one ton over for mail.

It must be remembered that the lift of a ship varies with the temperature and the height of the barometer, and the "standard conditions" are an arbitrary valuation of these two variables, which is supposed to give an indication of average conditions. It would be possible to obtain 10 tons more lift in England and 10 tons less lift in Egypt under certain conditions. A commercial service has to take the worst conditions, however, and this is one reason for making a theoretical allowance for fuel weight of 100 per cent. in excess of the still air allowance under "standard conditions."

As these ships are to-day the R.100 wants at least ten tons extra lift, and the R.101, 22.5 tons extra lift to make them commercial propositions upon the London-Egypt route at the low cruising speed of 70 m.p.h. Let us now examine the result of raising the speed to 90 m.p.h.

| | Present max. speed. | Increased weight of engines for 90. m.p.h. | Incr. wt. of hull structure for extra strength required for higher speed. | Increase of fuel weight. |
|-------|---------------------|--|---|--------------------------|
| R.100 | 80 | 40% | 20% | 75% |
| R.101 | 70 | 100% | 65% | 75% |

¹The R.101 would make a more favourable showing with lighter engines.

THE WORLD, THE AIR AND THE FUTURE

A calculation based on the above figures would show that as a result of the increased weight involved in raising their cruising speed to 90 m.p.h., the R.100 could carry no pay load, and only about half the fuel required, whilst the R.101 could not lift off the ground with either fuel or pay load.

Clearly something drastic has to be done if a commercial ship of adequate speed is to be built. Before describing the steps advocated to increase the speed of the R.100 to 90 m.p.h., it will, I think, be desirable to state the difficulties in airship operation to which a solution must be found, as any solution is likely to involve extra weight. Every increase in weight, however, can be compensated for only by an increase in the size of the ship. Consequently it is only after we have formulated all our requirements that we shall be in a position to indicate the minimum size of vessel required.

In the introductory chapter, attention was drawn to the fact that existing airships do not obey one of the fundamental laws of transport. Alone among vehicles in use to-day, they cannot make a landing of their own accord, and without extraneous aid. The aeroplane or flying boat can as a rule make a forced landing without damage. A marine vessel can always anchor or heave to. A train or a motor car or any kind of land vehicle can stop at any time. Airships, however, can only make a landing at a prepared base, and until this disability is overcome I am of the opinion that they can never develop into practical transport vehicles. It is and will, always remain possible for an airship to make a spectacular flight between two pre-determined points by taking risks, as the Graf Zeppelin did in crossing the Atlantic in 1928. Suppose, however, that that vessel had continued to encounter such strong head winds over Bermuda that her fuel had run short and she had been unable to make Lakehurst. The vessel would probably

AIRSHIPS: DEVELOPMENT AND PROSPECTS

have been lost,¹ although the crew and passengers might have been evacuated safely at Bermuda. The first requirement then is that the airship must be redesigned to enable her to alight at places at which no preparations have been specifically made to receive her.

Secondly, the ship should be able to dock, that is, to go into her shed upon any day of the year. Again, this requirement is only reasonable, and is the least that is essential to bring her into line with marine vessels. Accordingly some method must be devised that will enable this to be done.

These two requirements are quite separate and distinct, but it is desirable that every airship should be capable of fulfilling the first condition, and essential that it should be able to fulfil the second. No airship yet built can fulfil either.

This is a simple statement of fact, and no amount of "propaganda" upon the part of companies, individuals, or Air Ministries specifically interested in airship development, should be allowed to obscure its fundamental truth.

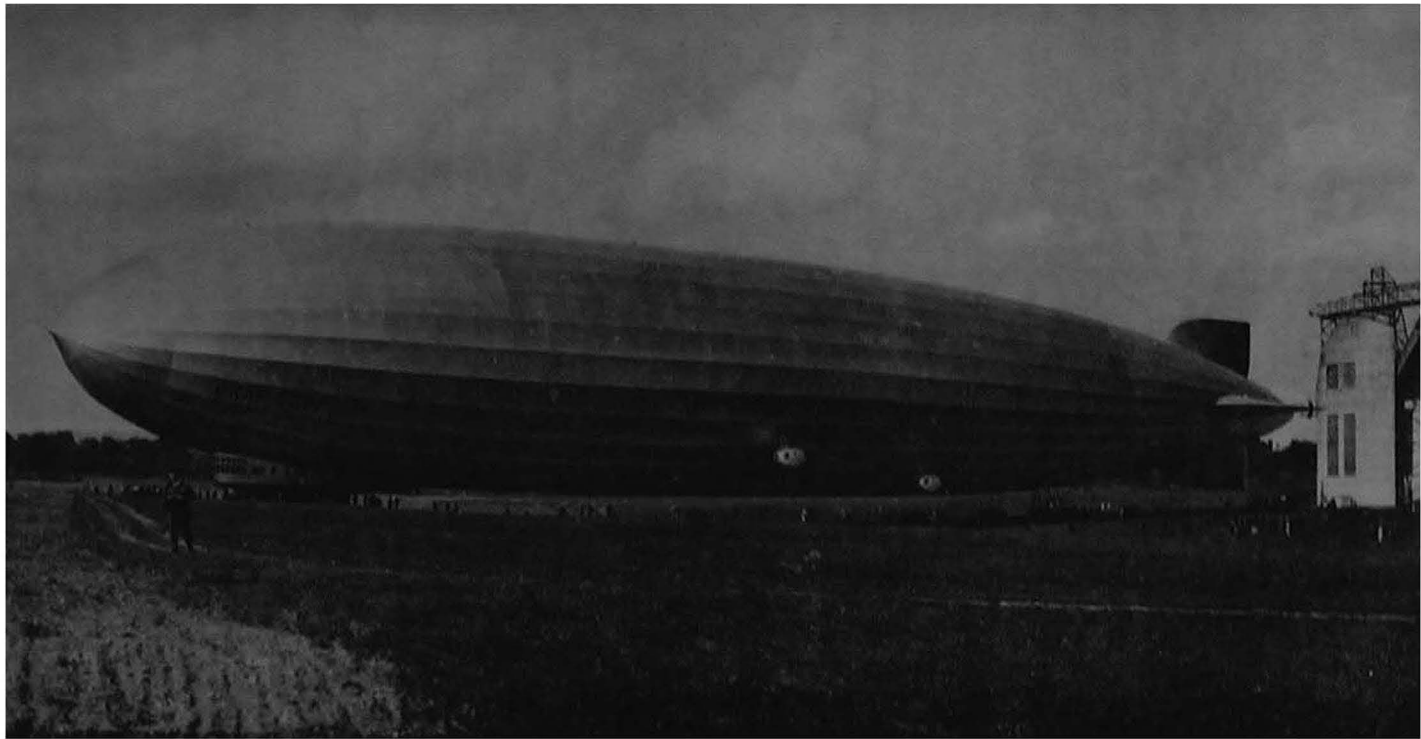
The only proposal, so far as I am aware, which can partially meet the second requirement, and enable an airship to enter a shed whatever the weather, is that of building a revolving shed operating in conjunction with some form of mechanical handling device. It cannot, however, meet what I believe to be an essential factor of the problem—namely, that at any time of the operation a 45 m.p.h. wind may shift 50 degrees in 10 seconds. No airship yet built could, if mechanically held, stand the stress imposed by such an alteration of wind, nor could a revolving shed be moved sufficiently quickly to maintain its position head to wind.

In order to prevent the reader from being misled

¹It is possible to anchor a ship with a drogue or with what is called a three point mooring system. Both are emergency systems involving risk, and cannot be considered as practical methods.

by the exaggerated claims that have been made for the "mooring mast" as a final solution of the airship handling problem, it is as well to state that the mooring mast does not pretend to be, and cannot be, a solution to either of the above-mentioned difficulties. Its function is different. As its name implies, it enables an airship to "moor" or "anchor" to the mast-head. But when attached thereto, the airship is free to swing round with the wind, and if the mooring mast is a "high" mast, i.e., say 200 feet, the airship is always air-borne and is accordingly in a very unstable condition—the reason being that the air, the medium in which she floats, alters in density with the temperature and barometric height. For instance, a change in temperature of 20 degrees would make a ship of the size of the R.100 some 4 tons heavier or lighter, and unless steps were taken to counteract this effect, the ship's tail would either hit the ground, or the ship would take up a very large angle from the horizontal, in other words, attempt to "stand on her head." The method used to ensure equilibrium is to lighten the ship by discharging ballast, and then to keep the tail down by a series of weights that may be lifted in succession as the ship becomes lighter, or lowered to the ground as the ship becomes heavier. These weights are made in the form of large garden rollers or artillery wheels, so that they can move round with the ship as the wind tends to alter its direction. Within limits, this method maintains the airship approximately horizontal—obviously however, the limits are too narrow for commercial operation, and cannot counteract the effect of a heavy fall of snow.

At the risk of wearying the reader, I must explain in detail why I consider that the mooring mast cannot provide, by itself, adequate handling facilities for a commercial service. To begin with, let me give a few extracts from a book written against airships by one



(Photo by courtesy of the Luftschiffbau Zeppelin G.m.b.H.)

The GRAF ZEPPELIN outside her shed

The Graf Zeppelin is 749 feet long, and has a displacement of 3,375,000 cubic feet. It will be seen how small the people look in comparison with her giant structure, so that the difficulty of handling her by man-power requires no emphasis. The impossibility of man-handling a ship of twice or three times her displacement is at once apparent.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

of their foremost critics. The strictures made against the mooring mast are, I think, neither unfair nor prejudiced, but merely commonsense, and they must be met.

“It is obvious,” says this writer, “that before any attempt can be made to ‘secure’ an airship to her mooring mast she must be brought down to a height above the ground sufficiently low to enable the hauling-down rope to be caught by the mooring party.

“It is easy to understand that such a descent must be a ‘natural’ descent, i.e., the airship must descend by reason of a proper balance being struck between weight and buoyancy. She cannot be driven down by the action of her horizontal rudders or elevators, for, while it would be possible to use these to bring the mooring rope depending from her nose within reach of the men on the mast, she could not possibly be secured or held there. If she had been driven down below the height proper to her loading, she would ride up into the air on an angle as soon as her nose was held and her engines stopped. If, on the other hands she had been brought to the mast ‘heavy’ and with her engines and tail elevators keeping her off the ground, she would lie downwards from the mast, and drop her stern on the ground as soon as her engines were stopped.

“The temperature of the atmosphere varies with the distance from the ground. Sometimes the layers of air near the ground are hotter than those a little distance above the ground, the fall of temperature with height being more or less uniform. In these conditions the ‘temperature gradient’ is said to be positive, and it will be readily understood that in

THE WORLD, THE AIR AND THE FUTURE

certain circumstances this 'temperature gradient' can be very steep, i.e., the drop in temperature with height can be very rapid. Such conditions occur in tropical climates.

"The hotter the air is, the less dense it is. Hence an airship flying in equilibrium at a certain height and above such a gradient would become 'heavy,' and would fall quickly to the ground if great care were not taken to ensure that as she was brought within the effect of this gradient, she was given time to 'warm up' at successive stages of her descent. This, of course, is a matter which takes time, and it can only be done by flying the ship down, using the elevators or horizontal rudders to maintain her at the required successive levels during the operation.

"Further, close attention must be paid to the manœuvre, for obviously if she is to be brought to a state of equilibrium—of weight and buoyancy—say halfway up the gradient, she will tend at once to rise further if she is 'lifted' into a colder layer, and to sink lower at once if she is allowed to poke her nose into the warmer layers below her. She will be, in fact, in a very unstable condition and require very careful handling.

"If she is drawn to the mast while such a state of affairs persists, it is obvious that since the propellers must then be stopped, the value of the elevators will be lost. She can then only be kept horizontal by making use of ballast—an extremely difficult task. . . ."

These ballasting operations necessarily take time, and a criticism made by Brig.-Gen. F. H. Williamson, C.B., C.B.E., of the General Post Office, reads as follows:

¹ *This Airship Business* by E. F. Spanner, pp. 144-5 and 148-9.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

"Some few months ago Major Scott arranged for me to take a little run in the R.33. From the point of view of the layman I was immensely struck by the feeling of safety and of comfort in the airship, as well as by the enormous amount of space available. But there was one point on which I did not feel happy at the time. When we were coming down we got out our lines and so on to hitch up to the mooring mast, but suddenly the sun came out from behind the clouds and expanded the hydrogen so that we jumped up by some 200 or 300 feet, and it took two or three hours to come down. If such delays occur at each landing place on a long route, it might make a difference of some days in the total time of transit."¹

Whilst, therefore, it may be true to claim that, under certain conditions, airships may be made fast to a mooring mast, it is obvious that if a ship is left in this condition for any length of time she will require continual attention from the crew.

These views receive further practical confirmation from the experience of Commander Rosendahl, the commanding officer of the *Los Angeles*, who has had the latest and most extensive experience of operating from a mooring mast in the United States.

Returning from his trip to the Central zone, he arrived at Lakehurst shortly after midnight on March 3rd, 1928, but, owing to the presence of snow, did not think it wise to attempt to make fast to the mooring mast. After standing off for some seven hours and encountering snow and hail squalls whilst waiting for the gale to moderate, he preferred to attempt a

¹International Air Congress, London, 1923, page 848 (cited by Spanner, *op. cit.* 147).

THE WORLD, THE AIR AND THE FUTURE

ground landing. The following Press account is interesting:

"The dirigible reached her home hangar at Lakehurst before midnight on Friday to find the field swept by a 32-mile wind. The Commander, Charles Rosendahl, dropped two cables, but one of them snapped, leaving the dirigible bounding on the other, like a toy balloon, until it was cut loose and soared aloft.

"For four hours the aircraft circled over the field and then, when the wind seemed to be moderating, another attempt was made, and the crew were walking the ship across the field when a sudden gust swept it aloft again, this time with four men hanging to the cabin.

"As soon as Commander Rosendahl heard the cries of his unwilling passengers the engines were shut off and, before the men were torn from their holds, they were pulled into the cabin 200 feet up in the air.

"The arrival of snow caused emergency calls to be made for an augmented landing crew from nearby Naval stations, and finally, when there was only enough fuel for two more hours' cruising, the dirigible made a third and successful attempt to land through the feverish efforts of 300."¹

Commander Rosendahl, writing in *Science and Invention* a month or two after this experience, stated:

"The greatest problems of airship operation in the past have been those due to undeveloped methods and equipment for handling airships on the ground—in other words, terminal facilities for airships

¹ See *Gentlemen Prefer Aeroplanes*, by E. F. Spanner, page 122.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

have been inadequate. It is remarkable indeed that airships handled only by man power on the ground have been able to accomplish as much as they have."¹

Apart from these opinions, however, a further examination of the situation brings to light other difficulties. Consider for example the position of a ship "floating at the mast" in Canada, in winter. Clearly she must be prepared to suffer heavy snowfall. Now in the case of the R.100, the area of the ship upon which snow may lie deeply is not less than 46,000 square feet. Seven and a half inches of snow upon this area imposes a load of 66 tons, and would depress the ship on to the ground whatever pains were taken to keep her airborne. Before the ship can take on fuel or passengers for a flight, say to England, all snow must be removed from the cover. It is not easy to see how this can be achieved when the ship is at the mast and the snow frozen hard.

Operation from the mast will be hardly less difficult in the East, where winds are variable and temperature conditions liable to sudden change. The experience that befell a foreign airship has proved very definite upon this point. Although provided with a tail drag in the form of the normal system of artillery wheels, conditions arose during a perfectly calm summer day which within one minute lifted the ship to a pitch angle

¹Again in an article published in *The Sphere* of March 16th, 1929, he writes: "I believe the low mooring mast will eventually be adopted generally. The ship resting close to the ground, will there be subjected to less strain, and may be safely handled by various devices to control the craft horizontally and vertically."

It is worthy of note that, on arriving at Lakehurst after her successful Transatlantic flight at the beginning of August 1929, the Graf Zeppelin was unable to land at the mooring mast, owing to the high wind, and had to stand off for two or three hours until the wind had moderated sufficiently to allow of her making a safe landing.

THE WORLD, THE AIR AND THE FUTURE

of 85 degrees or to approximately a vertical position. Granted that the tail drag weights may be increased both in number and in weight, it is at least doubtful whether with the increased size of the R.100, any such system of tail weights may not prove more effective in theory than reliable in practice; in any case they cannot counteract a heavy fall of snow. Apart from these matters, however, there are certain requirements of a regular commercial service which make it imperative that the ships should be able, when necessary, to operate from the shed, at the base termini, and also that they should be able to make an unaided "landing" at intermediate stations.

The engines will require a complete overhaul, entailing the removal of the crankshaft from the bearings, after approximately each 300-600 hours running, or say, at the end of every third or sixth double Atlantic crossing. This overhaul can hardly be carried out in the ship. In calm weather it may be possible to lower an engine from an airship at the mast, on to a lorry on the ground without damaging it in the process; it is difficult to imagine that this operation can be carried out under windy conditions. For this reason alone, it would probably be necessary to place the ship in the shed at the end of every third or sixth flight.

Overhauls and repairs to the outer cover and the gas-bags may prove necessary at less frequent intervals, but will not be less serious when they do occur. It is difficult to see how a panel of the outer cover can be replaced with the ship at the mast. Similarly it is doubtful whether it will ever be a practical operation to change a gas-bag at the mast, although in the design of R.100, such a proceeding is theoretically possible.

Finally demurrage on these ships will prove to be one of the largest items on the operating account. Capital charges and depreciation upon each ship will

AIRSHIPS: DEVELOPMENT AND PROSPECTS

represent a demurrage fee of not less than £300 per day, and with such charges involved, it is evident the ships must be kept in operation. It will, therefore, be undesirable for a ship to be laid up for repair or overhaul more than is absolutely necessary; but if the ship can enter or leave her shed at any time, engines, outer cover, panels, and gas-bags can be changed during the period between flights, while the ship is being re-gassed and re-fuelled for the next flight. To place the ship out of commission for any purpose other than overhaul should be exceptional.

In the present layout of a mooring mast station such as Cardington, there is no provision for removing the ship from the mast into the shed except by man power in a dead calm. In these circumstances, what is going to happen if it becomes necessary to place the ship in the shed for any reason? Several days may elapse before weather conditions render this possible, and during all this while the ship will be lying idle at the mast, exposed to all the difficulties and dangers already enumerated, and occupying the mast to the disorganisation of the rest of the service. From the financial point of view such a condition is intolerable. Moreover, the actual bringing of airships into the shed by man power is in itself a matter which cannot be considered lightly. In the past it has frequently happened that small airships have been destroyed during an attempt to place them in the shed with man power in quite a mild wind. Ships of the size of the R.100 handled by man power on the ground, may be blown against the shed and seriously damaged and perhaps totally wrecked by quite a slight gust. Imagine a commercial company having assets of £500,000 (the value of a ship) continually liable to be destroyed by an unexpected gust of wind at an inconvenient moment. Consequently, means must be provided whereby the airship can either be placed in her

shed whenever necessary at the conclusion of a flight, or be secured in such a manner that she can lie at anchor safely, like a marine vessel. Summing up, we may say that, for commercial utility, the size of airships must be increased to a point that will render them incapable of being handled by man power, and that consequently our methods of handling them must be much improved before they can become commercially successful. It is better to face this fact now than later.

§ 4

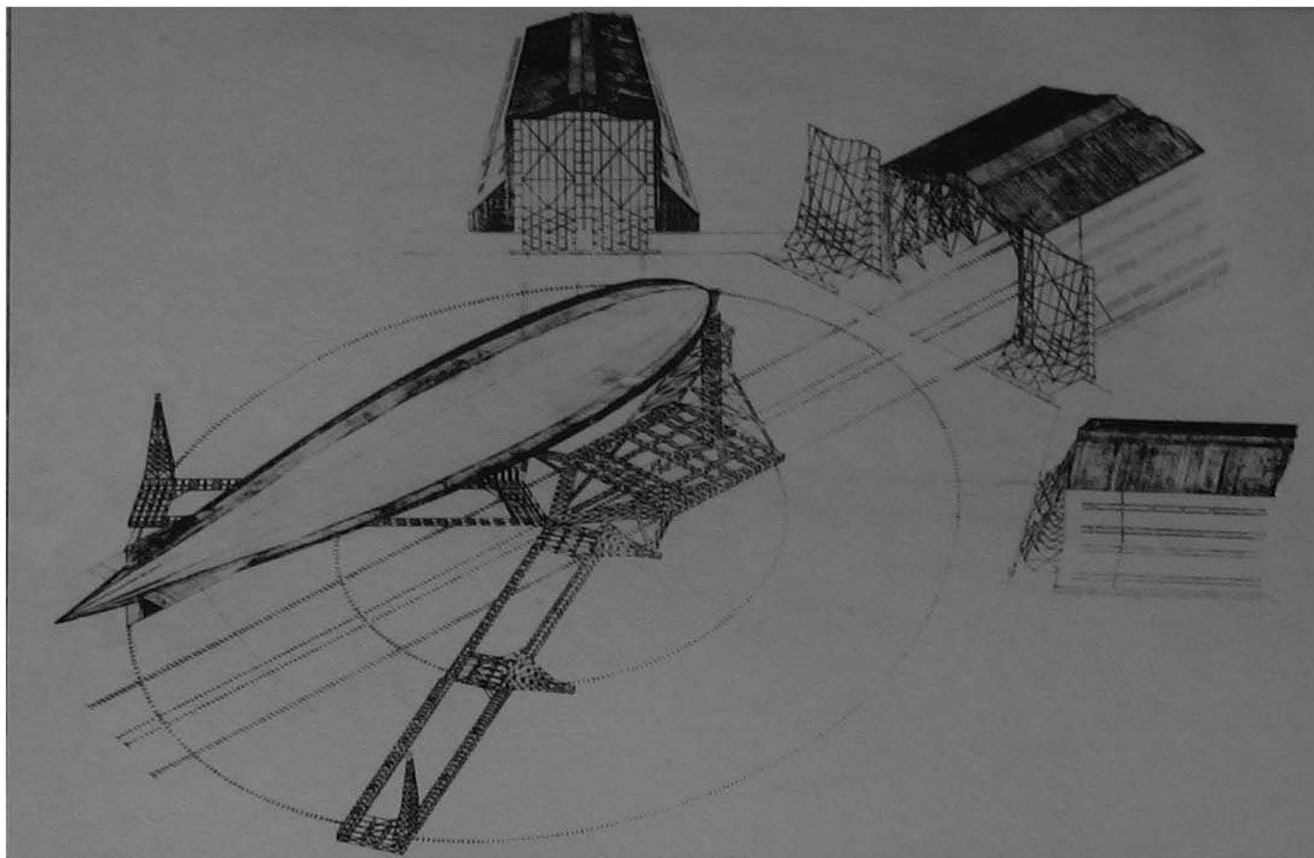
Solutions to the Three Main Problems

In the foregoing sections I have stated plainly and frankly the difficulties that have to be faced and overcome before a practical commercial airship can be built, as nothing is to be gained, in the long run, by refusing to face the facts. Fortunately these difficulties do not seem altogether insoluble, and I now have the more pleasant task of describing certain constructional improvements which will, I think, eventually prove successful in overcoming them.

It will be realised from our analysis of the situation that there were really three distinct problems to be solved:

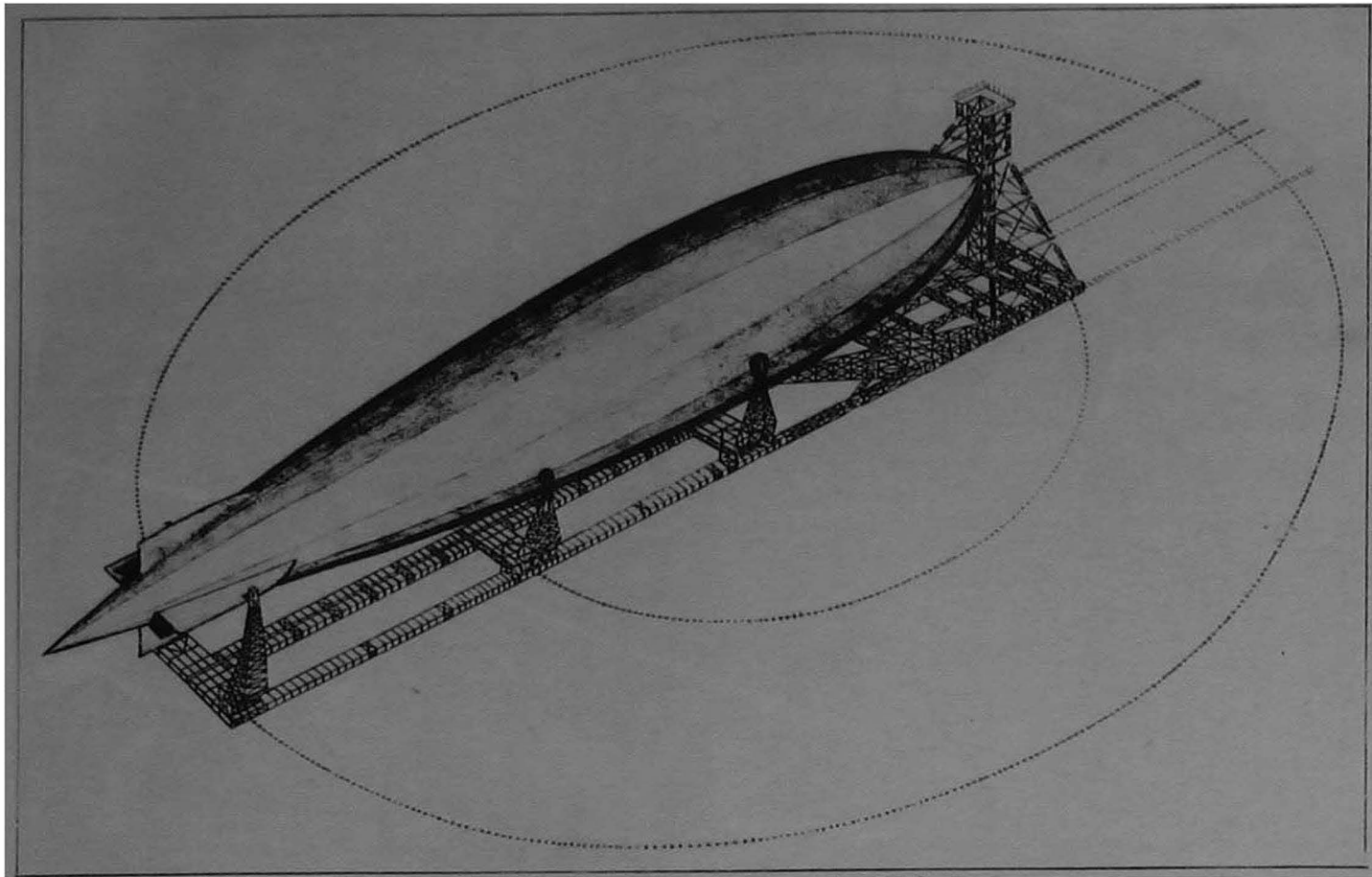
- (1) How to increase the cruising speed from 70 m.p.h. to 90 m.p.h.¹
- (2) How to evolve a method of putting a vessel into a shed and taking her out, in any average weather, by mechanical means.
- (3) How to develop an airship which could alight and moor without extraneous aid, and at places at which no preparation had been made.

¹The Zeppelin Company have already gone a long way in this direction in their adoption of gas fuel in the Graf Zeppelin.



A Drawing of the proposed Mooring and Docking Raft

The ship is attached to the Mast (the masthead being telescopically extended) and ready to be clasped by the claws of the rotatory raft which has its arms open to receive her.



A Drawing of the completed operation of the Raft

Here the masthead is telescopically shut, the ship is securely clasped in the claws of the raft, and ship, raft, mast, and claws are in position to be run into the shed as a unit.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

Each of these developments called for increased efficiency or extra weight, and the problems were of such magnitude, that I considered it desirable to separate them into the above categories. Furthermore, I had to rule out any reduction of weight that might involve a reduction of the factors of safety, since, during the building of the R.100, the Shenandoah had broken into three pieces by being structurally weak.

The solutions now to be described, I have named as follows:

(1) *The Howden Propulsion System*, which enables a gain of 65 per cent. in the propulsive efficiency to be obtained, without an increase of weight.

(2) *The Mooring and Docking Raft* which enables a ship to be placed in her shed in any average weather by mechanical means.

(3) *The "Elliptical" Design*, which enables an airship to alight upon any enclosed or partly enclosed water, such as a harbour, lake, estuary, etc., without extraneous aid, and thereafter to anchor or moor like a marine vessel.

The first two developments were worked out for the existing type of ship upon which we had all the calculations as it seemed to me that if the first two problems could be solved, a commercial service would become possible upon routes that could bear the overhead costs of sufficient emergency bases; whilst the solution of the third problem would enable the airship to operate commercially on any route whatsoever.

1. *The Howden Propulsion System*¹ involves two departures from existing practice. Firstly, instead of one

¹I should like to acknowledge the great assistance I have had from Squadron Leader Helmore, with the concurrence of the Air Ministry, on all questions relating to the gas fuel section of the development.

form of fuel, like petrol or diesel oil, being carried, two forms are carried, one lighter than air—in the form of a fuel gas—and one heavier than air—in the form of diesel or other oil. By arranging the burning of these two fuels in conjunction, it is possible to maintain the ship in equilibrium, and thus conserve both lifting gas and ballast. Furthermore, the fuel consumption is reduced, as the compression ratios of the engines can be raised, and air-cooled radial engines can be substituted for the gas fuel engines, thus saving still more weight.

Secondly, the disposition of the engines in the ship—a matter involving questions of propeller clearance, resistance of supporting structure, elimination of engine cars, etc.—is considerably altered, being rearranged on a principle which laboratory tests have shown to be productive of greater efficiency. The most interesting and important feature is that a proportion of the engines are placed towards the rear of the ship, in much the same place as the propellers in a torpedo. This has been rendered possible by reducing the length-diameter ratio of the ship from 8 to 1 in the Zeppelin type to 4 to 1, so as to minimise the effect of laying the weight of some of the engines upon the tail. The benefit achieved thereby is of great importance when bringing the ship to its securing position in the mooring and docking raft, as it is possible, by operating the propellers in a vertical direction, to give an almost instantaneous force of considerable magnitude either up or down at the tail of the ship. I have previously described how delicate is the condition of a ship just as she makes fast to a mooring mast, and an auxiliary of this nature should not only save much time but also make the operation more or less fool-proof.

The installation of the Howden Propulsion System in a ship of the R.100 class would reduce both the engine weight and the hull structure weight, and enable

AIRSHIPS: DEVELOPMENT AND PROSPECTS

a vessel of a 90 m.p.h. cruising speed to be built, such as would fulfil the conditions for the London-Egypt route I have already referred to. Consequently this system forms a solution to the first problem.

2. *Mooring and Docking Raft.*¹ In the same way as a liner requires tugs and capstans to manœuvre her into a dock, so does an airship, which presents as great an area to the wind as a liner, want some mechanical equivalent. During our investigations into this problem, many suggestions were made, but each proposal was tested by this question: Can the scheme proposed maintain a ship in safety, if at any stage of the operation of taking the ship from the mast and placing her in the shed, a 40-45 m.p.h. wind shifts 50 degrees in 10 seconds?

So far, the proposal I shall now describe is the only one that has passed this test. The general idea underlying it is simple. The ship is moored at a mooring mast in the usual way, and as soon as this has been done, a number of claws are mechanically operated and clasp the ship firmly about the centre line. When the ship is securely held in these claws, the whole structure embracing the mast, claws, and ship, is run into the shed on rails.

Several details have to be elaborated. The mast must be high to receive the ship, and low to enter the shed. Therefore it is made telescopic. The manœuvre of claspings the ship by the claws must be carried out when the ship is lying head to wind. Therefore the claws are mounted on a raft which is capable of rotation; and because the ship is held by the mast, it follows that the mast must be attached to the raft.

The next question for consideration is, at what part of the ship should the claws be attached? Again, it is

¹I should like to acknowledge the great assistance I have had in working out this device from the Cleveland Bridge Engineering Company and the Vickers Variable Speed Gear Company under the direction of Mr. Davis and Mr. Ingleby respectively.

THE WORLD, THE AIR AND THE FUTURE

obvious that they must be attached at that part of the ship that will prevent rolling in the event of a side gust. Therefore the claws are attached to strong points along the horizontal equator of the ship.

The next problem to be considered is in connection with the claws. How are they to be operated? If they are high enough to reach to the centre line of the ship, and if they are mounted on a raft which is rotated so as to lie in the same fore and aft line of the ship, it is obvious that, unless some precautions are taken, the claws will poke a hole in the ship's underside. Therefore the claws are made to rotate about a horizontal axis and lie down flat on the ground, and they only become vertical when the ship is so restrained that she cannot swing into the claws when upright. Not only is this done, but a further precaution is taken. The raft itself carrying the claws is made to open like a pair of scissors,¹ so that the ship can come to the mast between the arms of the raft, and be restrained in that position by ropes running from the claws to the ship. Once the ship is securely clasped in the claws, she can be treated in one of two ways. Either she can be left in the claws in the open, the raft being rotated so as always to keep the ship head to wind, or the raft can be rotated until the ship is in line with the shed, and then the ship, raft, mast and claws, can be run as a unit into the shed.² Furthermore, since the claws are fitted with a weighing device, the ship can be finally balanced prior to emergence from the shed with a minimum employment of personnel. To take the vessel out of the shed will, therefore, require but few men, as nothing has to be done beyond opening the doors and operating the levers controlling the transporting mechanism of the raft.

It will be realised, of course, that although we have a

¹ See Plate XX.

² See Plate XXI.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

solution in the mooring and docking raft for putting the ship into a shed, we are still faced, in the initial stages of the operation, with having to attach the vessel to the mooring point under those conditions already described, in which the vessel has little or no dynamic control.

The provision of tail engines enabling rapid longitudinal control to be provided in the place of the ordinary elevator control, which cannot, of course, function under static conditions should, however, render the operation of picking up the mooring point much easier than under existing conditions.

The weight of the necessary fittings carried in the ship, to which the claws are attached, will amount to three tons or so, and will involve an increase in the size of the ship to obtain the same performance as that of a vessel not so fitted.

3. *The Elliptical Ship.*¹ The changes in airship construction now to be described, are, I believe, of fundamental importance, since they go to the root of the airship navigation problem, and if the details can be worked out satisfactorily, will transform the whole future outlook.

The central idea of the new conception is to enable an airship to alight at unprepared places instead of making fast at a specifically constructed mooring mast, and the actual problem that has to be solved is to keep the ship under dynamic control by means of her rudders and elevators, until such time as the vessel is securely held and no longer in danger of being blown over by a side wind. I doubt if it is possible to do this with any system operated on land. If, however, the scene of operations is moved to the water, a means of solution soon presents itself. Under the midship part of the vessel, two long floats are constructed upon the same

¹ See Plate XXII.

THE WORLD, THE AIR AND THE FUTURE

lines as the hulls of the present flying boats, only much larger.

These floats are fitted with ballast tanks upon their lower side, and are fixed to the hull of the ship as far apart in a transverse direction as possible. At the same time the section of the airship is altered from the standard circular section to an elliptical section.¹ This new shape achieves four fundamental objects.

First. The resistance of the vessel to a side wind is reduced and altered in character by this modified shape.

Second. The overall height of the vessel is reduced, this again reducing the overturning moment due to the pressure of a side wind.

Third. The elliptical shape enables the boat hulls to be more widely spread, thus increasing the righting moment of the floats.

Fourth. The dynamic lift at a given speed is increased.

²To illustrate how such a vessel will be operated, we will suppose that the height of the longitudinal axis of the ship is 80 feet above the water line, and that the distance apart of the floats is also 80 feet, and furthermore that a side wind of 35 miles an hour exerts a force of just under 120 tons upon the side of the ship. In order to keep the ship from being blown over in a 35 miles an hour side wind, we shall require one of the boat hulls to push up with 120 tons and the other to pull down with 120 tons. Obviously, therefore, each float must have a buoyancy of over 120 tons, and at the same time acquire an actual weight of 120 tons. To enable this weight to be obtained the ship will alight on the water in exactly the same manner as a flying boat.³ The ballast tanks in the boat hulls

¹ See Plate XXIII.

² These figures are arbitrary, and do not refer to any specific vessel or design. As a matter of fact, the resultant force is a lifting force rather than an overturning one.

³ See Plate XXIV.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

will then be automatically filled with 120 tons of water by means of scoops, and as soon as they are full, the ship can be stopped, and will then float stably on the boat hulls.

The ship can then be moored to a buoy in exactly the same way as a marine vessel, and will lie approximately head to wind.

She will have fulfilled the conditions laid down, as at all times of the mooring operation she can withstand a 45 m.p.h. wind shifting 50 degrees in 10 seconds; as this will not give a component wind strength of more than 35 miles an hour at right angles to the fore and aft line of the ship. For a temporary stop, passengers can be embarked and taken off by boats, whilst the ship is moored to the buoy; at a terminal base the ship can go to a land base equipped with a mooring and docking raft, or be warped into a shed either floating or situated at the water's edge, in exactly the same way as a liner is warped into dock.

As will have been appreciated, the water ballast tanks were filled by the dynamic reaction of the hull on the water, and therefore this weight of water has been added to the ship, and she is held down against her will. As soon, therefore, as the sluices in the ballast tanks are opened, the ship will rise off the water as if being hoisted by a lift. A further important development is foreshadowed in this part of the scheme, which will result in economy in operation. Under normal circumstances it would be necessary to valve gas in order to bring the ship down from her 2,000 feet flying level to the surface. A ship, provided with floats as described, can be driven down by her engines, this not only allowing her to conserve gas, but automatically giving her an ability to resume her flying height without discharge of ballast. In other words, the airship is given the mobility and ease of handling of the flying boat, whilst retaining her

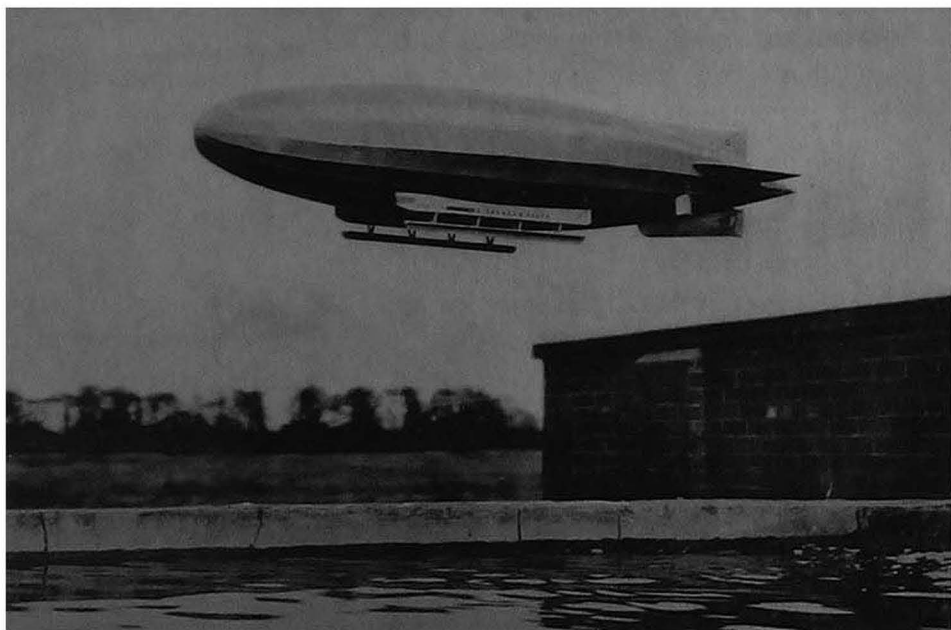
advantages of great range and buoyancy.¹ I do not see how this can ever be done upon unprepared land; and therefore the airship, like the flying boat, becomes a water vehicle and not a land vehicle insofar as her bases are concerned.

The advantages of the elliptical ship by no means stop at mooring and handling.

A rigid airship, if stationary, can only remain upon an even keel in the air provided she is in perfect vertical loading balance. Accordingly, all alterations of the magnitude or position of the weights carried in the airship, such as consumption of fuel, or movement of passengers, can only be compensated for by running the ship at an angle up or down.

The much greater beam of the new type, due to its elliptical shape, and the comparatively much higher horse-power and speed, will tend to reduce the angle required to compensate for a given alteration of trim, thus minimising the force of many criticisms against airships. Again, not only can the greater part of the ballast now carried be dispensed with, and added to pay load, but the vessel will be able to rise with negative lift. To take a concrete example. The actual useful lift of the R.100 is 64 tons, but of this amount 5 per cent. or $7\frac{1}{2}$ tons at least must be carried as emergency ballast, owing to the ship having to make a static landing at a mooring mast, while some 8 tons more are lost in bringing her to a safe flying level of, say, 2,000 feet. The available lift is then reduced from 64 to $48\frac{1}{2}$ tons; and as at least 36 tons of this must be taken off for crew and fuel, only $12\frac{1}{2}$ tons are left for pay load. With the new design it will be possible

¹The extent to which this method will be employed will depend upon the speed at which the ship can take the water. It is a future development, and until actual experience in operation has been obtained it would be unwise to claim the whole of the possible savings.



The Elliptical Ship. A Model in flight



The Elliptical Ship. A Model, showing the bow

AIRSHIPS: DEVELOPMENT AND PROSPECTS

to operate the ship like a flying boat, driving her into the wind, and raising her from the water with at least two tons negative lift.¹ The whole of these savings, comprising 2 tons negative lift, 8 tons ballast discharge to 2,000 feet, and 4½ tons of the 7½ tons of emergency ballast, can therefore be put against the loss due to the extra weight of the floats, etc.

Whilst the saving of ballast, etc., that can be made in operation will compensate for the added weight of the floats and docking raft attachments, and the Howden Propulsion System will allow of extra speed, it still remains desirable to increase the size of the ship in order to enable an adequate pay load to be carried and to increase the comfort of the passengers' quarters. And as it happens, the helpful feature inherent in the conception of the airship is that as her size is increased, so does she become more efficient. Hitherto, we have been precluded from increasing the size to any great degree, as we have had neither the handling facilities nor the ability to make an unpremeditated landing. Now, however, these new developments give us for the first time an opportunity of so increasing the size that a ship can be built of sufficient speed and strength for the Atlantic service.

I have therefore examined the possibility of building a 450-ton ship and there seems to be no technical reason against such a vessel. It would, however, be a large step to take at one stride, and I think that a vessel of between 350 and 360 tons is the largest that could be contemplated as the next step. The magnitude of this step would be in almost identical proportion to what was done in the case of the R.100.

Prior to the R.100 the largest vessel built was one of seventy tons, and the increase to 150 tons was therefore an increase of about 115 per cent. If we take the

¹ See Plate XXV.

THE WORLD, THE AIR AND THE FUTURE

150 tons of the R.100 and increase that by 115 per cent, we have a vessel of approximately 330 to 360 tons displacement.¹

I do not want to convey the impression that no more remains to be done. The laboratory and wind tunnel investigations on the elliptical ship show that a vessel of 360 tons displacement could be built with a cruising speed of 80 m.p.h. and an ability to withstand a 30 m.p.h. beam wind. This speed is too low, and it will be necessary to carry out extensive wind tunnel tests on models, in order to reduce the resistance. Furthermore, an increase in stability in a side wind is also desirable. In view of the experience gained as to the improvement that can be effected by research work of this character, I see no reason to doubt that the necessary advance can be made, but it would be unwise to advocate the actual construction of an elliptical type ship until these further researches are completed.

A ship designed for the Atlantic service, and incorporating all the improvements described, could have the following characteristics:—

Displacement—350 tons.

Cruising speed—90–100 m.p.h.

Range at cruising speed—5,000–7,000 miles.

Pay load 50 tons. This would enable 150 passengers and 20 tons of freight to be carried.

I do not think that much useful purpose would be gained by building a smaller vessel, as the airship is

¹The R.100 displaces approximately 156 tons and is termed a 5,000,000 cubic foot vehicle. This convention of measuring airships in cubic feet is not only cumbersome but fails to give the non-technical reader any idea of the lifting capacity of the vessel; so I shall refer to their displacement in tons in the same way as reference is made to marine vessels.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

essentially a long range vessel, and long range implies high speed and comfortable accommodation for passengers.

§ 5

Possibilities of the Future

With so young a science as Aviation, any doctrine to be of value must be based not only on a consideration of results already achieved, but also on a reasonable calculation of what is likely to be achieved within the next generation. Accordingly, we will now consider future possibilities and try to define the limits within which the airship will develop.

To achieve a fair perspective, I have outlined briefly the historical evolution of airships, and have given a description of the R.100, which represents the latest stage of their development; and I have also described the somewhat revolutionary changes that must be introduced in the immediate future, in order to turn the airship from an experimental craft into a practical transport vehicle. With these data before us, it is possible, I think, to forecast future developments with some accuracy, and to form a very fair estimate of what the ultimate capacity of the airship is likely to be.

The first question that presents itself is this: To what extent may we expect the present rate of progress to be maintained in the future? Can we anticipate say, within fifteen years, having a ship with a speed of 200 miles an hour and a range of 10,000 miles? I do not think so. I fail to see any ground for assuming that the speed of an airship is likely to rise much above 100 miles per hour—and this applies equally to an airship built upon the general lines of those now existing, and to one built upon my proposed new lines. Of course, no one can foresee what some revolutionary

THE WORLD, THE AIR AND THE FUTURE

invention may bring forth, but we have had few revolutionary inventions within the past fifty years. We have seen the application of known sciences and forces to commercial needs, as exemplified by the wireless, the gramophone, the motor car and the steam turbine; but all these developments are based upon physical knowledge that has existed for over fifty years and in many cases for over a century.

For instance, suppose that an engine could be invented having no weight, and using a fuel of no weight—the latter conception will materialise if ever we obtain the wireless transmission of electrical energy—even then, the speed of the airship could not be increased to any great degree, because the longitudinal strength of the structure of the vessel has to be increased almost in proportion to the square of the speed; and if the speed of any vessel were raised from 100 to 150 miles an hour, the increase in the weight of the hull structure required, would exceed that of the fuel and engines now carried. In this respect the aeroplane, as will be seen later, has a decided advantage, for although to-day, commercial aeroplanes have not an average speed of more than 110 miles an hour, nevertheless the speed of the fastest racer is over three times as much, namely 330 miles an hour.

Again, hardly any increase in speed could result from the unlikely discovery of a gas lighter than hydrogen as a lifting medium, since, if hydrogen weighed nothing at all, the resultant increase in the lift of the airship would be but 7 per cent. Nor do I think that any appreciable gain in this respect is to be anticipated from a possible improvement in materials. Such developments will be required to make airships more durable and reliable in structure, and less costly to manufacture, and also to free them from the necessity of that constant and unremitting inspection which the present situation demands; but it is difficult to imagine

AIRSHIPS: DEVELOPMENT AND PROSPECTS

such a gain in the efficiency of materials as would, in addition to the above improvements, affect the question of their speed.

There is the final possibility of an increase in speed resulting from an increase in size. But here, too, the limit is soon reached, as it is reasonable to question the practicability of vessels of more than 600 tons displacement. If the operating conditions of airships up to 600 tons or 20,000,000 cubic feet are examined, it will soon be found that a speed of more than 120-125 miles an hour is incompatible with a range of 7,000 miles and a proportionate pay load. And even to obtain this speed of 120 miles an hour, we should have to assume better engines, better structures and better materials than we could design or manufacture to-day.

We are forced then to the conclusion that the airship can never be a fast vehicle, the laws governing its development imposing on it a relatively low maximum speed which no advance in structural efficiency will enable it to exceed.¹ Accordingly it is quite conceivable that, at some future time, airships will be entirely displaced by heavier-than-air craft. The function of air transport is to sell speed to the travelling public, and if flying boats could be constructed, having a cruising speed of 200 m.p.h. and a sufficient range and pay load, it is more than likely that the public would patronise the faster service to the exclusion of the slower one. The time has not yet arrived, however, when we can construct flying boats of this character, and whether such a time will ever come is at best problematical. Heavier-than-air craft also have limits to their development, and there would seem to be certain fundamental reasons

¹ Here the case of the airship is analogous to that of the Atlantic liner. The *Mauretania* for example, was for twenty years the fastest liner on the service, and naval constructors are agreed that no great increase in speed can be expected.

THE WORLD, THE AIR AND THE FUTURE

why it is unlikely that we shall ever be able to build a commercial flying boat of the type suggested¹—unless, of course, some unexpected and revolutionary invention comes to our aid. If, therefore, the great need of the modern world for fast long-distance transport is to be met, it can only be by means of an improved type of airship. For the British Empire the introduction of such transport is, as I tried to show in an earlier chapter, a vital necessity; it behoves us then, in this country, especially, to push ahead with the development of the one type of vehicle that seems able to combine range and speed in sufficient degree to meet the requirements of the situation.

The new developments described in the last section, will, if successful, give to the airship, for the first time in its history, an ability to alight and take off from any enclosed water without previous preparation being made. To-day, an airship can only stop at a base previously prepared at a cost of tens of thousands of pounds. She cannot be used as any ordinary form of transport, as although she can fly where she likes, she can only stop at one of these laboriously prepared bases. With the new water landing device it will be possible for an airship to land in any harbour, disembark and take on passengers or fuel, and proceed on her voyage, just as if she were a marine vessel. The most overwhelming advantage this system gives from a commercial or naval point of view is that of mobility of supply base. The hydrogen and fuel-gas making plant will be erected upon an ordinary merchant vessel, and can then be sent to any part of the world, and it will only be at the constructional base, which will necessarily be on land, that these plants will be otherwise than afloat. For instance, if to-day, an airship meets with abnormal head winds

¹ In Mr. Norway's chapter on Heavier-than-Air Craft, the reasons are given in some detail.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

and runs out of fuel, and is unable to reach one of the mooring mast bases (which are thousands of miles apart) she is almost certainly lost, as she has to keep air-borne and cannot alight. The new type, however, will make for the nearest harbour, tie up at a buoy, wireless for a supply ship and remain riding comfortably at anchor for a week or so awaiting the supply vessel.

This development opens out quite a new vista for airships from the naval point of view, as the new type of ship will be able to operate without loosing lifting gas to any appreciable extent. If, for instance, a naval airship is operated upon diesel oil, she will be able to accompany the fleet for many weeks with no base at all, other than having her oil, fuel, and fresh water carried in one of the warships. Her range and endurance as a patrol or scout will be much extended, and in moderately fair weather she will be able to descend on the water and keep station with the fleet as if she were an ordinary naval vessel.

The advent of such a vessel must alter the outlook of any naval staff upon the type and number of cruisers required. For instance, a cruiser has two main functions: one, to fight other enemy warships, the other, to patrol and convoy, and to obtain information. Clearly for fighting purposes a squadron of cruisers will be more effective than a single cruiser; but owing to the double function they have to perform cruisers cannot always act in squadrons. If, however, half their duties could be transferred to airships, it would then be possible to keep the cruisers concentrated in squadrons at strategic points, and leave the patrolling, convoy, and reconnaissance work to be carried out by airships. To Great Britain, with her enormous length of trade routes to keep under surveillance, the advent of such a development in aeronautics must be all-important, and extensive

THE WORLD, THE AIR AND THE FUTURE

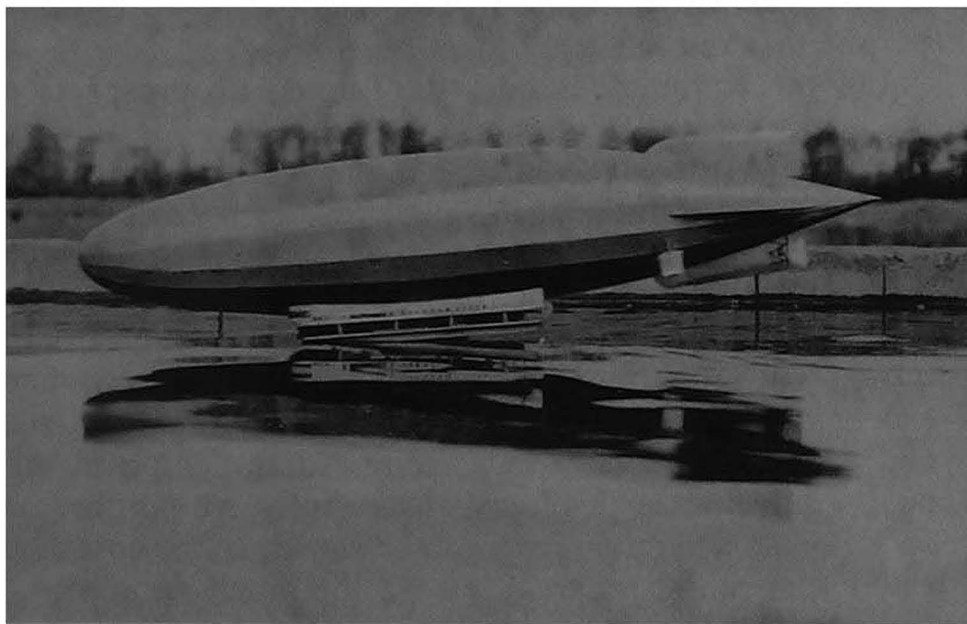
laboratory and design work upon the new type of airship, with a view to naval requirements, should, I think, be put in hand as speedily as possible.

On the commercial side, the immediate prospects of the airship may be summed up as follows:

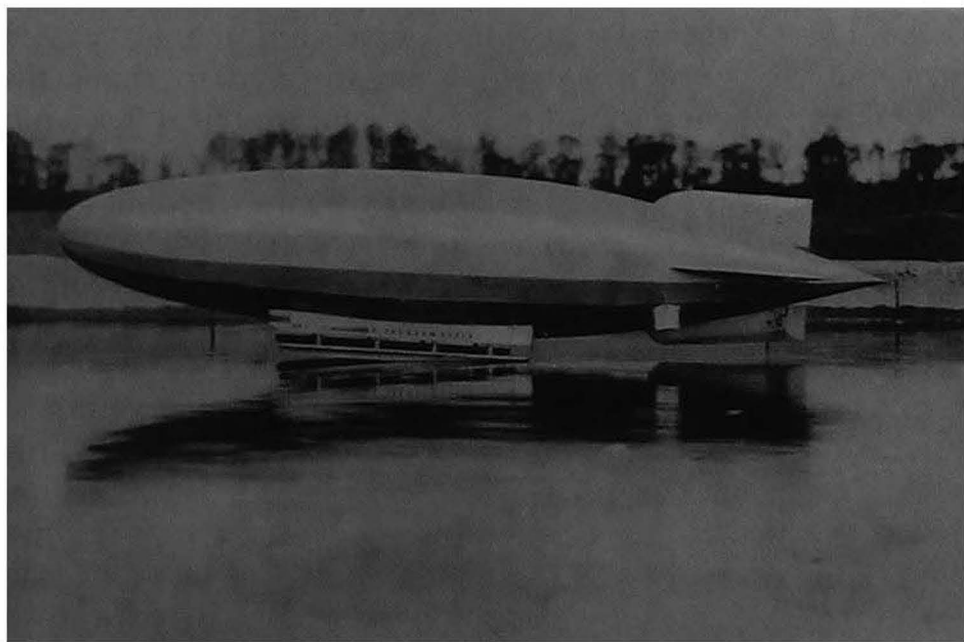
Provided the mechanical handling raft or its equivalent is successfully developed, we can envisage the early development of airship services upon routes that can be adequately supplied with emergency and terminal landing facilities. The heavy cost of this ground organisation will probably preclude this development anywhere except upon the Atlantic routes where traffic is both rich and dense. At a later date, provided the elliptical ship or its equivalent is developed successfully, we can forecast an expansion to other parts of the world, as the cost of an elaborate ground organisation will be much reduced.

If neither of these devices or their equivalent is developed successfully, I do not see much future for the airship.

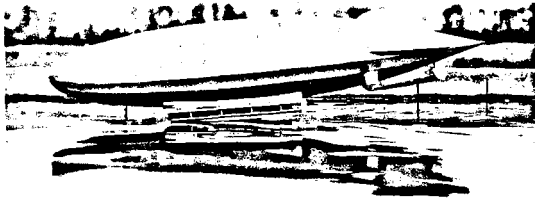
It is, of course, impossible to-day to fix a term to the life of the airship, and on a comprehensive view of the whole air situation, I am inclined to think that airships, if they can be made into practical transport vehicles, will be of use to the world for both naval and commercial purposes, for as many years to come as this generation need trouble about. Their life will last until such time as technical science can find a solution to those seemingly insoluble problems connected with the development of heavier-than-air craft. It is possible that these difficulties may one day be overcome; in which case the airship will be eliminated; and just as the Cunard Line was established with sailing vessels, which, as science developed, gave way, first to composite vessels, carrying both steam and sail, and later to steam vessels alone, which, in their turn,



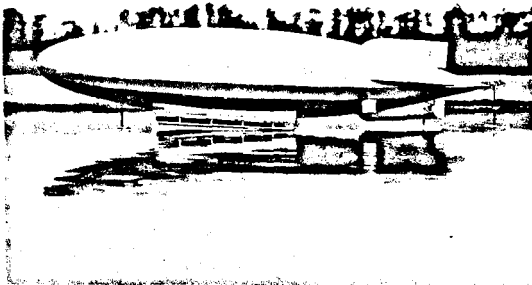
**The Elliptical Ship. A Model alighting on
the water**



**The Elliptical Ship. A Model taking off
from the water**



The Elliptical Ship. A Model alighting on
the water



The Elliptical Ship. A Model taking off
from the water

AIRSHIPS: DEVELOPMENT AND PROSPECTS

may perhaps be superseded by the advent of the internal combustion engine, so, at some future date may an Atlantic Air Service, which began with airships, gradually, and as development proceeds, yield place to a service of giant seaplanes.

§ 6

Justification of Airship Development

Now that we have examined the present airship situation and investigated future possibilities of development, we are in a position to judge whether the policy of reviving airships was correct. I think I shall be justified, therefore, in taking this opportunity of replying to various criticisms that have been levelled against me over the past few years for the part I have taken in assisting and advocating their development.

The criticisms fall into two distinct categories. Firstly, there are those which have been made from what I would term the narrow technical point of view, rather than from the standpoint of policy; and secondly, those which deal with the policy itself and with the magnitude of the expenditure incurred. As regards those in the first category, I have made it clear, that from the purely technical point of view, many of the criticisms were justified; but where I disagree is in the assumption that a technical difficulty cannot be overcome, if sufficient energy is put into the search for a solution.

In 1922-24, when the whole question of reviving airships was being debated, the situation was as follows. The only aeroplane Transatlantic flight that had been made was that by Alcock and Brown from Newfoundland to Ireland. The machine was, of course, overloaded, carried only the pilots, and crashed on landing. At the same time, the R.34 had crossed the Atlantic in

THE WORLD, THE AIR AND THE FUTURE

both directions, reached her intended destination in each case, and had carried over thirty persons. It was, therefore, quite clear that the airship was far ahead of the aeroplane, when it came to providing an aircraft of great range. The necessity to the British Empire, then as now, of obtaining aircraft of great range was urgent. In 1922, however, as a result of the R.38 disaster, the British Government decided to abandon airships altogether, and instructions were issued to the Disposals Board to sell all airships, airship bases, and material in the country, at the best prices obtainable. This seemed to me to be a very short-sighted policy, and I decided to fight that policy, in the hope that normal technical development would so improve airships as to make them practical transport vehicles.

The criticism which had been levelled against airships was, that although they might be of value for naval scouting, their fragility and cost, and the difficulty of handling them, made them unsuitable for commercial purposes. Furthermore, a large body of expert opinion held that the structure of the ship could never be made sufficiently strong to withstand the aero-dynamic conditions that the ships were likely to encounter. On the other hand, those who had been connected with airship development, not only in Germany, but in Great Britain, were firmly of the opinion that all the difficulties could be surmounted, and these airship experts were ready with a long array of arguments and figures to prove their contention.

Let me say at once, that, as a result of the last seven years' investigation and work upon the R.100, I am firmly convinced that the airship enthusiasts not only over-stated their case, but failed to realise that a vessel that could neither make a landing without elaborate extraneous aid, nor be housed or rigidly secured in rough weather, must always remain of doubtful value for commercial purposes. Again, most of the flying experience,

AIRSHIPS: DEVELOPMENT AND PROSPECTS

which, when compared with that of the aeroplane was very small, had been obtained in fine weather. Owing to the fact that a mooring and handling arrangement for airships had not been developed, it was only possible to bring these ships out in fine weather, with the result that difficulties of operation in, what one might term, quite normal weather, were gravely underestimated. Practical conditions of commercial operation had not been given due consideration, and, apart from landing operations, many of the conditions which were looked upon as normal to airship flights, seemed, to my mind, fatal to the pretensions of the airship as an efficient transport vehicle. As an example, I need only refer to the general installation of fuel, which was so designed that the whole of the fuel carried could be dropped in case of emergency; a most useful manoeuvre if it had to be carried out in mid Atlantic with a full complement of passengers!

It is true that I did not appreciate at the time the seriousness of the handling question. When I did so, I endeavoured to adapt the mast system to a floating base, as not only would the base be movable, but the winds over the sea are steadier than over the land. However, these proposals were over-ruled by the Air Ministry, with unfortunate results, as is now apparent. At the same time, the more I investigated the mooring and handling situation, the less I liked it; and after a good deal of work by Mr. Wallis, my chief designer, upon alternative heads to the mast and methods of attachment, we regretfully came to the conclusion that the mast alone could never become a practical means of handling ships for commercial purposes.

The situation by this time was serious. I had advocated the Government's embarking upon the development of airships, I had the R.100 well started and nearly half built, and the more I studied the position as a whole, the more I was sensible to the vital necessity

THE WORLD, THE AIR AND THE FUTURE

of developing our Empire communications; and now, after all our efforts, it seemed as though the vehicle, on which we had counted to give us the fast long-distance transport we so badly needed, was going to prove a cruel disappointment!

There were two courses open: One was to confess failure, the other, to say nothing, and get down to the real problem and find a solution. I had one further difficulty. I had undertaken to write some articles on airship subjects. Were these to be of an optimistic nature or of a pessimistic nature? I decided on the former course with mixed feelings of hope and trepidation. If, however, the mooring mast idea was to be discarded, the problem before us was nothing less than to make an airship so strong and robust that she could stand being held broadside on to a wind of gale force, and so fast and of such a shape that dynamic control would be much greater than had ever yet been contemplated.

The full implications of the changes that were involved were not, of course, as clear then as they are to-day, and although we were quite definite as regards the object to be achieved, I should be the first to admit that it was by luck rather than good management that the various developments have been co-ordinated to form what I hope may prove a solution to the problem.

The problem was so great that it was necessary to proceed step by step. I am speaking, of course, of design, and not of actual construction. To begin with, the ship had to be made much more robust, and her longitudinal strength greatly increased, and coupled with this, her speed had to be increased in a corresponding degree—all of this calling for more weight. The first step was to reduce the length-diameter ratio, and so take advantage of a stumpier form. This led me into the difficulty of being unable to dispose of the increased number of engines for the higher speed, and in turn

AIRSHIPS: DEVELOPMENT AND PROSPECTS

necessitated an entirely new fuel installation and engine mounting scheme. This portion of the programme, already described as the Howden Propulsion System, was completed in 1927. The next step was to make a ship so designed structurally capable of being held broadside on to the wind in a 35 m.p.h. wind, and to enable her, when so held, to be taken in and out of a shed, when a wind of this velocity was blowing at right angles to the shed. This portion, described as the Mooring and Docking Raft, was completed in 1928.

By the end of 1927, however, it was already clear that the first two problems could be solved, and before the year was out an approximate design incorporating the improvements was completed. I then went over to the United States to investigate the financial and commercial implications of an Atlantic service.

The last and final step was to incorporate all the features of these two designs into yet a third, and to design a ship that would be capable of making a landing without extraneous aid, of being anchored in a safe and stable manner like a marine vessel, and of being moved into or out of a shed in any weather other than a full gale. This portion, which was completed in 1929, I have described as the "Elliptical" ship.

Accordingly, therefore, to meet normal operating conditions, I have been forced to devise an entirely different method of construction, control and handling, because existing airships suffer from an inherent difficulty which no mechanical ingenuity can overcome—namely that, at some period of their operation, a nicety of trim and balance in the vessel obtains, such as automatically involves a condition of stability capable of being upset by relatively small external forces. There still remain several other problems to be considered, mainly in connection with detail design, and whilst to-day we have workable solutions as embodied in the

THE WORLD, THE AIR AND THE FUTURE

R.100, there is naturally room for improvement. The more important of these problems I will briefly indicate.

¹To begin with, let me remind the reader that we have to construct a vessel that is the size of the *Mauretania*, but only weighs some 90 tons. The actual area of the outer cover or envelope is $4\frac{1}{2}$ acres, so it is easy to realise that the thickness of this outer cover must be very small, as only some $4\frac{1}{2}$ tons can be allowed for the total cover. It takes the place, however, of the steel plating of an ocean vessel, and has to withstand rain, hail and snow. At a full speed of say 80 miles an hour, one must realise that the air is rushing past and over the cover at the speed of a hurricane. The cover itself is made of linen protected in several ways. Firstly, it has to be made water-proof to prevent the absorption of moisture. Secondly, it has to be protected with special oxides to prevent the actinic rays of the sun rotting the fabric. Thirdly, it is covered on the outside so as to reflect the sun's rays, and thus minimise the amount of heat that would otherwise pass through it to the gas-bags, and heat the gases contained therein. Fourthly, it has to be so mounted and fixed into place on the ship that it will withstand the stresses imposed upon it during flight. With the exception of the fourth condition, it may be said that the cover is satisfactory, and the Los Angeles cover, after four years' operation, is in excellent condition. As regards the fourth condition, although there is at present no case of structural failure recorded other than that which occurred to the fin covering of the Graf Zeppelin during her voyage to the U.S.A. in 1928, there is no doubt that much remains to be done in this respect. In fact, it would not be too much to say that this constitutes one of the major problems of detail design. As a result of much thought and research, a solution appears to be in sight, and will probably be incorporated in later ships.

¹The figures quoted in this Section are those relating to the R.100.

AIRSHIPS: DEVELOPMENT AND PROSPECTS

As regards the structure of the ship itself, there is no doubt that all ships prior to the R.100 were much too weak, and it was a realisation of this fact which led me to double the strength of the R.100, as regards longitudinal stresses, upon the requirements laid down by the Airworthiness of Airships Panel.

In the contemplated designs of later ships I propose to increase this strength still further, although Dr. Dürr, the chief designer of the Zeppelin Company, informed me, after inspecting the R.100, that in his opinion I had wasted weight in making the ship stronger than was necessary. However, it is better to be safe than sorry, and it is, I think, a satisfactory indication of the possibilities of development, to know that the strength can be increased to so great a degree over that of vessels that have navigated the Atlantic successfully.

The gas-bags themselves constitute a somewhat unpractical element in airships to-day. They are made of cotton fabric coated with goldbeater skins, the latter being the actual membrane skin of the intestines of the ox. Very nearly a million skins are required for such a vessel as the R.100, and as a result, the gas-bags cost not far short of £50,000. Though bags made up in this way are the most serviceable that have been produced hitherto, it cannot be pretended that they present a really satisfactory solution to the problem. It seems, however, that the artificial silk trade will come to our assistance, and that, in the not too distant future, we shall have a synthetic substitute for goldbeater skin that can be manufactured in whatever quantity we desire.

I have said enough to show that the detail problems as well as the major ones are being faced, and I therefore pass on to other considerations, as I do not wish to weary the reader with more technical matter than is essential to a proper understanding of the question under discussion.

THE WORLD, THE AIR AND THE FUTURE

Turning now to the second criticism, namely, that too much money has been spent on the airship programme, I can only say that the reason for this is, that in 1924, Mr. MacDonald's Government altered the scheme which I had submitted to Mr. Baldwin's Government, and which that Government had provisionally accepted, and embarked upon a policy of State development, in the place of proceeding upon the lines of subsidising private enterprise. In the scheme I put forward, the Government were to advance £400,000 by way of subsidy, and £300,000 was to be provided from private sources. This sum was to build and test the first ship and, in addition, to equip two floating bases that could be despatched to any part of the world, in order to test the route. The main idea was to prevent the necessity of having to select sites and bases prior to the testing of the first ship, as I thought that developments might ensue that would alter our views as to the situation of the bases. This, of course, is what has occurred. The Government have spent over £2,000,000 instead of £400,000. The reasons that they have for doing so, may or may not justify the difference in expenditure, but this is for them to defend and not for me.

I have always thought that the Government policy of turning down the mobile base scheme was dictated by political rather than technical reasons. Lord Thomson, the then Secretary of State for Air, speaking in the House of Lords on the 21st May, 1924, made the following statement:

"For example, a grave technical objection was the fact that, in his latest proposals, Commander Burney did not propose to construct what the Air Ministry considered suitable bases in India and an intermediate station before his first flight to the former country was undertaken. He, indeed, thought of

AIRSHIPS: DEVELOPMENT AND PROSPECTS

utilising the untried method of mooring masts on monitors, a procedure which, in the opinion of the Air Ministry experts, would have involved unwarrantable risks."¹

As a matter of fact the United States were, at that time, fitting out the store ship *Patoka* upon the same lines, and a few months later tested her out with complete success.

The political reasons are clear. At that time the Air Ministry and Admiralty were in conflict as to which department should control the development of airships. If operations were run from the water, if the bases were ships, obviously the Admiralty could not be left out. On the other hand, if the bases were on land the Air Ministry could justifiably claim control.

However, whatever reasons the Government may have had for rejecting the mobile base scheme in favour of the fixed land base, the result has proved most unfortunate, as, except for a few demonstration flights with the existing ships, it is doubtful whether these land bases in Egypt, India, and Canada will ever be used except as emergency stations. Mooring masts have already been erected at Ismailia, Karachi and Montreal, and a huge shed, claiming to be the largest in the world, has been built at Karachi. Yet it seems that these magnificent preparations will prove, from a commercial point of view, to have been premature. On the one hand the bases, being inland and not on the water, are of small value for any type of airship designed to alight on water, and, for reasons stated in previous sections of this chapter, I am convinced that future airships are likely to be designed on this principle. On the other hand, the actual mooring masts can be of little practical use as land bases, either for the new or for the existing

¹ *Parliamentary Debates House of Lords*, Vol. 57. No. 39. Col. 564.

THE WORLD, THE AIR AND THE FUTURE

type of airship, since the introduction of the mooring and docking raft—and this system or some other that serves the same purpose is, as I have shown, essential for landing airships on *terra firma*, if they are to meet the needs of a commercial service—will make them redundant. The question of the proposed bases at Durban and in Australia should, I think, be reconsidered in the light of these new developments.

A final word now upon the R.100. Although I do not think that she will be of much use commercially until she has undergone the necessary alterations to enable her to use the mooring and docking raft, she will fulfil and in fact exceed her contract requirements, and will, in that sense be a perfectly sound ship whilst actually flying. Nor is this all. Unless the R.100 had been built, it is hardly likely that the conception of the new elliptical water-ship would have taken shape as a practical proposition in design. The problems were too great and too many to have been solved in one step. As an experimental ship, therefore—and, as I have repeatedly said, it is as an experimental ship that she must be regarded—the R.100 has served her purpose admirably; and in view of what the "experiment" has taught us, and of the new developments it has rendered possible, I claim that the time, money, and effort expended on it, have been more than justified. And this is my answer to my critics.

[NOTE.—The contentions advanced in this chapter have been strikingly borne out by the experience of the Graf Zeppelin in her attempted flight across the Atlantic in May, 1929. The ship's engines broke down, and owing to her inability to land except at a specially prepared base some hundreds of miles away, she narrowly escaped complete disaster.]

HEAVIER-THAN-AIR CRAFT

CHAPTER VI

HEAVIER-THAN-AIR CRAFT

1. The Land Aeroplane
2. The Flying Boat

§ 1

The Land Aeroplane

The operation of commercial aeroplanes upon an organised route is entirely a post-war development of transport. In the years that have elapsed since the first commercial air line was inaugurated in 1919 there has been a remarkable development in the size and the capacity of the machines used for this purpose, and a great extension of routes throughout the world. Every year the machines employed tend to get larger and to conform more to the amenities of the older forms of transport; every year sees an extension of the mileage over which it is possible to fly with regularity and safety.

With so great a development in so short a time, it is not unnatural that the most exaggerated claims should be made freely for the future of air transport. It is hardly possible to-day to pick up a penny newspaper without finding in it some reference to a "giant air liner," though in hard fact the carrying capacity of the largest commercial aeroplane now flying on a regular service is less than that of one small motor lorry. Because the speed of the commercial aeroplane to-day is equal to the maximum speed record of a few years ago, the forecast is freely made that within a few years passenger

THE WORLD, THE AIR AND THE FUTURE

carrying aeroplanes will be travelling at over three hundred miles an hour, the speed record to-day.

In this chapter an attempt will be made to explain the principles which must govern the development of the commercial aeroplane, partly in order that the reader may be in a position to discount the grosser of these journalistic exaggerations, and partly to explain the basis upon which a forecast of the future development of the land aeroplane has been made. To predict a limit to any form of engineering achievement is to court ridicule when in a very few years the achievement outstrips the prophecy; at the same time, unless a forecast of future development be made, both engineer and air line operator are working in the dark. In the light of present knowledge it appears that the commercial aeroplane will have a definite range of development ahead of it beyond which no further advance can be anticipated, but this is not to say that in five years' time the increase in aeronautical knowledge will not permit a clearer view of the later stages of development.

It will be assumed that the reader is familiar with the general outline of an aeroplane. The machine consists, broadly, of a body or fuselage in which the pilot and passengers are accommodated, of wings which are attached to the body and form the means of support, of a tail unit for control purposes, and of a wheeled undercarriage which carries the weight of the machine upon the ground.

The machine is driven forwards by the thrust of the propellers, each driven by an engine—generally a petrol engine. Since the machine derives its lift from driving a set of inclined planes—the wings—through the air, it will be readily appreciated that the faster it goes the more it will lift with a given area of wing.

Consider now a machine of a definite weight—say a total weight of 3,000 lbs. Let the area of the wing

HEAVIER-THAN-AIR CRAFT

be 300 sq. feet. Then a wing of normal characteristics will require to be driven through the air at a speed of 57 m.p.h. to develop a lift of 3,000 lbs. at its angle of maximum lift. That is to say, the aeroplane will have to run along the grass of the aerodrome till it reaches that speed before it can leave the ground. Once in the air the speed of the machine is dependent upon the resistance of the wings and the rest of the machine in relation to the power of the engine.

To increase the maximum speed of this machine there are several courses open to the designer. First, and most obviously, he can increase the power of the engine. For the moment it will be presumed that this cannot be done; the most powerful aeroplane engine that exists is already fitted. What can then be done to increase the speed?

Evidently the resistance of the machine must be reduced. This can be done by re-designing the body, the undercarriage, and the tail to give the very least resistance possible—perhaps at the sacrifice of other attributes. The shapes that give the least resistance to the air flow will probably be very expensive to manufacture; the engine may have to be so boxed in with cowling that it will take a couple of hours to change a sparking plug. Nevertheless, the machine will be faster.

The shape of the wing section will probably not be capable of any very great improvement. But there is an avenue for the reduction of resistance here—the area of the wing may be reduced. It may very well be the case that half the total resistance of the machine is due to the wing.

Suppose the area of the wing be reduced to one-third—to 100 square feet instead of 300. Its resistance will be reduced by that amount, within small limits. The small wing will still lift the weight of the machine

THE WORLD, THE AIR AND THE FUTURE

if it is driven fast enough through the air, but the speed necessary to lift 3,000 lbs., with this little wing will now be 100 m.p.h. and the machine will have to attain this speed before it can leave the ground. It will, however, be very much faster. If the weight of the machine could be reduced, say to 2,500 lbs., the area of the wing could be reduced to 84 square feet, for the same minimum speed of 100 m.p.h., and the aeroplane would be faster still.

So much for the theory of increasing speed. In practice, however, it may be not irrelevant to note that there is little use in building a very high speed aeroplane unless a pilot can be found to fly it. In the case examined, the minimum speed of the machine has been increased to one hundred miles an hour. Consider now what it means to fly such a machine.

In the first place, at that speed, the slightest accident in landing will result in the death of the pilot. If a light aeroplane with a minimum speed of about 40 m.p.h. should break a wheel while landing at that speed the machine may turn over; it will be unfortunate and expensive to the owner, but nobody in the machine will be hurt. If such a thing should happen on our hundred mile an hour machine the impact with the ground would be terrific. Moreover, the slightest irregularity of the ground would be sufficient to cause the machine to turn a somersault at such a speed; a molehill on the aerodrome would be quite sufficient.

High landing speeds are dangerous.

The matter of high speed has been dwelt upon at some length because of the repeated assertion that, since the speed record now stands at 370 miles an hour, it can only be a matter of a few years before aeroplanes are carrying passengers for great distances at such a speed. It will be interesting to examine the record-

HEAVIER-THAN-AIR CRAFT

breaking machine critically to see how likely this assertion is to be fulfilled.

The minimum speed of the machine is about 95 m.p.h. For this reason, it was made a seaplane, partly because it requires a greater space in which to land and take off at these speeds than could be provided by any land aerodrome, and partly because of the very uniform and smooth surface that water can provide in suitable conditions.

It may be stated straight away that these machines are only flown in suitable conditions; strong winds or small waves make an attempt at flight so hazardous as to be out of the question.

This machine carries petrol for a flight of an hour only, or a range of about three hundred miles. It is a single seater and can, of course, carry no paying load at all. The life of the engine at full speed is probably not more than ten hours, and the cost of the engine in moderate production would be about £3,000. The physical strain of flying this machine upon the pilot is intense. With machines of this type, whose pilots are trained for many months to fly these high speed racers, failure of the pilot is a far more likely cause of accident than failure of the machine.

It will be seen from the above that an immense distance has yet to be traversed in aeroplane design before a machine can be produced which will carry passengers in safety at three hundred miles an hour, or at any speed approaching this. In no other form of transport has the specialised machine provided so misleading a view of progress as in the case of the aeroplane. The racing seaplane described above represents a serious endeavour to attain the maximum possible speed in level flight, regardless of all other considerations. For that narrow purpose the machine is extremely

THE WORLD, THE AIR AND THE FUTURE

efficient. It leaves the problem of high speed *commercial* flight exactly as it was before the machine was built.

So much for speed. Turning to the range of aeroplanes, or the distance that can be covered in a single flight, we find that many of the same considerations determine the range of aeroplanes upon commercial service as determine the speed.

The range of any aeroplane is in direct proportion to the weight of fuel and oil that it can carry. Suppose an aeroplane be loaded up with fuel, till a weight of fuel is carried equal to the weight of the machine. What is the difference in characteristics between the loaded and the unloaded machine?

First, the weight of the loaded machine is double that of the unloaded machine. This puts up the minimum flying speed; the loaded machine must travel at a greater speed to support its weight in the air. If the minimum flying speed of the unloaded machine was forty miles an hour, the minimum flying speed of the loaded machine will be fifty-six miles an hour.

Since the power of the engine is the same in each case, the loaded machine, when running along the ground to attain flying speed, will accelerate very much more slowly than the unloaded machine. To attain equal speed the loaded machine will require a much longer run. But the loaded machine has to attain a higher speed still by reason of its higher minimum flying speed. For these reasons the run of the loaded machine when taking off may be as much as three times that of the unloaded machine. This may necessitate a very extensive aerodrome.

Because the weight of the loaded machine is double that of the unloaded machine, all parts of the structure will be working at double the stress. For this reason, gross overloading of a machine may produce a structural



(Photo by courtesy of Imperial Airways Limited.)

The Imperial Airways 21-seater 'ARGOSY' Aeroplane G-EBLF

(For specification see List of Illustrations)

HEAVIER-THAN-AIR CRAFT

failure. In most cases of record long distance flights, arrangements are made whereby the majority of the fuel can be jettisoned to lighten the machine, if it should become necessary to make a landing soon after the commencement of a record flight. If this is not done there may be a danger of the undercarriage collapsing, since the loads in this part of the structure are heavier when landing than when taking off. For this reason, also, fine weather and calm air are usually chosen for the start of the record flight. As the flight proceeds and fuel is burnt up, so the machine gets lighter and relatively stronger.

The effect of loading up an aeroplane, then, is to increase the minimum flying speed, very much increase the run to take off, and to reduce the structural safety of the machine. Record breaking long distance machines, generally speaking, are not specially designed for the purpose although one notable exception exists in England. Usually they are military machines of the day bomber type, fitted with special tanks and loaded up to the limit imposed by the run to take off or by structural weakness. It is not uncommon for these heavily loaded machines to run for a mile before staggering off the ground. Once off, the climbing angle is extremely bad, of the order of one hundred feet of height gained for every mile flown.

Such flights, of course, are neither safe nor commercial; needless to say, no paying load is carried. The relationship between the maximum range under safe commercial conditions and the maximum range under record breaking conditions would not be very easy to determine but for the fortunate circumstance that in certain cases a standard commercial machine has been used for record breaking.

When Colonel Lindbergh flew from New York to Paris, in the summer of 1927, he used a Ryan commercial

THE WORLD, THE AIR AND THE FUTURE

monoplane. The alterations necessary for his flight were not so great as to impair a comparison between the record breaking machine and the machine as retailed for commercial service.

The machine as used for the Atlantic flight had a maximum range of about 4,000 miles; the distance flown from New York to Paris was 3,600 miles. The total weight of the machine at the commencement of the flight was 5,130 lbs., of which about 2,800 lbs. was fuel and oil.

The minimum flying speed was about 71 miles an hour.¹

The commercial version of the same machine shows very different characteristics. The maximum permissible weight for which the machine is designed is 3,300 lbs. Comparison of this figure with that for the record breaking machine shows to what extent the latter was overloaded. The minimum flying speed of the commercial machine is 49 m.p.h. Of the 3,300 lbs. tankage is provided for 600 lbs. of fuel and 720 lbs. of paying load, the balance representing the weight of the machine and the pilot.²

The 600 lbs. of fuel gives the machine a range of about 700 miles. That is to say, when the machine is carrying what the makers consider to be a reasonable economic load the range of the machine is 700 miles as opposed to the 4,000 miles of the record flight.

Suppose the machine to be loaded up to its commercial weight with fuel; that is to say, suppose the 720 lbs. of paying load to be transformed into fuel. The machine would then be carrying the pilot, 1,320 lbs. of fuel, and no paying load at all. In this case her range would be about 1,550 miles—as opposed to the 4,000 miles of the record breaking machine.

¹ *Flight*—June 9th, 1927.

² *The Aeroplane*—December 7th, 1927.

HEAVIER-THAN-AIR CRAFT

The latter comparison shows directly what is to be gained by taking risks. The structural strength of the machine for commercial service was laid down on a basis which would permit the machine a range of 1,550 miles. Manifestly the designer of an aeroplane does not put in heavier members than are necessary for the work they have to do. By grossly overloading the structure the range of the machine was increased to 4,000 miles, but this feat, admirable in itself, can have no commercial significance at all. The range of this machine, when operated under safe commercial conditions and carrying a paying load, is 700 miles in the extreme. The range achieved in Lindbergh's flight means nothing to commercial aviation, other than the advertisement of aviation as a whole.

The largest passenger carrying aeroplane in regular use in England to-day is the Argosy.¹ This machine has a total weight when fully loaded of 18,000 lbs., or about eight tons. The normal paying load is about 4,500 lbs., two tons, and is generally represented by twenty passengers, with their luggage. The machine is fitted with tankage for 1,800 lbs. of fuel and oil, giving it an extreme range of 340 miles, at a cruising speed of 95 miles an hour. Three engines are fitted, each of about 400 h.p. The minimum flying speed is in the neighbourhood of 55 miles an hour when the machine is fully loaded.²

This machine is generally regarded as the safest, most efficient, and most economic passenger carrying aeroplane in the world. Carrying its two tons of paying load for only 340 miles at a speed of under a hundred miles an hour, it is evidently very far removed from the giant air liners of journalistic imagination. Taking this

¹ See Plates XXVI and XXVII.

² Advertisement in *The Aeroplane*—August 1st, 1927.

THE WORLD, THE AIR AND THE FUTURE

machine as a basis, it will be interesting to examine the future of the type and to attempt to forecast the ultimate development of the large aeroplane of the future.

In the first place, it is not to be expected that an increase in the size of the aeroplane will increase its efficiency to any marked extent other things being equal. In fact, the tendency is for the aeroplane to become more inefficient as a vehicle of transport in the larger sizes. As the size is increased so the weight of the structure, expressed as a percentage of the total weight, increases, to the detriment of the percentage weight available for paying load and fuel. In fact, to point the moral by an absurdity, the size of the aeroplane could be increased to such a point that, with the best design in the world, it would only be possible for the machine to lift its own weight, with no weight at all available for paying load or fuel.

This tendency to an increasing structure weight may be postponed in two ways. With the increase in size more economical methods of construction become possible, the solid spar gives place to the box girder, and, in turn, the box girder to the lattice girder. For the same relative strength it becomes possible to use a lighter type of structure in the larger aeroplane so that the fundamental increase in the percentage structure weight is neutralised and, up to a point, with increasing size the percentage structure weight remains constant. Increasing the size still further, however, a point is reached when this relief ceases to take effect. The aeroplane has reached such a size that the most economical structure for weight is already being used, a further increase of size means merely an increase in the dimensions of the various members. From this point the structure weight must follow the fundamental law, and consequently an aeroplane beyond this size becomes inefficient. The same load will be more efficiently

HEAVIER-THAN-AIR CRAFT

carried in two aeroplanes of half the carrying capacity than in one very large machine.

The second way in which the tendency to increasing structure weight may be postponed is by increasing the minimum flying speed. This means, in effect, reducing the wing surface relatively on the larger machine, with a consequent saving in weight.

Of all the temptations which beset the designer of aeroplanes, this temptation to increase the minimum flying speed is the most insidious. The reduction in structure weight means that a greater paying load can be carried; the reduction in wing area means that with the same engine the machine can attain a higher speed. Since the fuel carried is sufficient to keep the engine going for a definite number of hours, the higher speed means that the machine has a greater range. If the greater range is not required, then a less amount of fuel will be needed for the same range, and a further increase in the paying load becomes possible.

It is not surprising that soon after the war, when commercial flying was in its infancy in England, and operators were still feeling their way, there came a definite, and realised, tendency to increase the minimum flying speed of passenger aeroplanes. It was soon proved in practice that a machine with a minimum flying speed of fifty miles an hour was safe, and could be brought safely through the ordeal of a forced landing due to engine failure in the agricultural country between London and Paris. In the next design of passenger machine the designer increased the landing speed to fifty-five, at the same time asserting his opinion that "the pilots would get used to it." The pilots, on whose shoulders the burden of any increased danger fell, grumbled, but did in fact get used to it. For a further increase in efficiency the landing speed was put up to sixty in the next design; the pilots grumbled louder than

THE WORLD, THE AIR AND THE FUTURE

before, and with the increased paying load of the new machines the financial prospects of the operating companies began to look more rosy. The next design increased the landing speed to sixty-three miles an hour with full load, carrying ten passengers with the same engine which had previously carried four at the beginning of the process. Serious trouble with the pilots marked the introduction of the new machine, but they submitted loyally to the judgement of their experts, and grew accustomed to the higher landing speeds. Backed by a more intensive system of operation, it was this machine which proved that air transport between England and the Continent would some day be an efficient and a paying proposition.

But this was the end. For three years the machine held its own in the service with few serious accidents, but with the weight of evidence piling up against it. The landing speed was too high to enable a forced landing to be made safely in the country over which it had to operate; if failure of its single engine occurred it was only an even chance whether there was a field within gliding distance of the machine capable of accommodating its landing without a crash. Finally a bad crash in the course of a difficult forced landing, in which the pilot and several passengers were killed, brought matters to a head, and the type was abandoned. In its place Imperial Airways, placing safety before the greatest operating efficiency, began to concentrate upon the three engined machine of rather lower landing speed; of this type the Argosy is an outstanding example.

It must be realised, then, that the efficiency of the very large machine of the future cannot be maintained by any very great increase in the landing speed. In years to come the braking of aeroplanes to reduce their run upon the ground after landing will be developed further than it is to-day, but it is doubtful whether

HEAVIER-THAN-AIR CRAFT

this development will be used by the operator of a regular service to increase the landing speed. To do so would be to presume that aeroplanes of the present day are safe enough in a forced landing and that no higher standard of safety is required. This is a bold assumption, and one which can hardly be upheld. There is a marked tendency at the present day to utilise all technical advances to make air travel safer—not to increase the operating efficiency.

If this tendency be maintained, and at present there is every indication that the air line operators intend to maintain it, then it follows that the landing speed of the passenger carrying aeroplane operating on a regular service is unlikely to rise above sixty miles an hour.

It is not easy to sum up the varying factors referred to above in such a way as to obtain a clear idea of what is the actual maximum size of the large aeroplane of the future, beyond which the increasing structure weight would render the machine less efficient than a smaller one. In 1924 the Secretary of the United States Navy set up a committee to report upon the inherent limitations of the aeroplane; this committee stated that in their opinion a total weight of between 40,000 and 50,000 lbs. marked the limit beyond which increase of size would not be profitable.

This conclusion appears to agree fairly well with the limit that must be set to the size of an aeroplane by practical considerations, if the machine is to be operated under such conditions as can be foreseen to-day. A machine of 50,000 lbs. weight, or 22 tons, would have a span of about 115 feet if a biplane, or 150 feet if a monoplane—as is more probable. The problems of housing such a craft and handling it on the ground are serious, while its great weight necessitates a heavy and a complex system of undercarriage wheels if it is not to get bogged in the winter upon the soft grass land of an

THE WORLD, THE AIR AND THE FUTURE

aerodrome. The span of the machine will add further to the difficulties of the pilot in a forced landing, both in regard to the absolute size of the aeroplane and in regard to the slowness in manœuvring inseparable from a great span. And finally, it must be remembered that the component parts of the machine must be capable of transport by road or by rail. In the case of a very large machine this will necessitate the construction of the structure in small units, which may add appreciably to the weight.

In the aeroplane of the future a certain degree of aerodynamic advance is to be anticipated. In the light of present knowledge it does not seem likely that any great advance in the efficiency of the wings will be made, but there exists a large scope for improvement in the efficiency of the machine by the process known as "cleaning up." The ideal aeroplane, from the aerodynamic point of view, would present the appearance of a smooth streamline shape with wings and tail surfaces merging smoothly into the lines of the body. No external struts and wires should be visible; the undercarriage would be retracted into the hull in flight. There would be no excrescences to mar the outline of the machine at all; the shape would be as perfect as the body of a seagull.

How far are we still from this ideal may be seen by a glance at the *Argosy*, illustrated on Plate XXVII. In aeroplane design the aerodynamic idealist is at variance with the practical man who has to operate the machine. To present a streamline shape the engines should be entirely enclosed within the hull of the machine. But engines have to be cooled; they must be placed in such a position that the propellers can rotate; they must be accessible for maintenance. Wireless and lighting services of the machine must be provided for with dynamos,



(Photo by courtesy of Imperial Airways Limited)

Interior of the 'Argosy' 21-seater Aeroplane



(Photo by courtesy of 'Flight'.)

A Model of the new 40-seater Handley Page (See list of Illustrations for further details of these machines)

HEAVIER-THAN-AIR CRAFT

and the most practical way to drive the dynamo is to provide it with a little windmill propeller and put it out in the air stream. It may be necessary to provide a ladder to enable the pilot to reach his cockpit. It may not be possible, for operational reasons, to make a very good shape of fuselage.

All these points militate against the aerodynamic performance of the machine, and they cannot be dismissed as trivial. In actual fact the most successful large aeroplanes are frequently the worst aerodynamically, because commercial success depends not so much upon aerodynamic efficiency as upon the regularity of the service. No aerodynamic feature can be permitted in a commercial machine which makes the machine more difficult to maintain in service, or more difficult for the pilot to navigate in bad weather. Practical considerations must come first.

It will be seen, then, that aerodynamic advance in the design of commercial aeroplanes is likely to be slow. A useful criterion of aerodynamic efficiency between machines of equal performance (minimum flying speed, top speed, and climbing speed) is the total weight carried per horse-power of the engine.

The wt./h.p. of the Argosy when fully loaded is 15 lbs. The wt./h.p. of the Ryan monoplane with its commercial load (3,300 lbs. total weight) is 14.7 lbs. The wt./h.p. of Lindbergh's machine at the commencement of the Atlantic flight was 23 lbs. The figure of 15 lbs. per h.p. is very general among commercial aeroplanes of the present day, an increase in this ratio making for a long run to take off and a poor rate of climb.

For the purpose of examining the large aeroplane of the future it will be assumed that the aerodynamic efficiency will be increased till it becomes possible for the machine to carry 25 lbs. per h.p. with a performance equal to that of present day commercial aeroplanes in

THE WORLD, THE AIR AND THE FUTURE

get off and in climb. That is to say, an increase in aerodynamic efficiency of 66 per cent. is anticipated as the maximum attainable in the distant future. To achieve this, it will be necessary that the undercarriage of the machine should be retractable into the hull in order to eliminate its head resistance. It will also, in all probability, be necessary to devise some means of catapulting the machine off the ground at the commencement of its flight. The increased weight per h.p., with the existing propulsive system, must involve slower acceleration on the ground and hence a long run to take off unless the acceleration be assisted in some way. Alternatively, developments of the propulsive system may be made which will enable a larger proportion of the power of the engine to be used for acceleration at slow speeds on the ground, but of such a development there is, as yet, no sign.

This increase in aerodynamic efficiency will be achieved at the expense of weight. It will not be possible to build a retractable undercarriage so light as a fixed one, nor is it reasonable to suppose that, with the same materials and standards of design, a perfectly streamlined aeroplane can be produced for so light a weight as one in which the structural considerations are pre-eminent. On the other hand, it must be presumed that there will be a continuous advance in the materials available for the use of the designer, and that the science of design itself will progress, enabling the production of lighter structures as the years go on.

In considering the weight of the aeroplane of the future, then, these opposing tendencies must be appreciated. It will be seen from the above data that in the case of the Ryan commercial monoplane, 40 per cent. of the total weight of the machine is available for paying load and fuel, and in the case of the Argosy, 35 per cent.

HEAVIER-THAN-AIR CRAFT

The aeroplane of the future will be a multi-engined craft in the interests of safety; the weights will therefore tend rather to follow those of the Argosy than the Ryan. Summing up all the above considerations of weight, and in view of the great aerodynamic advance anticipated, it seems reasonable to expect that the machine of the future will be able to carry 45 per cent. of its total weight in the form of paying load and fuel, but not more. In determining this ratio the reduced weight of engines due to the increase in the wt./h.p. of the machine has been considered.

Finally, in the consideration of the aeroplane of the future, the weight of its fuel must be examined. Modern aeroplane engines consume fuel at the rate of .53 to .48 lb. per brake-horse-power hour. In the laboratory a consumption of .32 lb. has been attained, but at the sacrifice of almost every quality which makes an engine desirable for use in service. For our aeroplane of the future, however, it will be assumed that this consumption has been achieved in service without sacrifice of any of the other features of the engine.

Taking all the advances together which have been forecast for attainment in the distant future, it will be interesting to see what they amount to in the case of a concrete example—the Argosy. Taking the same weight of 18,000 lbs., the machine of the future will require engines of only 720 h.p. to give the same performance as the 1,200 h.p. at present fitted. For fuel and paying load, 8,100 lbs. will be available, instead of 6,300, as at present.

The cruising speed of 95 m.p.h. will remain the same as at present. Taking the paying load of 4,500 lbs. as the same in each case, the machine of the future will carry it for about 1,950 miles, instead of only 340 as at present.

THE WORLD, THE AIR AND THE FUTURE

Taking the range of 340 miles as the same in each case, the machine of the future will carry a paying load of 7,500 lbs. over this range, instead of 4,500 lbs. as at present.

From the above example it will be seen that the range of the aeroplane of the future may be expected to increase in a greater proportion than the paying load that can be carried, though it should be remembered that the future paying load will be carried for very much less horse-power than it is to-day, and therefore very much more cheaply.

The manner in which these qualities will be utilised depends entirely upon the use to which the machine is to be put. If an air line is operating over a civilised country and in competition with established and efficient railway services, the quality that it must sell is its speed. Suppose its route to be one of a thousand miles in length—say from London to Rome. It will probably pay to make the journey in one flight without any intermediate stops at all, because the time spent in refuelling the machine, say at Paris and at Turin, would reduce the average speed of the flight by perhaps as much as twenty per cent., and so would bring the speed of the aeroplane down to within measurable distance of its competitor—the railway. When operating over civilised countries, therefore, it will pay to use the increased range of the machine.

In the case of an uncivilised country matters are very different. In a country provided with no railways and few roads, the aeroplane has not to compete with land transport. High speed then becomes of little value; it does not matter very much to the settler whether his goods reach him from the city a thousand miles away in ten hours or in twenty, travelling by air, so long as he does not have to wait for them a week, travelling by land. In this instance it pays to use the load-carrying

HEAVIER-THAN-AIR CRAFT

capacity of the machine to the fullest extent and so to cheapen the cost of transport of the goods, spacing the aerodromes as closely as it is possible with regard to the capital outlay, flying the route in relatively short hops with frequent aerodrome stops for refuelling.

Having examined the range and paying load of the 18,000 lb. machine of the future, we can now investigate the performance of the largest practicable type—the 50,000 lb. machine. So far as can be seen at present, this must represent finality in the development of the present type of aeroplane.

The machine will have a cruising speed of 95 m.p.h. Carrying 25 lbs. per h.p. her engines will develop a maximum power of 2,000 h.p., the power at cruising speed being about 1,500 h.p. There will be available for fuel and paying load a total weight of 22,500 lbs., or just ten tons.

If the whole of this weight were carried as fuel, the machine would have an ultimate range of 4,470 miles, carrying no paying load at all. If 50 per cent. of the disposable load be carried in the form of fuel and the other 50 per cent. in the form of paying load, the machine would have a range of 2,230 miles when carrying a load of five tons.

It may be argued that the speed of the machine of the future must be increased; that a speed of ninety-five miles an hour will not be sufficient to enable the machine to battle with head winds and still maintain a regular service running to timetable. For this reason it will be interesting to see what the effect is on the machine if the cruising speed be increased.

If the cruising speed of the machine is increased from 95 m.p.h. to 120 m.p.h. just double the horse-power will be required, since the power necessary is increased approximately as the cube of the relative speeds in a

THE WORLD, THE AIR AND THE FUTURE

machine of normal characteristics. The machine can then only carry 12.5 lbs. per h.p. Two thousand extra horse-power will be required, and the additional weight of these engines and their installation will not be less than 2 lbs. per h.p. The total disposable load available for paying load and fuel will then be 18,500 lbs., or about 8.3 tons.

If the whole of this weight were carried as fuel, the machine would have an ultimate range of 2,320 miles, carrying no paying load at all. If 50 per cent. of the disposable load be carried in the form of fuel and the other 50 per cent. in the form of paying load, the machine would have a range of 1,160 miles when carrying a paying load of 4.1 tons.

It must be realised that, exactly as in the case of Colonel Lindbergh's machine referred to earlier in this chapter, the performance of this machine of the future may be very largely increased by taking risks. Such risks, however, form no part of the business of a commercial enterprise. The performances quoted above represent the greatest development of the aeroplane that can be foreseen at present, and no further development of the normal type of heavier than air flying machine seems possible.

Throughout this chapter only the conventional type of heavier-than-air machine has been considered. This limitation has been justified, because although there exist one or two unconventional types of heavier-than-air machine which have not yet been considered, it is felt that there is no prospect yet in sight of the unconventional types equalling the conventional type in efficiency.

The most important of the unconventional types is the Autogiro,¹ in which a system of rotating planes replaces the fixed surfaces of the normal aeroplane. The chief characteristic of this machine is the extremely

¹ See Plate XXIX.

HEAVIER-THAN-AIR CRAFT

slow landing speeds which become possible with this arrangement. It would be unfair to detail the disadvantages which balance this great advantage of slow landing, because the type is as yet in a very early stage of development, and it is safe to say that many of the present disabilities of the machine will be overcome within the next two or three years. The most that can be said at the present is that, though the Autogiro will have a wide sphere of usefulness for special purposes, it is unlikely to displace the fixed wing type of aeroplane where the ability to carry great weights or to cover great distances are the primary considerations.

Finally, in what period of time is the aeroplane of the future, as indicated in this chapter, likely to be achieved? Here the answer must be pure guesswork, but the indications at present are that a period of fifty years for the attainment of the type would be a moderate estimate.¹ Much, of course, depends upon the commercial demand for more efficient and for larger aeroplanes, and in regard to size it is still doubtful whether operators will require the maximum size of aeroplane that can be developed. Where speed is the object of a service, that object is better met by a service of aeroplanes each carrying ten passengers, and starting once an hour, than by a service of machines each carrying a hundred passengers, and starting once a day. Needless to say, however, the latter is the cheaper service of the two.

Since the war the advance in the commercial efficiency of the aeroplane has been disappointing. Safety has been greatly improved, and reliability. But so far from an improvement in commercial efficiency, progress has rather been in the reverse direction. In 1922, the year of the introduction of the machine which

¹ [I do not agree with Mr. Norway's figure of fifty years. I think progress will be much quicker in view of the unlimited capital available for development.—D.B.]

THE WORLD, THE AIR AND THE FUTURE

had the minimum flying speed developed to its highest point, passengers were carried between London and Paris for an expenditure of 45 h.p. per passenger. To-day the Argosy carries them over the same route at a lower speed for an expenditure of 60 h.p. per passenger. The increased horse-power is the price that has been paid for a considerable increase in the safety and reliability of the machine. But it will be seen that the evolution of the commercial aeroplane has actually produced a machine of lower performance to-day than was flying on the Paris service seven years ago. Progress in performance has been backwards.

§ 2

The Flying Boat

The design of marine aeroplanes falls into two classes: float seaplanes and flying boats. A float seaplane, generally speaking, is a machine very similar to a land aeroplane, in which a float replaces each of the two wheels of the undercarriage to enable the machine to alight on water. In many cases the land and sea machines are identical, a land machine being transformed into an efficient seaplane merely by changing the undercarriage.

Such machines are generally constructed only in small sizes, below a total weight of 10,000 lbs. In larger sizes than this it becomes advantageous both for weight and seaworthiness to combine the fuselage of the machine with the floats, making, in effect, a seaworthy boat of the fuselage to which the wings, tail, and engines are attached. The resulting machine is the flying boat as we know it to-day.

Boats of this type have been built and operated successfully, chiefly for naval purposes, up to a total weight of 30,000 lbs., or 13 tons. These boats are by no



(Photo by courtesy of the Newcastle Aeroclub and North Mail.)

Autogiro C.8. Mark II. Type, fitted with Lynx engine

(For specification see List of Illustrations)

HEAVIER-THAN-AIR CRAFT

means fair weather craft. It is common practice to leave them moored out at anchor for months on end at all seasons of the year, and they are capable of taking off and landing with safety in seas five feet high from trough to crest.

In the previous section of this chapter, dealing with the land aeroplane, the possible increase in the performance of land aeroplanes in the future has been investigated, and certain forecasts have been made. A corresponding forecast for the future of the flying boat must necessarily be couched in much less definite terms, both because there has been much less experience in operating commercial flying boats upon a regular service, and also because of certain design latitudes which have no parallel in the case of the land aeroplane.

It was shown in the case of the land aeroplane that the minimum flying speed of the machine was definitely limited by the size of the aerodrome, or the size of the field in which a forced landing has to be made. It was shown how a progressive attempt was made to achieve the great advantages which accrue from a higher minimum speed in the case of the machine used on the London-Paris route, and it was shown that a definite limit was reached in this direction, beyond which the machine tended to become unsafe in operation. It was shown that for commercial land machines a minimum flying speed of sixty miles an hour was the greatest that could be tolerated.

Consider now the case of the flying boat. Such boats are most suitable for operating over long sea routes, having their bases in estuaries or sheltered anchorages along the route. Operating over sea, the problem of a forced landing in a confined space such as a field ceases to exist; in the case of engine failure no consideration of space need hamper the pilot in his

landing. The same conditions apply to a great degree at each base along the route; an estuary or inlet of the sea such as the Medway or Southampton Water provides a far larger aerodrome for flying boats than can be economically provided for the land machine.

It becomes immediately apparent, then, that here is an avenue by which the designer may increase the efficiency of his machine. It has been shown in the case of the Ryan monoplane examined in the previous section that an increase in the minimum flying speed from 49 to 71 m.p.h. enabled the machine to leave the ground when it was 55 per cent. heavier, and the greater part of this gain may be expressed in useful load. With the unlimited aerodromes that are available for the flying boat it would seem at first sight that there is no reason why this process should not be carried on indefinitely, till machines were produced with minimum flying speeds of 90, 100, or even 120 m.p.h., carrying immense paying loads very economically at extremely high speeds.

This tendency towards an increased minimum flying speed is very evident in the design of flying boats to-day. Before discussing the extent to which it has been carried, however, it will be of interest to examine the characteristics of the flying boat which set a definite limit to progress in this direction.

It will be taken as an assumption that any commercial passenger-carrying flying boat must be capable of making a safe landing on the water without the use of its engines. That is to say, if the flying boat should run out of fuel in the air it must be capable of making a good landing in suitable conditions of weather. This is the basic assumption; but for this there is no reason why the minimum flying speed should not be increased to almost any extent, if perfectly calm water conditions be assumed for the landing.

HEAVIER-THAN-AIR CRAFT

Consider the case of a monoplane passenger-carrying flying boat which has a minimum flying speed of 60 m.p.h. This machine is to be re-designed to give it a minimum flying speed of 85 m.p.h. To do this the area of the wing must be halved; the new wing will be about two-thirds the span and about two-thirds the width of the old wing. The new wing will be lighter, which will add to the useful load of the machine, and it will have less resistance, which means that the machine will have a higher speed with the same engines.

The hull of the boat, however, remains the same size, since this is determined by the total weight of the machine. The result is that the new machine has less wing in proportion to the hull than the old one, and the effect of this is that the machine must glide more steeply when the engines are shut off.

It may not be very easy for the reader to follow the argument in this respect. It may perhaps be put most clearly if the argument be carried to absurdity, and the wing be imagined to be reduced to the size of a postage stamp on each side of the hull. The gliding angle of such a machine would be very near the vertical; in the slang of the aeroplane pilot it would "glide like a brick." This expression is frequently used of machines in which the ratio between the lift and head resistance of the machine is smaller than usual, with the result that the machine has a steeper gliding angle than is usually the case.

Now an aeroplane or flying boat when landing does not glide straight down and hit the earth or sea while still gliding on an inclined path. Such a proceeding would result in a certain crash due to the considerable downwards velocity of the machine. In practice the machine is levelled out as the ground is approached, and for a few seconds is flying parallel with the ground, borne onwards by its own momentum with the speed rapidly falling. This process is carried out within a foot or so of the

THE WORLD, THE AIR AND THE FUTURE

ground; when the speed of the machine has fallen to its minimum flying speed the machine drops out of the air on to the grass or sea—a matter of six inches in a good landing.

Now our imaginary flying boat with the postage stamp wings obviously cannot do this. Gliding practically vertically it cannot flatten out and skim along the surface of the sea before alighting; if it attempts to do so its downward momentum will be such that it will merely drop down into the water in a horizontal position with its downwards velocity very little reduced. This case is an absurdity, but it serves to point the basic fact that if the gliding angle of a machine be progressively increased, a point will be reached when it is no longer possible to carry out the flattening-out process which is essential to a safe landing. In other words, if the minimum flying speed of a given flying boat be progressively increased, a point will be reached when the boat cannot be landed without the use of engines to assist the boat to fly parallel with the water at the last moment.

The precise minimum flying speed at which this point is reached must be dependent upon the design characteristics of the boat in question; no doubt as soon as this effect begins to appear as a serious obstacle to the designer, much ingenuity will be expended in postponing its incidence. An indication of the effect, however, is found in the behaviour of the present-day Schneider Trophy monoplane seaplanes. These machines have a minimum flying speed in the region of 95 m.p.h. They can be landed safely without the use of the engine. There is, however, a definite impression that it will not be safe to proceed much further with the increase in minimum speed, and that a minimum speed of 110 m.p.h. would represent the point at which landing these seaplanes without engine would become a matter of difficulty.

HEAVIER-THAN-AIR CRAFT

It is with the greatest reserve that this evidence must be used in considering the limitations of the large commercial flying boat, since the proportion of wing to body in the two types may be very widely different. The indications are, however, that, if anything, the large boat will be rather worse in this respect than the racing machine, since for practical reasons it will not be possible to reduce the resistance of the boat hull to the same degree of perfection as has been achieved in the racing machine. The hull must be designed to make the boat thoroughly seaworthy in a rough sea, and the conditions of hull design which make for seaworthiness are unfortunately at variance with those which would be dictated if low resistance were the only aim.

Moreover, it must be remembered that the large flying boat must be capable of a forced landing without engines in a moderate sea. It will not be sufficient for the operator of these boats that a mill-pond calm should be necessary if the boat is to make a forced landing undamaged; she must be able to bring off her forced landing in safety in any reasonable sea conditions at any point along the route. This requirement will bring down the minimum speed from that which is theoretically possible. Balancing these considerations, the most that can be said upon the very slender evidence available is that it is unlikely that the minimum flying speed of the large flying boat of the future will exceed 90 m.p.h.

It must be realised that this figure is likely to represent the absolute limit that can be achieved. It will be seen, however, that in the opinion of one school of designers these speeds can never be attained in practical commercial operation.

It is probably correct to say that at the present time the design of flying boats is passing through an evolutionary stage of experimenting with high minimum

THE WORLD, THE AIR AND THE FUTURE

speeds. The experiment, so far, has been carried out almost entirely by the German designers, who form what might be termed a school of design in favour of high minimum speeds. English designers, on the other hand, form another school who hold that the great theoretical advantages of the high minimum speed cannot be realised in the practical circumstances under which flying boats must be operated.

The arguments are very simple. The English designers maintain that a boat with a high minimum speed is difficult to get off the water in the rough sea conditions that must be catered for in the practical operation of these boats. If, in addition, the boat is underpowered, as would be indicated by a high ratio of weight to horse-power, the boat will take an excessively long run in the calmest water to attain her minimum flying speed and so take off.

In rough water the impact of the waves upon the hull will prevent the boat from attaining the necessary speed, and the boat will be unable to leave the water. In addition, the landing of a boat with a high minimum speed in a short, steep sea, or on the long crests and valleys of an ocean swell, must be a matter of some hazard; in the interests of safety the minimum flying speed must be kept relatively low.

The German attitude is equally clear. Admitting the disadvantages of a high minimum speed and a high power loading, the commercial gain in the use of these machines is so great that the operator will very soon find a means of using them. They maintain that the increase in danger has been overestimated and, when all the factors are placed upon a strictly commercial basis, the balance is overwhelmingly in favour of the machine with the high minimum speed.

The position, in fact, is exactly analagous to that

HEAVIER-THAN-AIR CRAFT

which arose in the design of land machines for the London-Paris route. As in that case, it is probable that the machine of the future will have a minimum speed somewhere between the two extremes.

In the accompanying table is shown a comparison of present-day English and German practice. The low power loading and the low minimum speeds of the English machines should be noted in comparison with the German, and the corresponding fact that on the average the German machines can carry 33 per cent. more load than the English machines. It is probably the fact, however, that the English machines can get off with their load in a five-foot sea, while the German machines would require relatively calm water to get off with the full load for which they are designed. For landing in rough water the English machines would be markedly superior to the German.

| <i>Machine.</i> | <i>Fully loaded weight. (tons)</i> | <i>Power loading Lbs.-H.P.</i> | <i>Wing area (sq. ft.)</i> | <i>Maximum speed. m.p.h.</i> | <i>Estimated minimum speed without engines m.p.h.</i> | <i>Disposable load including crew. per cent.</i> |
|--------------------------|------------------------------------|--------------------------------|----------------------------|------------------------------|---|--|
| <i>English Machines:</i> | | | | | | |
| Short Calcutta | 9.2 | 13.0 | 1,825 | 121 | 60 | 34 |
| Blackburn Iris | 12.0 | 13.5 | — | 118 | 57 | 37.5 |
| <i>German Machines:</i> | | | | | | |
| Dornier Superwal | 13.8 | 15.5 | 1,513 | 136 | 81 | 47.7 |
| Rohrbach Romar | 18.7 | 19.6 | 1,820 | 129 | 85 | 47.5 |

These machines have all been built and flown, and represent the current practice in existing machines, as opposed to machines which have not yet been flown. None of them have yet been operated for a sufficient time in conditions comparable with those of an Empire service to enable an opinion to be formed as to the suitability, or otherwise, of either type for such a service.

THE WORLD, THE AIR AND THE FUTURE

The machines are there, but commercial experience with them has yet to be gained.¹

In attempting to forecast the possible future development of the commercial flying boat, then, it becomes necessary at the outset to establish a prototype boat, representative of present-day practice, as a starting point. In the case of the land aeroplane this starting point was provided by an aeroplane which has been tried and proved to be the most efficient means of aerial transport that exists at present—the Armstrong Argosy. In the case of the flying boat no such starting point exists, because no boat has yet been submitted to the test of intensive, continuous, commercial operation over a lengthy period.

The performance of the prototype boat will be taken as being midway between British and German practice. There seems to be some reason for the belief that British practice has been much influenced by Service considerations, and that in commercial operation it may be readily arranged that the boats have sheltered bases from which to operate. On the other hand, it would seem that present-day German practice is unlikely to produce the most efficient boat, since the operator will be faced too often with the situation that the boat cannot get off the water with its full load under the prevailing conditions of sea and wind.

For the performance of the prototype boat, then, a power loading of 15 lbs./h.p. will be taken, with a minimum flying speed of 70 m.p.h. The boat will have a top speed of about 130 m.p.h. and a cruising speed of about 115 m.p.h. In these circumstances 42 per cent. of the gross weight will be available for disposable load, including the crew and equipment.

¹ The Short Calcutta is now being operated in the Mediterranean by Imperial Airways in connection with the Indian Air Mail. Comparative figures with the other boats, however, are not yet available.



(Photo by courtesy of the Supermarine Aviation Works Limited.)

**Supermarine 'SOUTHAMPTON,' twin engine Flying Boat H.B. 6,
fitted with Lorraine engines
(For specification see List of Illustrations)**

HEAVIER-THAN-AIR CRAFT

With this stalling speed, there is some evidence for the belief that about 80,000 lbs. represents the maximum weight to which this boat could be built; if the size were increased beyond this point without a corresponding increase in the minimum speed, the percentage disposable load would be reduced.

It will be seen that, except in the matter of size, the characteristics of this boat lie between those of the British and German boats mentioned in the above table. The boat could be built to-day if there were the demand for it, and it is thought that a boat of this type will, in the course of a year or so, prove to be the most suitable for operating the Empire services which are now coming into being. On the basis that the weight of paying load carried should equal the weight of the fuel, the boat would carry a load of 7 tons for a distance of about 950 miles.

It does not seem to be very likely that there will be any great aerodynamic advance in flying boats that will enable a very much larger weight to be carried per horsepower. Unlike the land aeroplane, there is no undercarriage which in the future may be housed in flight, nor is it possible to shape a seaworthy hull, furnished as it must always be with steps and flares, to the perfectly streamline shape that may be possible on the land machine. The water resistance of the hull, too, presents a serious obstacle to an increased power ratio. Taking all these factors into consideration, it does not seem probable that the flying boat of the future will be able to carry a load of more than 17 lbs. per h.p. while retaining the same water and air characteristics as the prototype boat.

The minimum speed will be assumed to remain at 70 m.p.h., the top speed at 130, and the cruising speed at 115 m.p.h. With the increased efficiency of materials, however, and the greater experience of design, it is

THE WORLD, THE AIR AND THE FUTURE

probable that the disposable load, including crew, will be increased from 42 per cent. to 55 per cent. of the gross weight. The size is assumed to remain the same—viz, 80,000 lbs. as the maximum economic size, though, if a portion of the percentage disposable load were to be sacrificed, the boat might be built considerably larger.

Finally, as in the case of the land aeroplane, the fuel consumption of the engines is assumed to be reduced in the future to .32 lb. per b.h.p. hour.

On the basis taken before, that the weight of paying load should equal the weight of the fuel to be carried, this boat would carry a load of 9.5 tons for a range of 2,200 miles. It is considered that this performance is the utmost which the flying boat is likely to achieve in practical commercial service, though a considerable increase in performance may be obtained by the expedient of increasing the minimum speed, at the expense of the regularity of operation of the service.

It does not seem likely that progress to this point will be so long delayed as in the case of the aeroplane. Only a small aerodynamic and hydrodynamic advance has been assumed; the advances in fuel consumption and in disposable load being the most considerable items. The fuel consumption should be attained within the next fifteen years. In view of the progress that has been made in flying boats within the last few years, the opinion is put forward that within twenty years boats of the type described will be flying on the Empire routes.

COMPARISONS

CHAPTER VII

COMPARISON BETWEEN HEAVIER- THAN-AIR CRAFT AND LIGHTER-THAN-AIR CRAFT

1. General Observations
2. Different Types of Aircraft classified and compared
3. Summary of Conclusions

§ 1

General Observations

WE have now examined the technical position of both heavier-than-air craft and lighter-than-air craft, and our survey has shown us that there is little connection between the two lines of development. In characteristics and performance the two types of aircraft are markedly dissimilar. They differ in range, speed, strength, carrying capacity, method of operation, and so forth; and, consequently, each will have its own special uses as a means of transport. In the present chapter, therefore, I propose to compare the respective functions of the two types, and to consider the ways in which each can best help the world's needs.

In analysing the problem of airships, we arrived at the conclusion that, although the airship is to-day the only type of craft which is inherently capable of providing the world with a really long-distance vehicle,

THE WORLD, THE AIR AND THE FUTURE

it suffers, as at present constituted, from such serious disadvantages that its utility as a commercial vehicle is still dependent on further technical advance. It is necessary, therefore, to state quite emphatically that the comparison I now propose to make between heavier-than-air and lighter-than-air craft is based upon the assumption that either the proposals here advanced for the mooring and docking raft and the elliptical ship, or some other developments which will achieve an equivalent result, are capable of being successfully carried out. Of course, I do not wish it to be implied that these proposals are the only ones that are likely to be evolved or that they are necessarily the best. What I do say is, that, unless some idea is evolved which will obviate the present handling difficulties of airships, it is highly improbable that they will ever become commercial vehicles capable of operating a long route to a regular schedule.

One result of our technical analysis of the situation has been to make clear that of the three types of aircraft, the airship will prove the most serviceable for long-distance oceanic flights, the flying boat for middle distances, and the aeroplane for short land routes. But the most important conclusion that has been reached is not, I think, that the airship and the flying boat are predestined to be the types of craft used for the great trunk routes, but the fact that each will operate from a water base. The air and the water will be their natural elements, and not the land. To Great Britain this fact is overwhelmingly important, as the close connection between sea-centrality and air-centrality outlined in the earlier part of the book, will be developed thereby, and, as time goes on, and airships and flying boats of the type forecast are built, we shall see Great Britain increasingly reaping the benefit of her geographical position.

COMPARISONS

At the same time this point must not be stretched too far. Both types of craft will be able to fly over the land for vast distances, and places like Zürich, for instance, which are situated on lakes, will become inland ocean air-ports. Lakes will become of major importance, and we may expect to see large schemes developed, whereby rivers in valleys are dammed and large artificial lakes made to afford bases for flying boats and airships. Provided aircraft continue to improve and develop upon their present lines, it will become more and more obvious, as each year passes, that aquadromes, to coin a word, rather than land aerodromes will be required for our main trunk routes. And here, England will be happily served by her numerous harbours. In places such as Pembroke, Portland, Poole, Falmouth, to mention but a few, we already have ideal "aquadromes" provided by the hand of Nature herself, and there will be no need for a capital outlay.

The reason for requiring a relatively large area of enclosed water is that if flying boats are to be kept under stable control it will always be necessary to make a dynamic landing. This involves not only a relatively large forward speed at the moment of contact between the aircraft and the ground, but an eventual transference of the weight from the air to the ground. In the case of the airship, the operation is even more difficult, as it is necessary to take weight into the ship to keep her down and stable. It is, however, impossible with craft weighing 50 tons or more to bump them at high speed over undulating and uneven land, owing to the high inertia stresses set up thereby. The only alternative is to land them upon enclosed waters, such as lakes or harbours, the surface of which is not only always level, but automatically provides the equivalent of a huge spring or cushion.

THE WORLD, THE AIR AND THE FUTURE

This new development in aircraft operation has been apparent for some time, and is one of the reasons why I have advocated, so strongly, combining the Air Ministry and Admiralty into one Department.¹ To those who have not had the opportunity of considering and working upon the design of aircraft, such a development would be neither obvious nor expected, because in regard to airships and aeroplanes of the size of those that have hitherto been built, it does not apply to the same extent as it will to the larger types of the future. It is only when the large airship, of say 150 tons and over, and the large aeroplane, of 15 to 20 tons and over, come into operation, that it will begin to apply; and with airships of 300 tons and over, and aeroplanes of 30 tons and over, their operation, except from water bases, will be so hazardous as to be impracticable from a commercial point of view.

Having established this general axiom that the large aircraft of the future will be water aircraft, we can proceed to some general observations that apply to all different types of aircraft.

To begin with, it must be remembered that the commercial range of any aircraft is much less than either a record result or the theoretical estimate.

Take, for instance, an aircraft with a speed of 100 m.p.h. capable of carrying a payload of 10 tons a distance of 2,500 miles.² These figures will, of course, be the designer's estimated figures, and, under most favourable conditions, they will no doubt be obtained in practice.

Upon a commercial service, however, the schedule has to be drawn up to allow for unfavourable conditions, and since the density of the air varies greatly both with the temperature and with the barometric pressure, it

¹ See Chapter VIII.

² This performance can be anticipated with the flying boats of the future.

COMPARISONS

is possible with both airships and aeroplanes to encounter conditions which will reduce the lift by at least 10 per cent. In the case of flying boats, too, the same reduction might be made by bad sea conditions, which would hinder the take-off. This reduction of 10 per cent. in lift would not be so important if it could be taken off the aircraft as a whole. This, however, is impossible. For instance, under the most favourable conditions, the dead weight of the machine or ship will be equal to the combined weight of the pay load and fuel. The dead weight cannot, of course, be altered. The reduction, therefore, is 20 per cent. in the pay load and fuel.

Now arises another difficulty. If the commercial company is selling its accommodation some days ahead of the actual departure, it must either reduce its available pay load and fuel by 20 per cent. or it must be able, if necessary, to reduce its fuel alone by 40 per cent. The range, therefore, of our hypothetical craft is reduced from 2,500 miles, either to 2,000 miles, or to 1,500 miles. Let us take the more favourable of these two figures, and assume that the range has now come down to 2,000 miles, and consider the journey to be made. The meteorological conditions may be adverse. At least 25 m.p.h., in the average, must be deducted from the still air cruising speed of the vehicle—in fact the National Air Transport Company, in America, has found that in practice this is what may be expected upon the average, and, in arranging the schedule of any service, automatically reduces the calculated speed of the machine by this amount. The range is, therefore, reduced to 1,500 miles. Our reduction cannot, however, stop here. There is a great difference between a long flight and a short flight. For instance, upon the London-Paris service, the actual flying time is only a little over two hours, and therefore

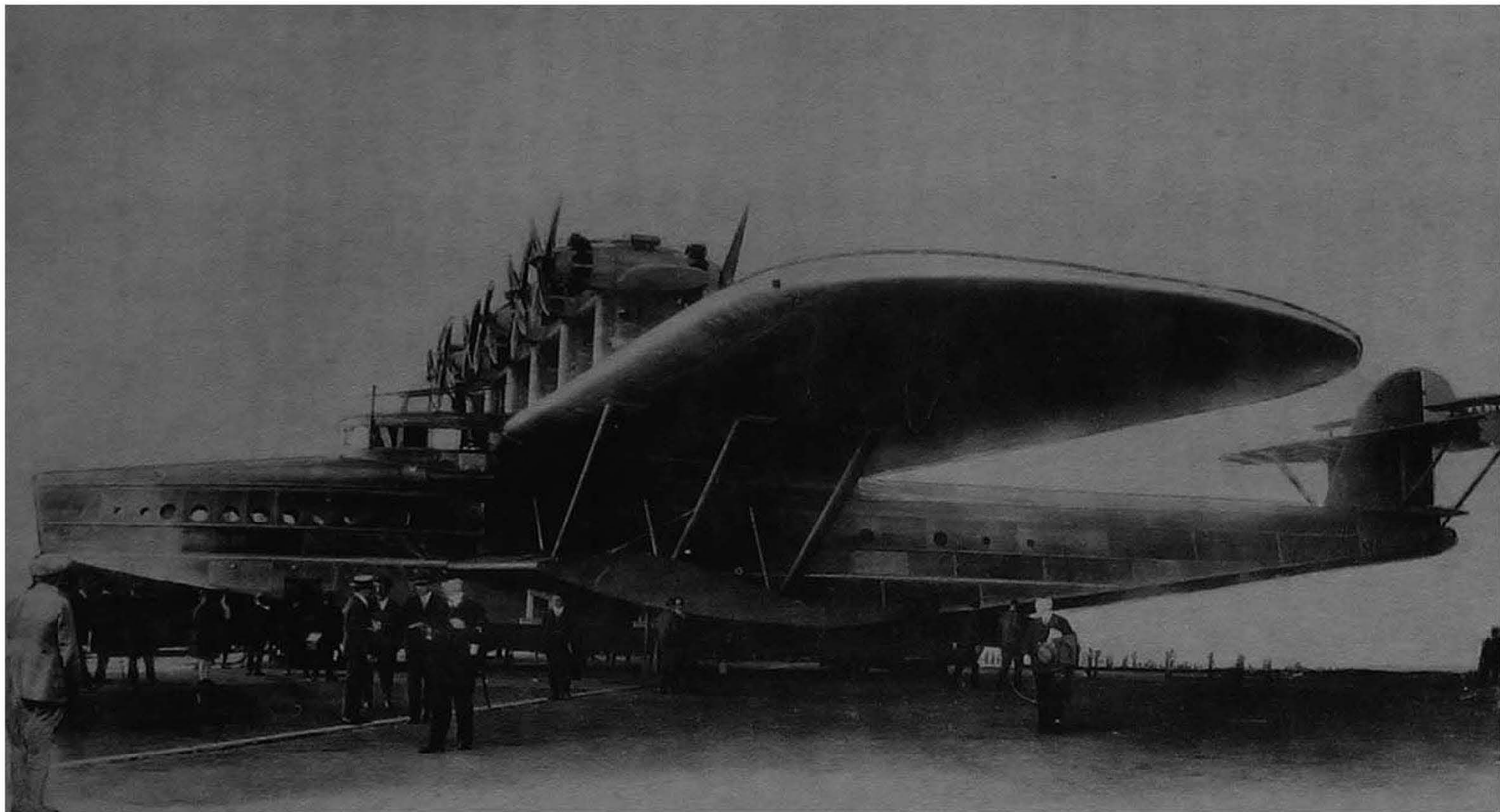
THE WORLD, THE AIR AND THE FUTURE

it is possible to know, before departure, that the visibility conditions for landing at the termination of the flight will be satisfactory. If the conditions are bad, departure is delayed. Upon a long flight, however, there is ample time for the local conditions at the arrival base to change, and accordingly a further margin must be arranged for such an eventuality. Fortunately fog, which is the greatest danger to heavier-than-air craft, does not form when winds are high, and a portion of the margin arranged for the contrary winds, can with safety be assured for fog conditions on arrival.¹ The least margin, however, that could reasonably be allowed would be 10 per cent. of the total fuel supply, or 250 miles range, reducing the range to 1,250 from the designed range of 2,500.

For practical purposes then, we can say that the commercial range of any aircraft cannot exceed 50 per cent. of the designed range, and that under these conditions the actual available pay load will not exceed 80 per cent. of the designed pay load.

It may be thought that the allowance of only 10 per cent. for bad visibility conditions for landing is unduly optimistic; but, on the other hand, it must be borne in mind that considerable development is taking place in the invention and design of instruments to facilitate landing in foggy weather. Directional wireless can now give an accurate bearing to within two degrees, and other devices are in process of development that will enable a "blind" machine to make a safe landing. It would seem only reasonable, since we are considering conditions such as may be effected within a few years, to give some weight to these developments.

¹ The airship has an advantage in this respect as, being lighter-than-air, she can hover and nose her way into her base without any great expenditure of fuel.



(Photo by courtesy of Pacific and Atlantic Photos Limited.)

The 60-seater, three decker Dornier Flying Boat

(For specification see List of Illustrations)

COMPARISONS

Examining the airship and the large flying boat upon the basis of these facts, we can see that the range of the 7,000 mile airship is reduced, for commercial purposes, to 3,500 miles, and that of the flying boat from 2,500 to 1,250. In round figures then, the range of the airship for a 100 m.p.h. cruising speed is three times the range of the flying boat. Accordingly, any commercial exploitation of air transport must be based upon an acknowledgment of this fact.

It is as yet too early to lay down any definite scale of the cost of operations, as, with the exception of comparatively small land machines, there is no record of performance over a series of years. It is thought, however, that the large flying boats should be cheaper in cost per ton mile than, say, the Imperial Airways machines,¹ and that airship transport should be about half the cost of flying boat transport.

All forms of transport require sufficient volume of traffic to reduce the overhead charges to a reasonable amount, and aircraft are no exception. It would be true to say that at the present time (1929) there is no aeroplane line in the world which is running at a profit without a subsidy. It is quite true that Imperial Airways have declared a dividend, but the dividend was less than a third of the subsidy received from the British Government. Similarly, in the United States, many of the contractors for air mail contracts are making a profit, but the scale of the contract is fixed in such a way that it becomes a form of subsidy. We may expect that it will be in the United States where the first commercially profitable air routes will operate, as it is in that country that the greatest volume of traffic exists, and the purchasing capacity of the inhabitants

¹The latest figures given for Imperial Airways by the Secretary of State for Air are 15. 10d. per ton mile, exclusive of overhead charges, but inclusive of maintenance charges.

THE WORLD, THE AIR AND THE FUTURE

is sufficient to support air lines upon their present costs.

We may, however, expect a gradual fall in costs, and in ten years they should certainly be less by one-third than those of to-day, and may well be under one-half.

§ 2

The Different Types of Aircraft Classified and Compared

Though we are accustomed to classify aircraft under the two distinct headings of heavier-than-air and lighter-than-air machines, we must also take note of the fact that whereas lighter-than-air machines consist of one kind only—the rigid airship, heavier-than-air machines, can be sub-divided into three separate classes—the flying boat, the large land aeroplane, and the small taxi land-plane. In comparing the uses of aircraft, therefore, we have to deal with four distinct groups. At present, these overlap considerably in their functions, but as flying becomes more general, and development proceeds, this overlapping will, in all probability, tend to be reduced. All that aircraft can do, as we have said before, is to sell speed to the travelling public. On the other hand it is no use any particular type of craft trying to sell its “speed” unless it can also offer a practical range, and carry a sufficient pay load to make its service commercial.

The marketable value of aircraft, therefore, depends on speed, range, and carrying capacity—safety, of course, being in this discussion, taken for granted; and it is the varying combination of these three factors, which must ultimately determine the special uses and functions of the different types.

We have seen in the aeroplane chapter that an increase

COMPARISONS

of size beyond a certain point does not tend to increase the range, and we have also seen that an increase in size beyond a certain point does not tend to increase the actual pay load, but does in fact reduce the proportional pay load. Furthermore, there is a definite limit to the size of land machines upon practical grounds, and this limit in size is reached in their case, long before it is reached in the case of flying boats. There are several reasons for this.

First: In spite of all talk about multi-engine machines with very reliable engines, a land machine must be small enough to have a reasonable chance of making a safe landing and of being able to take off again.

Second: The landing carriage has to be strong enough, not only to carry the dead load of the machine, but to withstand the shocks and bumps experienced when landing on rough ground.

Third: A very large land machine would be unable to land and take off upon ordinary soft grass land. The wheel loading would become so high that special concrete landing grounds would have to be constructed.

Fourth: The weight of the landing carriage increases rapidly with the size, and already, in what we may term medium machines, the weight of the wheels, carriage, and fuselage, exceeds that of the hull of a flying boat of the same power.¹

At the same time, the larger the machine, the greater the comfort in which passengers can be carried; and the greater the actual pay load of the machine, the smaller are the comparative operating costs. With flying boats there is the great advantage that the larger they are built the more seaworthy they become.

Other advantages of the larger machine are that it lessens noise and reduces the likelihood of air sickness.

¹The Editor of the *Aeroplane* has summed up the situation in almost identical terms.

THE WORLD, THE AIR AND THE FUTURE

A flying machine in this latter respect is like a marine vessel—the larger the machine, the less the motion; and this inherent advantage of the large machine, coupled with the extra speed and comfort that can be provided, will consistently urge constructors to build the largest-size flying boat that is economic. Similarly, the further the passenger can be removed from the proximity of the engines, the less the noise.

Three of the four groups of flying machines will therefore be required for the commercial air transport lines, the smallest being land machines, the medium being flying boats, and the largest being rigid airships.

The fourth class is what might be termed the private, or taxi, machine, and it is these machines that would be used by private owners, or for special charter, and would not necessarily fly over specially prepared routes. In their case the question of making a safe forced landing and a safe get-away is all important. The rapid growth in the popularity of what is called the "Moth," or lighter aeroplane type, has been in reality due more to its small size and easy handling qualities than to any question of price.

It would appear, that the flying boat is likely to develop into a longer range machine than the land machine, as although for the medium-sized machines there will be no gain in actual range for the flying boats, when a medium-sized land machine is compared with a large-sized flying boat, the latter will gain in two respects. Firstly, the proportional weight of the operating crew will be less in the larger machine, and, secondly, the actual pay load will be considerably larger; consequently it is probable that a greater proportional load will be put into fuel for the larger flying boat.

The probable grouping in years to come will be as follows:—(In all cases the commercial range is taken as 50 per cent. of the still air range under standard conditions.)

COMPARISONS

- Group 1. Large Rigid Airship. Speed 100 m.p.h. Commercial range 3,500 miles. Pay load 50-100 tons. Total loaded displacement 350-600 tons.
- Group 2. Large Flying Boat. Speed 120-150 m.p.h. Commercial range 1,250 miles. Pay load 10 tons. Total loaded weight 70-100 tons.
- Group 3. Large Land Machine. Speed 110-130 m.p.h. Commercial range 600 miles. Pay load 4 tons. Total loaded weight 20 tons.
- Group 4. Private or Taxi Machine. Speed 130-250 m.p.h. Commercial range 500-1,000 miles. Load variable as required for special conditions. Total loaded weight will probably not exceed 10 tons.

If the speeds were reduced, pay load could be increased in all cases. It is thought, however, that speeds will stabilise around 120 m.p.h., as at this speed the effect of head winds, etc., is reduced to an extent enabling regular schedules to be maintained. It is to be noted that the flying boat has a higher speed than the land plane, double the range, and two and a half times the pay load.

In instituting a comparison between the rigid airship and the flying boat, the point that we have to bear steadily in mind is that the value of each must be judged by its capacity to carry a sufficient pay load to run a commercial service. On which of the two types, for example, are we to build our hopes of establishing a commercial air service across the Atlantic? Before we discuss this question, however, a word must be said about the relative claims of heavier-than-air machines and lighter-than-air machines to be considered as

THE WORLD, THE AIR AND THE FUTURE

efficient vehicles, from the point of view of design and mechanical operation, for making the Transatlantic flight. And here I cannot do better than quote from an article written by the Assistant Secretary of the United States Navy for Aeronautics, who sets out very clearly certain technical differences in the two types, and with whose conclusions, as far as they go, I am in entire agreement:

“During the last ten years approximately thirty attempts have been made to cross the Atlantic by land machines or flying boats. Between 1918 and 1927 there were eight attempts, of which four succeeded. In three instances the machines were landed at the place intended, in an undamaged condition, and in none of these experiments were any lives lost.

“The record of 1927 and 1928 is however a melancholy one, in that approximately two-thirds of the attempts were unsuccessful, and the majority ended in the loss of the machine and the deaths of the occupants. Of these flights the start of the trip was usually delayed considerably on account of bad weather. In only two attempts out of a total of nearly twenty did the pilots succeed in landing on the place intended. And in only three or four of them was the ultimate landing made without damage to the machine.

“Though there is no need for pessimism, there is no use in disguising the fact that so far experience indubitably shows that any attempt to cross the Atlantic by aeroplane is an exceedingly dangerous business and one which, with the passage of time, is not becoming less hazardous.

“If, however, the record of the rigid airship in the same field be examined, the story is very different. Three attempts have been made to cross the Atlantic, all of which have succeeded, and in every case the voyage ended at the point originally selected.

COMPARISONS

"When the Zeppelin airship, Los Angeles, went to the United States four years ago, the insurance premium was only 5 per cent., in spite of the experimental nature of the undertaking from the point of view of the underwriters, who were unable to distribute the risk over a number of similar ventures.

"Though there is no hope that any transport service will be free wholly from mishap, yet unless profit is made from mistakes, then no progress can be made.

"There are seven reasons why a flight of considerable duration may fail to succeed. They are (1) Exhaustion of fuel. (2) Engine breakdown. (3) Structural failure. (4) Accumulation of ice. (5) Errors of navigation. (6) Fire. (7) Loss of control.

"For an aeroplane engaged in flight over the sea the exhaustion of fuel constitutes a serious menace. Bearing in mind the strength of the adverse winds usually met over the Atlantic, if any degree of safety is to be assured 50 per cent. more fuel should be carried than normal conditions require. The obvious result is that with the present-day machine there is no room for any commercial load—which should be at least 15 lbs. per horse-power.

"To the airship, on the other hand, fuel exhaustion does not present the same risk. Also an airship puts a much smaller proportion of its total load-carrying capacity into fuel, and yet has a greater radius of action. Even to-day an airship can be designed to carry a pay load of 10 lbs. per horse-power and still have a cruising radius of twice the distance from London to New York at a speed of 60 miles an hour.

"Engine failure, in the case of any heavier-than-air machine flying over the Atlantic, means almost certain disaster. To the airship, engine breakdown results in delay and inconvenience rather than danger, on account of the inherent qualities of her design.

THE WORLD, THE AIR AND THE FUTURE

"Structural failure presents a greater hazard to the rigid airship than to the heavier-than-air machine, but the probability of this occurrence in the case of the former type is not as great as its detractors suggest. And it is one which experience and research will relegate to the improbable.

"The accumulation of ice or snow on the hull of an airship or on the wings and fuselage of an aeroplane constitutes a menace. Though mechanical and physical guards against this danger would appear to be of little value, advantage may, and should, be taken of the fact that ice can only form within one or two degrees from the freezing point. Here again the airship has the advantage over the aeroplane, for its captain has freedom of choice of position in the vertical plane. Also the reserve radius of action which is denied to the pilot of the latter craft, enables the airship captain to change the latitude of his ship and so bring her into air of a higher temperature.

"Errors in navigation will always present an appreciable hazard, but those in an airship have an advantage over the crew of the aeroplane of to-day in that they are freer to move, and they can employ methods of navigation similar to those used on ocean going ships.

"Fire in the air is merely a question of attention to the details of engine installation and care in the use of highly inflammable fuel. The first of these causes is being bereft rapidly of its significance, and within the next year or so we should see a Diesel engine suitable for aircraft in commercial use. Loss of control is also a cause of diaster which the passage of time will see eliminated.

"An examination of all these causes of the possible failure of an aerial trans-oceanic voyage will show that, of the seven, there are two of major importance and three

COMPARISONS

of secondary magnitude, but, nevertheless, of real and serious import for the heavier-than-air machine. Errors in navigation and loss of control should be excluded within a year or two, engine failure and accumulation of ice will remain.

"These will always present more danger to the aeroplane than to the airship. To the latter, structural failure and accumulation of ice are the only real dangers. They can, as already indicated, be overcome—and even if they were not, they are slight compared with the dangers run by an aeroplane through inability to reach its destination and consequent descent upon the sea."

Turning now to the commercial issue, what do we find? Simply this: that as regards an Atlantic service the flying boat cannot be said to compete with the airship at all! It is actually possible, as we have seen, to build heavier-than-air craft that will fly the Atlantic, but when doing so they can carry no commercial load. In other words, they will be engaged in stunt-flying pure and simple. It would, in fact, be equivalent to running a motor-bus non-stop from Chicago to San Francisco or from Paris to Constantinople. It could be done. The motor-bus would, however, be carrying petrol instead of passengers, and a service upon these lines could not be commercial.

The conclusions I have arrived at on this matter, from an independent study of the situation, are in full accordance with the views expressed in the Report of a Committee set up in 1924 by the Secretary of the United States Navy to investigate the inherent limitations of the aeroplane.

In the opinion of the Committee . . . "a plane weighing between 40,000 and 50,000 lbs., with materials now known, marks a limit beyond which the increase of size would not be profitable. This seeming paradox

THE WORLD, THE AIR AND THE FUTURE

results from the fact that the ratio of disposable weight to gross weight grows less, due to limit of wing girder strength, heavier engines, heavier weights of material required for strength, multiple landing gear, etc. . . .” “The present maximum performance of heavier-than-air craft,” continues the Report, “may be increased about 30 per cent. by future development extending over an indefinite period of time. . . . Increase in performance may be obtained by engine development, adaptation of lighter materials to construction, some possible improvements in aerodynamical characteristics, such as wing surfaces, streamlines, balance control, etc., but an increase beyond the 30 per cent. cannot be foreseen, as within human accomplishment, with materials so far known.”

The report further expresses the opinion that “with materials now known to man, there is a point beyond which the aeroplane cannot be developed to do increased useful work, because beyond this point the larger the plane, the less disposable load it will carry, and therefore the less distance it can fly.”

Clearly, therefore, if we are to have a commercial air service across the Atlantic in the near future, we must look to the rigid airship and not to heavier-than-air craft to achieve it. So we will now consider the prospects and conditions of a Transatlantic airship service.

The decisive factor in regard to the pay load that can be carried by a given airship is mainly determined by the speed at which it is desired to drive the vessel. The difficulty of reaching a high speed in the airship is the same as in the case of a steamship, the reason being in each case that the horse-power required to drive the vessel varies roughly as the cube of the speed. For instance, if it requires 1,000 horse-power to drive a given airship at 50 miles an hour, it would take 8,000

COMPARISONS

horse-power to drive her at 100 miles an hour. The result is, of course, that at this higher speed of 100 miles an hour, the ship would consume four times the amount of fuel for each mile traversed, in addition to having to carry engines eight times as heavy. To obtain the greatest pay load, we want, therefore, to drive the ship at as slow a speed as is practicable.

We inevitably come to the conclusion that what determines the speed is the weather likely to be encountered, and the speed of the competing traffic upon the same route.

The fastest Atlantic liners now go about 29 knots, or say 33 land miles, per hour.¹

If there was never any wind, and the airship could always travel in still air, a speed of 70 miles per hour would be more than double that of the fastest liner. As we have seen, however, the general experience indicates that upon fixed routes, at least 25 m.p.h. must be allowed for contrary winds, so that a speed of 95 m.p.h. (mitigated by selection of route) must be attained to enable an airship to make the Atlantic crossing at double the speed of the fastest liner. Upon the Atlantic route, this allowance for contrary winds can be treated in a way that is not possible on a long-distance but fixed aeroplane route.² Upon the westward route, in order to avoid the prevailing westerly wind, a course via the Azores and Bermuda will often have to be taken, increasing the actual geographical length of the route by certainly 15 per cent. and sometimes more. If, therefore, we take full allowance for "cheating" the head winds by making use of the great cruising range of the

¹ S.S. Bremen is reported to have done 29 knots.

² By a fixed aeroplane route is meant one on which emergency landing grounds are provided at frequent intervals, and which is lighted by beacons at night. This route is, therefore, as fixed as a railway track, and aeroplanes using it cannot make wide detours to avoid head winds.

THE WORLD, THE AIR AND THE FUTURE

airship, we shall still have an adverse margin of about 20 per cent. to allow for, even if we cut down the average adverse wind under these conditions to so low a figure as 5 m.p.h. This still entails raising the speed to over 85 m.p.h. If however we are to be sure of reducing the time of transport upon the westerly run of an Atlantic service to 2 or 2½ days, we shall require a speed of between 95 and 100 m.p.h.

The easterly route is much easier, as the prevailing winds in the North Atlantic ocean blow from west to east at all times of the year with varying intensity. In the winter months these prevailing winds reach high velocities, and it is possible that a vessel leaving New York with a speed in still air of 95 m.p.h. may, in fact, make its passage at between 130 and 140 m.p.h.

During the summer months the return journey to Europe may be better via Newfoundland; but in general the decision as to whether the northern or the southern route is taken will depend on the conditions prevailing at the time, special regard always being paid to the difficulties and dangers inherent in ice and snow. These can only be avoided by going south.¹

Thus it is evident that the air route between London and New York may be nearly 1,000 miles longer, on the outward journey from London, than on the return journey, owing to the wide detour which may have to be made to the south, in order to avoid this prevailing westerly wind. It goes without saying, that, as such a necessity will often arise, stations will be required both in Bermuda and the Azores.

In calculating speeds and distances, we must be careful not to confuse nautical miles with land miles. All charts give the distances in nautical miles, since at

¹The United States Meteorological Board now issues a monthly chart of the wind currents over North America, together with a recommended course for Transatlantic aircraft.

COMPARISONS

sea, speed is usually reckoned in knots. A knot, however, is rather more than a mile per hour, so that a speed of 80 knots is equivalent to a speed of 90 miles an hour. If, therefore, we estimate the distance between London and New York at 3,800 nautical miles, and due allowance is made for contrary head winds, a ship with a cruising speed of 80 knots would require 48 hours; whereas upon the return journey, the distance between New York and London would be 3,150 nautical miles, and a time allowance of 40 hours should be ample.

But now an important question arises. Will airships be able to keep their schedule times with reasonable punctuality? It is often argued against airships that they will be no use for a commercial service, as they are too much at the mercy of the elements to be relied on to carry out a regular time-table. This is, I think, entirely to misconceive the situation. Delays owing to adverse weather conditions, there are of course, from time to time, bound to be. If an airship encounters heavy winds and has to stop to refuel, she will necessarily be late on her schedule time, by the number of hours it has taken her to refuel, and by the amount of time she has been retarded by the adverse winds. But delays due to bad weather are experienced in all forms of travel. Railway travelling, for example, is often badly disorganised by fogs, storms or snow. A heavy snowfall in Central Europe has been known to upset the through-Continental train service for days together. Sea-travel is subject to similar delays. The ordinary Atlantic liner of to-day is quite often one day and sometimes two days late during the winter months, and, all things considered, I do not think that the 80 knot or 90 m.p.h. airship should suffer in the regularity of its time-table nearly as much as do our present-day liners.

Granted, then, we can in actual fact run a 48-hour service, we have another factor to take into consideration,

THE WORLD, THE AIR AND THE FUTURE

and that is the frequency of the service. It is not of much advantage to put on a 48-hour service between London and New York, if at the same time the ships only sail at intervals of one week. The frequency of the service should at least equal the time of transit. Consequently, in order to take full advantage of the increase of speed possible, an alternate day service should be organised.

We now have to consider the magnitude of the financial problem involved. So far, tentative figures have been worked out for an Atlantic service running bi-weekly. At a later date, and if the service proved satisfactory, more vessels could be put on, and the service changed from a bi-weekly to an alternate day service, but for the present it is anticipated that a bi-weekly is all that could be inaugurated. For such a service a capital expenditure of approximately six and a half million sterling would be required in order to provide the ships and their bases, together with the necessary fuelling stations at each base and in the Azores and Bermuda. The vessels we are considering, being some twice the size of the R.100, and of the new elliptical water type, should be capable of carrying an average of 100 passengers. Accommodation would be provided for 150 passengers, but in no system of transport can one contemplate more than two-thirds of the available accommodation being occupied on the average.

The question of the revenue to be obtained from the transport of passengers necessarily depends upon the fare that is charged, and on this point I have altered my views during the last year. Previously I was of the opinion that the fare should not exceed £100 per passenger, but Dr. Eckener's experience with the Graf Zeppelin, and mine with the R.100, lead me to think that a fare of £200 could be charged, and would not

COMPARISONS

be too high to prevent the accommodation of the ships being booked up. For instance, when Dr. Eckener returned from the United States to Europe, he had over one hundred applications at £600 a berth, and prior to the trials of the R.100, I had a large number of applications at £1,000 a berth. Admittedly a large number of people making these applications were animated by the desire to obtain a novel experience in advance of the general public, and in consequence were ready to pay a fictitious price for this privilege.

At the same time there is a great difference between £200, and £600 or £1,000, and until actual experience has been obtained, I venture to think that one is not unduly optimistic in basing one's calculations upon £200 a passenger.

How then, will the annual passenger receipts of a bi-weekly airship service work out on this basis? On an average calculation of 100 passengers per ship for each trip, and counting 50 weeks to the year, the total number of passengers transported annually will be 20,000, or some 10 per cent. of the existing first-class steamship traffic.¹ The total passenger receipts may therefore be estimated at about £3,800,000 per annum, after allowing 5 per cent. reduction for agents' fees.

Let us now turn to mails. A Bill was recently introduced into Congress by Mr. Kelly, of Pennsylvania, in which the American Government took powers to pay a rate not exceeding 3 dollars per lb. for all mail carried across the Atlantic, and the British Postmaster-General has stated that he is prepared to pay 8s. a lb.

¹The total number of first-class Atlantic steamship passengers between North America and Europe from 1st January, 1927, to 11th November, 1927, was as follows:

| | | |
|-----------|-----|---------|
| Westbound | ... | 85,223 |
| Eastbound | ... | 89,544 |
| Total | ... | 174,767 |

THE WORLD, THE AIR AND THE FUTURE

for all mail carried, and proposes making a surcharge of 6*d.* per letter. It is understood that the American Government may, when the time comes, make no surcharge for Atlantic mails, but send the whole of the first-class mail by air transport. In any case the surcharge on the American side, if it is made, should not exceed 12 cents.

The proposed methods of handling the matter by the British and United States authorities are largely dependent upon the different conditions operating on the two sides of the Atlantic. The United States Postmaster-General controls the whole of the mail in the United States, whereas the British Postmaster-General only controls the British mail. At the same time, Great Britain is largely a collecting country for the whole of Europe, and therefore arrangements would have to be made for the issue of air mail stamps throughout Europe, and the service would have to be advertised. This would necessarily put up the cost of handling the air mail.

As regards mails themselves, there is a great deal of misconception upon the part of the public as to their magnitude. If we take first-class mail only, and by that I mean sealed letters and postcards, the total tonnage from North America to Europe is only 35 tons per week, and as regards the European mail, there are only some sixteen tons of British mail and sixteen tons of Continental mail, making a total of thirty-two tons per week. It is estimated that not more than 40 per cent. of the existing British mail and 30 per cent. of the existing Continental mail, or a total of just over eleven tons, would be collected by the new service, and at the rate of payment anticipated by the British Postmaster-General, the revenue accruing therefrom would be approximately half a million sterling per annum.

COMPARISONS

On the other hand, if the United States were to send the whole of their mail by air, and the Canadian Government were to do likewise, the total receipts from this source would amount to approximately two million sterling per annum. An analysis of the mail shows that some twenty-five letters can be carried to the pound and therefore a rate of 3 dollars a pound works out at 12 cents a letter. It would seem that the United States Government would be more than justified, if they decided to put on board aircraft the whole of the American mail for Europe, without making any surcharge, as the gain in general business efficiency to be obtained from the introduction of a 48-hour service would many times outweigh the financial cost involved.

Adding up the different items of revenue, we obtain a grand total of £6,300,000 per annum; against which there would be an estimated cost of running the service (including depreciation for ships and bases), of not less than £3,000,000 per annum, giving a return of £3,300,000 on a cash capital of £6,500,000.

In order to guard against the excessive optimism which these figures might induce, it is as well to say that tentative estimates of this character can in no way be compared with the actual results obtained in other forms of transport, because we have no experience in practice either of the costs or of the extent to which the service would be patronised. At the same time the analysis shows that there are solid grounds for believing that a service of this character can be made commercial, and that sooner or later financial interests are certain to try it out.

From a commercial point of view, the Atlantic route is by far the most attractive for an airship service, because nowhere else in the world is there either so vast a traffic, so great a mail, or so rich a travelling public. Consequently, if a commercial airship service

THE WORLD, THE AIR AND THE FUTURE

could not be made to pay across the Atlantic, it is most unlikely that it would be made to pay in any other part of the world. For this reason I venture to think that the only sound policy to pursue as far as airship development is concerned is to concentrate all our energies upon establishing an Atlantic service.

To establish it the co-operation of the United States will be necessary, as I do not think a winter service to Canada is feasible. Snow is the airship's greatest bugbear, and until we have much more experience of operating airships in cold climates, it would, I think, be foolish to jeopardise the Atlantic service for a political object. Canada will benefit almost as much if the service is run to New York or Baltimore in the winter as if run to Montreal. Moreover, the American traffic is ten times as great as the Canadian traffic, both in mails and in passengers, and therefore upon economic grounds as well as technical grounds I think it essential to operate between England and the United States. I am not saying that a service to Montreal will not be possible at some future date. I do emphasise the fact, however, that we have quite enough problems to solve in establishing a reliable Atlantic service, without adding to them the complication of attempting to moor vessels for several months of the year in temperatures below freezing point. In any case, the new vessels will require open water, free from broken ice, on which to alight, and this will remain a controlling factor for many years to come.

§ 3

Summary of Conclusions

Let us now briefly recapitulate our conclusions in regard to the comparative uses of the several types of aircraft. Then, having clearly indicated the precise

COMPARISONS

part we expect each particular mode of air transport to play in the developments of the future, we shall be in a better position to deal with those Imperial and International questions of organisation and policy, which will form the subject of our final chapter.

We think then, that as time goes on, the different types of aircraft will tend more and more to specialise in their fields of operation; and, unless science steps in to upset probabilities with some revolutionary invention, we anticipate a development that will divide them up into four distinct groups or classes. The functions of these groups in a world-system of airways may be differentiated somewhat as follows.

Airships, provided the proposed new developments can be carried out successfully, will operate upon the main trunk routes over the oceans, first across the North Atlantic, and when a service is developed satisfactorily upon that route, across the South Atlantic and Pacific; also upon the routes to South Africa, India, and Australasia. They will operate, in fact, upon any world route where there is sufficient traffic to make the service commercial.

Flying boats will, for the time being, mainly develop the Eastern routes, serving Egypt, India, and the Far East, but reaching out also to Australia and the Cape, and they will build up a great system of feeder services to fructify the main airship routes, once these are established. A start has already been made by Imperial Airways, and a service from England to India is in operation.

Assisting and feeding these routes will come the land aeroplanes, machines not much bigger than perhaps twice the size of the latest Imperial Airways machine.

Finally, the fourth group of private or taxi machines will be used to feed any or all of the former three groups.

THE WORLD, THE AIR AND THE FUTURE

As we have often remarked, the real requirement of the world is for long-distance craft, and the fact that a vessel is a long-distance craft implies that passengers will have to be accommodated for considerable periods. Hence the question of comfort becomes an all-important consideration in air travel. Now it so happens that it is precisely the airship and the flying boat—the two types of craft for long distances—and so far as can be seen, they alone, that are likely to be able to provide adequate comfort for the traveller, and this by reason of their great size. Owing to the large spaces available, both can make adequate provision for sleeping, sitting, and restaurant accommodation; also for the same reason of their greater size, their motion will be far more equable than that of the aeroplane, so that in their case air sickness should be greatly reduced, and perhaps eliminated altogether.

The prospects of the flying boat would seem to be particularly bright. Having a higher potential speed than the airship, it is morally certain that upon any route upon which the flying boat has sufficient range to operate, it will cut out or eliminate the airship, so soon as it can compete with it economically. Similarly, it will tend more and more to displace the land aeroplane, owing to its greater comfort and better economic return. Altogether then, we may say that at some time in the distant future, air routes will, wherever possible, be operated by flying boats.

The future before the private or taxi planes would not seem to be very great, unless some unforeseen development takes place.

The inherent defects from which they suffer are too great to enable them to be used with the same ubiquity as motor cars, or with the same dependence as the train.

In essence, they will always be comparatively short-range machines, and because of this, the time they can

COMPARISONS

save will be small in scale as compared with the through lines. They are dependent upon land aerodromes for safe landing, and will, because of their small size, always remain uncomfortable. Again, owing to their inability to hover, rise, or land vertically, they can be only used for day flying, and will be largely dependent upon fine weather. Furthermore, they will not be able to approach the centres of large cities to pick up their passengers.

In regard to safety, a definite distinction must be made between this type of flying and that of an organised transport service operating a fixed route. In the latter, the operators are professionals, knowing, through constant flying, every inch of the ground over which they fly, equipped with wireless telegraphy giving them information and instructions for landing, acquainted with the specialities of the weather conditions of the locality, and operating over a route with numerous and clearly demarcated emergency landing grounds.

This will seldom be the case with the taxi or private machine, as its main function will be to transport passengers over distances where no established air line is in operation.

It will, of course, be used for flying as a sport, in the same way as yachting; and in undeveloped countries with a relatively small population, few roads, and insufficient railways, it will also prove of considerable value as a means of transport.

Mr. Hinkler's flight to Australia from England in fifteen days, and Lady Bailey's 28,000 mile flight round Africa, both of which took place in 1928, are indications of the kind of use to which this type of machine will be put in the future.

In actual numbers, these machines will, of course, greatly surpass the larger transport machines, but the effect they will have upon the more highly developed

THE WORLD, THE AIR AND THE FUTURE

countries, will be small in comparison with the effect of the long distance types. In countries like England and the more closely settled States of the United States, their use will be restricted almost entirely to pleasure trips, where regularity and the maintenance of a time table are not required.

If, however, a machine of this kind could be constructed, that would hover, that could rise and land vertically, and which it was impossible to upset or stall, then, indeed, we might hope to see an aerial development upon the scale of the motor car development. A start towards such a machine can be seen in the Auto-Giro, and it may be that in time to come some greatly improved model upon these lines will be produced that will fulfil all the above requirements. Once this happens, we may be quite sure that in a short time the machine will be developed as a road vehicle as well, giving finally to the world the dream of the ages. What a chance there will be for the Mr. Ford of that day!

ADMINISTRATION AND POLICY

CHAPTER VIII

ADMINISTRATION AND POLICY

The International Organisation of Civil Flying—Airworthiness Certificates—Denationalisation of Aerodromes—The League of Nations to be the Controlling Authority—The Law of the Air

The Air Problem of Great Britain and the Empire—Need of Administrative Reforms—Waste Under Present System—Fusion of Navy and Air Force Desirable in Interests of Efficiency and Economy—Money Saved to be Devoted to Air Development of the Empire—Suggestions as to how the Money can best be Spent—Programme of Policy Outlined—Conclusion

HAVING completed our technical analysis of the air situation, we will devote this our last chapter to administrative issues, and to questions of air politics generally. And in dealing with these aspects of the aviation problem, it will be convenient, I think, if we group our conclusions under two separate headings. There are, in the first place, certain general conclusions that can be reached relating to all countries, and bearing upon the international situation; and secondly, there are those of a more detailed character that concern England and the British Empire in particular. We will take the general conclusions first.

And here, the first point I wish to emphasise is the desirability of reaching some general international agreement as soon as possible in regard to what are known as "Airworthiness Certificates." To-day each country lays down its own regulations as to the conditions to be fulfilled before an air machine of any kind is deemed

THE WORLD, THE AIR AND THE FUTURE

airworthy, with the result that a ship or plane in one country may be prohibited from engaging in transport work in another.

Such variations in airworthiness regulations may be a great handicap, from the commercial point of view, to a country like Great Britain, where Air Ministry regulations in these matters have become voluminous. In their desire to ensure safety in the early days of aviation, the official element decided to govern all construction with a mass of precautionary legislation. With the development of responsible aircraft firms, the reasons for this policy have vanished, and to-day the procedure is a definite handicap. It is a known fact that many of the American machines that have flown the Atlantic, including that used by Colonel Lindbergh on his famous flight, would not have received an airworthiness certificate if they had been manufactured in Great Britain.

I do not wish it to be implied that I am criticising the inspection of workmanship or materials, but rather the Governmental control of design. For instance, American and German firms adopted a system of welding in the construction of their metal machines, thereby greatly reducing the cost of manufacture. It was only after these countries had sold many machines built on this system, that the Air Ministry allowed British firms to do likewise. Meanwhile, however, foreign manufacturers had established a lead and captured markets, during the period in which the Air Ministry kept British manufacturers tied down to the old regulations. Of course the ultimate result has been greatly to increase the cost of manufacture in Great Britain as compared with foreign countries—so much so that in the United States, machines are now being manufactured at about 12s. 6d., per pound weight, as compared with over £1 per pound weight in Great Britain, and this in spite of the fact that wages in the

ADMINISTRATION AND POLICY

United States are more than double. A somewhat unhelpful contribution to our export trade.

Surely the time has arrived to sweep away the majority of these detail regulations, and to put aircraft inspection upon the same basis as that now in force under the Board of Trade for our Mercantile Marine. The Air Ministry should realise that it is the manufacturer himself who will insist upon adequate strength and safety. How else could he continue in business? No one is going to buy a machine with a bad name, and therefore safety will be obtained more certainly by leaving the manufacturer alone and letting him get on with his business.¹

It may be asked, why is Great Britain more official-ridden than any other country in aeronautical matters? The answer is, I think, that every aircraft manufacturer in the country is dependent for his existence on Air Ministry orders, as, owing to the policy the Government have pursued since the Armistice, civil aviation hardly exists. Consequently the Air Ministry, very rightly insisting upon their own ideas for their own purchases, have been led to insist upon these same ideas being applied to civil machines. This dependence upon Air Ministry orders imposes a severe handicap on our manufacturers. It destroys initiative and hampers progress. Mr. Sigrist, Joint Managing Director of the Hawker Company, said no more than the truth, when he complained that² "The Air

¹ The British Aviation Group have now secured authority to undertake the duty of inspecting light aeroplanes in private ownership. (See *The Times* of August 8th, 1929.) This means that they will be able to issue Certificates of Airworthiness, and is a move in the right direction. But the transference of the task of inspecting civil aircraft from the Government to private hands should be extended to all aircraft that do not ply for hire. There is no more reason why a private aeroplane should be subject to Government inspection than a private motor car. The matter might well be left to the owner and his Insurance Company.

² *Morning Post* Report.

THE WORLD, THE AIR AND THE FUTURE

Ministry's present system of ordering aircraft caused the constructor to work in fits and starts, and precluded him from ever obtaining the full benefit of output. The constructor's factory might be busy working overtime for six or nine months, and then there might be a sudden slump. This system made it difficult to retain the better class of workmen in the factory, because these men preferred to get into more stable industries." If there were a real industry for the production of civil aviation machines, the firms would not be so dependent upon the Air Ministry, and could push ahead with production, like any other class of manufacturer.

In order to prove our statement that British aircraft construction has to depend almost entirely on Air Ministry orders, we need only compare Great Britain's position with that of foreign countries.

In 1928, exclusive of light aeroplanes, Great Britain had a grand total of 21 commercial craft, against at least 15 times as many in Germany; whilst the latest available figures for the United States show that on November 1st, 1928, orders for 5,200 new aircraft were still unfulfilled, and that the total output for 1929 was expected to be between 8,000 and 10,000 new machines.

As might be expected, the figures for passengers and freight transported by air tell the same story. In 1927, German commercial aircraft carried 102,600 passengers against Great Britain's 18,800, and 472 tons of mails against Great Britain's 45 tons. As regards the United States, we find that, in 1928, that country added 7,500 miles of lighted airways for night flying to her main routes, against none at all for Great Britain. While it would be unfair to compare the possibilities of aviation development in Germany or the United States with such possibilities in Great Britain alone, owing to the very different conditions, it is

ADMINISTRATION AND POLICY

pertinent to compare these countries with the British Empire. And in view of the fact that we must stretch our own air lines to the Empire before we can really make a beginning, does it not seem reasonable to suggest that the policy of reduced official interference coupled with increased subsidies adopted by France, Germany and the United States, will give far better results than the policy hitherto adopted by Great Britain?

There would seem to be a clear field for the League of Nations to operate in, with regard to the whole system of Airworthiness Certificates. We do not want a multiplicity of either Airworthiness authorities or bureaucratic officials, and the idea would be for the League of Nations to appoint their own licensing authorities in each country. The power to grant or withhold certificates would be invested in these authorities, and any certificate granted by them, being an international certificate, would hold good for all countries. One advantage of such a system would be that it would tend to take the control of civil machines out of the hands of the military air force officials in every country—a result which is greatly to be desired, and ought to be achieved at as early a date as possible.

Briefly then, I propose that civil flying should, as far as possible, be put under the control of the League of Nations. To assist in making this scheme concrete, all or a large proportion of civil aerodromes should be ceded or turned over to the League of Nations by every European Government, in much the same way as Mussolini has recently ceded a small area of territory to the Pope. A traveller flying about Europe would, in effect, never leave League of Nations territory, and would not enter the country of the national Government ceding the aerodrome unless he wished. Thus would a start be made towards international flying, and we should not have a recurrence of such a position as arose

THE WORLD, THE AIR AND THE FUTURE

when British Imperial Airways were held up upon the route to India because Persia would not agree to British planes landing on her territory.

Other questions that the League of Nations might profitably take up are those relating to passports, customs, landing and departure permits for all aircraft. An international agreement might be come to whereby all these functions, insofar as passengers and freight carried by aircraft are concerned, were placed under the control of the League, which would administer them through its own specially appointed agents in each country. In this way it should be possible to arrive at a condition of affairs in Europe, in which civil aircraft will be able to fly about as freely and as unhampered as they do to-day in the United States of America. Later, the same system could be extended beyond the confines of Europe, and in years to come, when the range of aircraft has increased to a sufficient degree to enable the United States, Canada and South America to be reached, the same conditions could be applied to those countries.

One great obstacle to the freeing of civil aircraft from the control of the Government Departments in the various European countries, is the vested interest that is being built up, and which depends upon the present restrictions being maintained. The more formalities, the more restrictions, the more interference, the more jobs for Government officials. To carry out a reform on the lines suggested will not be easy, and may in fact, for the very cause just mentioned, become more difficult as each year passes, but it is to be hoped that public opinion in each country may become sufficiently vocal to impress upon the political element the desirability of effecting some such constructive development.

In the United States the Federal Government is already endeavouring to co-ordinate the activities of State officials in regard to civil aviation, and thereby to

ADMINISTRATION AND POLICY

arrive at a measure of uniformity in all matters pertaining to flying and landing regulations. If we are to have an efficient inter-European air service, a similar uniformity with regard to such matters must be established in Europe, and the best way to bring this about would be for the various states to delegate a certain measure of administrative control to an International body like the League of Nations.

Then there is the whole question of air legislation. The laws relating to aircraft require codification, and this is also a work that might well be undertaken by the League, whose task it would likewise be to obtain the assent of the various national Governments to all the articles and procedure embodied in such a legislative code. In this way there would be one Law of the Air for the whole world. Further, it is important that the nations should come to an agreement regarding the rights of neutral aircraft in time of war. The same questions that have arisen in sea-warfare during the last thousand years will also arise in regard to aircraft; and they will be even more complicated in their diversity. Clearly, much future trouble and discord will be saved if the laws governing all such questions can be settled once and for all by international agreement. The solution of the problem of the Freedom of the Air in war time, therefore, offers another useful field for League of Nations activity.

The great difficulty in the way of establishing an efficient system of air communications in Europe, is the fact that such a system necessitates a partial abandonment of sovereignty on the part of the various national states. No such obstacle, stands in the way of air development within the British Empire. Here the problem is purely a domestic one, and its solution depends entirely on our own initiative and

THE WORLD, THE AIR AND THE FUTURE

enterprise. The fact that we have not made any real attempt to get at grips with it so far, is due to our own deficient statesmanship, and not to international difficulties or to any checks imposed on us from outside. The Dominions await our lead. They are eager to support us in launching the comprehensive air policy that the Empire needs. It is we in Great Britain who are backward and irresolute.

Yet this matter is one of extreme urgency. This book will have failed in one of its main objects, if the importance of air transport as a means of developing and consolidating the Imperial fabric has not been clearly established. If, however, I have succeeded in establishing this fact, then it becomes quite clear, I think, that not only must we reorganise our Governmental activities in regard to aircraft, but we shall also have to look at the whole large question of our disbursements on National and Imperial defence from an entirely new angle of vision.

At the present time Britain's Defence Budget costs her the huge annual sum of £120,000,000; and if we examine the rationale of this expenditure with eyes unclouded by tradition and in the light of new issues, it at once becomes apparent that the policy directing the outlay is both wasteful and out of date, and that the whole system requires drastic revision.

Of the total amount, some £15,000,000 a year is devoted to what are called non-substantive services, and is utilised in paying pensions, retirement gratuities, and the like; but the remainder, over £100,000,000 is spent on the Army, Navy, and Air Force. If this £100,000,000 a year is to be spent at all, it is and can only be justified as a national insurance premium upon the safety of the country and the Empire in the event of war. Upon any other ground it is complete and absolute waste of money and man power. Included in it is a sum that

ADMINISTRATION AND POLICY

hitherto has never exceeded half a million in one year for civil aviation. Now, if it be true that our own future prosperity and that of the Empire depend to a vital degree upon our being able to weld our scattered Imperial Commonwealth into a single organic whole, and if it be also true that a condition precedent to this welding process is speedy communications between the constituent parts of the Empire, then, does it not follow logically that the development of our air communications is one of the most, if not the most, important link in the chain of our defensive preparations?

I am not dealing now with the question of aircraft being used for war purposes—either directly for actual warlike operations, or indirectly as civil craft utilisable in time of need as a valuable reserve. Here I am dealing with them simply and solely as a means of assisting us to build up an Empire whose economic strength and political stability will be such that the whole Commonwealth can view the expenditure of money upon armaments with confidence and equanimity, secure in the knowledge that the necessary taxation can be borne without damage to the general welfare of the community. Upon these grounds alone, it is not unreasonable to suggest that not less than 10 per cent. of the total expenditure upon war insurance should be devoted to forcing the growth of our civil aviation lines. This would amount to some £10,000,000 a year, or twenty times the amount we are now spending, and would necessarily be obtained by a drastic reduction upon the moneys now expended upon the Navy and Army. To many this may seem a fantastic sum, but I venture to think that 10 per cent. is not too large a proportion of our expenditure to devote to the building up of a solid and enduring fabric of Empire.

As we showed in the analysis of the situation in the Defence chapter, the present Air Force cannot be looked

THE WORLD, THE AIR AND THE FUTURE

upon as anything except a nucleus or training service, able and sufficient to organise a great expansion in time of war. For a rapid expansion the two major requirements are *personnel* in the form of pilots, navigators and ground staff, and a large manufacturing capacity. Both can be provided by the civil aviation side, leaving to the military side the production of type machines of special character, and the conception and construction of the training, tactical, and strategic technique. For this purpose a large permanent force is not required. Provided it is of sufficient size to provide a realistic war training, and to carry out such police duties as can be more cheaply carried out by aircraft than by Naval vessels or Army units, we can rest assured that any further money available can be spent better in other directions. For instance, one important provision that can be made, for which there will not be much to show, but which is absolutely essential for a rapid expansion, is the provision of the necessary jigs, fixtures, gauges, and special machinery, that are required for each and every type of machine or engine that is different from the normal commercial machine, and would be needed in time of war. The organisation of a factory and the provision of the jigs, fixtures and gauges takes longer, as any practical manufacturer will confirm, than the actual construction of a machine. The country, then, would obtain a cheaper and better insurance by cutting down the number of Service machines that are actually built, and providing in their stead, duplicate sets of jigs, fixtures, and gauges, and contracting with manufacturing firms to have these fitted, set up and tested out, and then stored for emergency.

I must repeat that, for war purposes, we cannot hope to maintain much more than a fortnight's supply of machines and pilots, and that our real insurance must be in our reserves for rapid expansion. These facts

ADMINISTRATION AND POLICY

should be faced and not glossed over. It may be more spectacular for the public and more attractive to the Air Force to have more machines available for flying than fixtures and gauges in various factories in store—but it is not good business, and as a country we cannot afford to pay for display or *amour propre*.

First and foremost, then there should be an immediate severance of all matters connected with civil aircraft from those connected with naval and military aircraft, all matters relating to civil aircraft being transferred to the Civil Department dealing with Trade or Communications, to which Department they rightly belong. Personally, I should like to see Great Britain adopt the idea already in force in many other countries, of a Ministry of Communications combining the steamships, railways, aircraft, cables, roads, wireless and the like, under a single unified control. But that is another matter, and cannot be discussed here.

As an example of how unsatisfactory is the present system of having a military department in charge of civil flying, I need only instance the policy that has been pursued in regard to airship development.

The original idea of establishing a Government Airship Building Department at Catdington was based, presumably, upon the plea that, since the Royal Navy has its own dockyards in which warships are built, the Royal Air Force should have an airship yard; but as the Royal Navy does not build Atlantic liners, it is difficult to see the analogy. The result, however, of a military department constructing commercial aircraft, must be for military considerations to conflict with commercial requirements, and when any conflict of interest between the commercial companies and the Government Department takes place, the commercial company goes to the wall. As an instance of this, I may mention that, out of a vote of over £2,000,000

THE WORLD, THE AIR AND THE FUTURE

for commercial airships, the Government Department has spent upon its own activities over £1,650,000, leaving only £350,000 for the commercial side. Furthermore, unproductive expenditure has been duplicated, and under the present scheme, two airship factories have been established, one at Howden and one at Cardington. With the completion of the R.100 and the R.101, however, the skilled staffs of both factories are being dispersed with the exception of a small number of men. The point is that at present there is not enough airship work to keep two establishments in being, and even when commercial operations are inaugurated with the new design of ship, it is unlikely that expansion will be sufficiently rapid to necessitate two factories, for several years. Obviously it will be cheaper to build a naval scout type of airship (if one is required), in a factory for building commercial vessels, than it will be to keep a special establishment open for such a purpose. In any case the policy of the State itself undertaking the construction and operation of commercial airships, is open to serious objection upon two grounds.

In the first place, if the officials who advise the Secretary of State for Air are themselves competing with commercial firms in the design of commercial vessels, it follows that one competitor is the judge, jury and prosecutor of the other, wherever there is a conflict of opinion. Moreover the mischief does not stop there. Under the arrangements between the State and Government officials in regard to patents taken out by such officials, the usual course is for the inventor to assign his patent to the State. The State has then free use of his invention for State purposes, and allows the inventor to exploit the commercial uses of the invention for his own benefit. This is a perfectly fair and reasonable procedure under normal conditions. In this case, however, the situation is entirely different. The air-

ADMINISTRATION AND POLICY

ships are admittedly being produced for commercial purposes, and the fact is at once clear that the Government officials are using State money to develop inventions, whose sole outlet is for commercial purposes.

At the present time these same officials are the only technical advisers to the Secretary of State for Air, with practical airship knowledge; and not only do they advise him upon all matters connected with airships, but they are also upon the Airworthiness Committee which decides the conditions under which an Airworthiness Certificate is to be given.

I want to make it quite clear that I am not making any charge against any official of abusing his position to his own advantage. I am sure that no British official would do so; the standard of integrity is far too high to allow of any such suggestion. What I do say is, that it is wrong for a system to be so devised that it can put any Government employee into the invidious position of having to make official reports on patents in which he may be pecuniarily interested.

If it is thought that the best way to develop airships is always to build two simultaneously, and if the Government is afraid of one firm getting a monopoly, then let there be two commercial firms entrusted with the work, each under contract to build one ship. In this way, the State officials will be disinterested, and their judgments cannot be open to criticism on the score of partiality.

A year or two ago the British Government, in an endeavour to economise, announced that it proposed to abolish the Ministry of Transport. So far it has found it impossible to do so. In any case it would seem to be rather absurd to economise upon one of the few Departments which the development of mechanical and scientific knowledge is certain to expand rather than contract. Would it not be better to try to organise

THE WORLD, THE AIR AND THE FUTURE

for conditions that will be with us in ten or twenty years, rather than to organise upon lines that are twenty years out of date? In the early days of aviation, when the older Services were somewhat hostile to aircraft, there were strong arguments for creating a separate Ministry able to devote itself exclusively to the development of fighting aircraft; but now that aircraft are universally accepted, I believe their development is hampered and confined by the yearly conflict of vested interests which takes place when the estimates between the three Services are settled and approved by the Cabinet.

For some years the House of Commons has toyed with the idea of a Ministry of Defence, but little progress has been made in this direction. The expert heads of the three Services have always condemned the idea. Personally I think they always will, and I find myself for once in agreement with Commander Kenworthy, M.P., who has said that one might as well expect a committee of jockeys, bookmakers, and trainers to submit a report to the Government as to the best way of abolishing horse racing, as expect the permanent officials and the experts of the three fighting departments to effect a large reduction in their own higher appointments.

Due entirely to House of Commons pressure, two moves towards co-ordination have been made since the war. First, a Permanent Committee consisting of the three Chiefs of Staff of the Imperial Defence Committee has been formed, and second, an Imperial Defence Committee has been inaugurated, to which officers from all three Services are appointed. The time has, I think, now arrived when this process should be taken further, and I should like to see the Air Ministry and Admiralty formed into one Department, and the Navy and Air Force into one Service—this to be regarded as a first step towards the eventual formation of a

ADMINISTRATION AND POLICY

Ministry of Defence, if such a development seemed desirable.

The question at once arises as to the position of the Army under an arrangement of this kind. The Army, like the Navy, needs its technical machines for use in scouting, gun-direction and the like. To-day, the Navy has its Naval Air-arm, and when the Air Force and the Navy are combined into one organisation, the obvious development will be for the Army to have its "Army Air-arm" upon the same basis, and in the same manner,—indenting upon the new combined Service for its equipment and training, somewhat as the Navy indents upon the Air Force to-day. In this way it will be enabled to carry out its police duties in India, Iraq, the Sudan, and elsewhere in a far more economical manner than is possible under the present system.

But why, it may be asked, should the Air Ministry be combined with the Admiralty and not with the War Office? The answer is clear. As pointed out in the Defence chapter, there is an essential difference between the Army on the one hand and the Navy and the Air Force on the other, the former being a holding force, and the two latter striking, but not holding forces. Furthermore, it is in the transference of duties from the Navy to the Air Force that waste of money now occurs owing to an overlapping of functions; and the only way to stop this waste is to combine the two services. Moreover, the size of the Army is really regulated by the number of troops required throughout the Empire as garrison or police forces, and is not governed by, and does not depend upon, the size of the Armies of other Powers. With our Navy and Air Force the problem is different, because of the mobility and striking capacity of each. Thus, we have been in the habit of regulating the size of our Navy upon that of any possible opponent, rather than upon the basis of policing

THE WORLD, THE AIR AND THE FUTURE

the high seas, and the size of our Air Force is always compared with that of other Powers within striking distance.

But perhaps the argument in this controversy that will carry most weight can be deduced from conclusions already reached in the preceding chapter dealing with the comparison between different types of aircraft. It is there pointed out that the flying boat will develop to several times the size of any land machines, and that in consequence, not only will it have greater range and more robustness, but it will be able to carry a heavier armament, than any land machine. These flying boats will in fact form the nucleus of the flying Navy of the future. They will be the machines that will do the long range bombing. How then can there be any reason whatsoever in having one Department controlling flying boats when used as an independent air-arm, and another controlling the same machines when used with Naval vessels?

Similarly with regard to airships. Since it seems probable that all airships will operate from the water, it automatically follows that the gas plants, etc., will be constructed in sea-going vessels so as to ensure mobility. In time of war, when the commercial airships are mobilised for reconnaissance work, it will be necessary for the airship supply vessels to be directed by one of the fighting departments. What is going to happen? Is the airship to be under the Air Ministry, and the airship floating base to act under orders from the Admiralty? Are the vessels on which the airship depends for her supplies to be under a different Department from that under which she herself operates? A remarkably efficient arrangement! Or perhaps the Air Ministry intends to provide its own supply vessels, and contemplates building and administering a special service of destroyers and cruisers to protect them?

Such absurdities bring out clearly the inadequacy

ADMINISTRATION AND POLICY

of our present system, and show that in the interests of economy and efficiency alike, the reorganisation of our Fighting Departments on a more rational basis is urgently needed. And the central need of the situation is, as I have said, the fusion of the Navy and the Air Force. With the defence of these islands and of the narrow waters both at home and abroad, having now become a matter for aircraft rather than for naval vessels, and with the prospect of the air extending its area of control with every new increase in the range and capacity of aircraft, the Navy no longer holds its pre-war position in regard to the functions entrusted to it, and must be prepared to submit to a still further curtailment of its specific duties and responsibilities as the years go on. Consequently, the Admiralty must face the logic of the situation, and realise that the Navy cannot rightly retain its old position in regard to moneys voted, unless the Air Force and Navy are merged into one Service.

If this combination were effected, I think that both Parliament and the country would insist on at least half the staff and administrative positions being given to officials and officers with air experience. At a later date, with common entry, and with Naval and Air training for every officer, a common outlook and experience would be ensured. The important thing, to my mind, is to ensure that one political head is responsible for both departments, so that the waste of the immense sums of money which now takes place each year, due to a conflict of vested interests between the two services, may be brought to a speedy and abrupt conclusion.

Briefly then, I am advocating that a sum of approximately £10,000,000¹ a year should be saved from the

¹This sum could not, of course, be spent in the first year. Neither could it be saved upon the other estimates in the first year. It is a figure that might be reached after several years from the adoption of the policy.

THE WORLD, THE AIR AND THE FUTURE

estimates of the fighting services, the bulk being obtained from Naval votes; and through the suggested amalgamation between the Navy and the Air Force, such a saving could, I am convinced, be obtained without loss of naval or military power. And furthermore, I propose that the money so saved should be devoted to a comprehensive policy of developing air mail and passenger lines to every Dominion within the Empire.

Now it is quite clear that the establishing of a complete system of Imperial air communications must be a lengthy and arduous business. Accordingly, any policy that is ultimately decided on, must, if it is to have a fair chance of success, be given time to mature. I suggest, therefore, that a scheme be laid down and organised to cover a period of not less than ten years, during which time it would aim at establishing a daily mail and passenger service between Great Britain and every Dominion. An integral part of the scheme would be the linking up with these main routes of feeder lines connecting every Crown Colony and Dependency. Were such a scheme successfully carried out, we could contemplate Canada being but 48 hours distant, Bombay 60 hours, Australia 5 days, New Zealand 6 days, and South Africa $3\frac{1}{2}$ days. Continuity of policy, however, is essential. I see no reason to think that the establishment of these Air Lines is of less importance than the establishment of the sugar-beet industry in Great Britain. For this latter purpose the House of Commons has, with the concurrence of all parties, established the industry upon a ten-year programme of Governmental assistance, and in the one and only air transport line, Imperial Airways, the subsidy is laid down for a similar period.¹

Supposing then our policy to be settled in principle, the next question we have to decide is one of method.

¹The sugar-beet industry will cost the taxpayer between twenty and thirty million sterling over the ten-year subsidy period.

ADMINISTRATION AND POLICY

How should our £10,000,000 be spent? Should it be spent upon some great State enterprise of air lines, or should it be spent in the form of subsidies to commercial undertakings desirous of entering the field of aviation, with the provision that not more than one undertaking is subsidised in each geographical area, and that co-operative working between the geographical areas is enforced? Here, unfortunately, we are entering the field of party politics; but leaving politics aside, and looking at the matter solely from the point of view of practical expediency, I am strongly of opinion that the available moneys should be used to subsidise commercial companies rather than to finance some great State undertaking. It would not be unfair to say, I think, that a service run by a commercial company would cost about half as much for an equivalent result, as would a similar service run by Government enterprise. On this matter I can speak with some experience.

The actual cost of building the R.100 apart from capital expenditure upon the shed, plant, mooring mast, etc., was £400,000. The building of a ship of exactly the same size, the R.101, involved the Government in an expenditure of £750,000, upon the same comparative basis, as in both cases the sums quoted include all materials, labour, overhead and experimental charges. But the real difference in cost between the two ships is even greater than appears from these figures, since in the case of a company, the charges of a London office are included in the overhead charges, whereas the London office charges of a Government Department, like the Air Ministry, are borne by other Governmental votes. Similarly no Government Department pays insurance premium, nor is it concerned with interest charges on bank overdrafts or depreciation upon its properties other than depreciation in the form of maintenance. These costs exist in Government enterprises in fact, just as

THE WORLD, THE AIR AND THE FUTURE

they do in private companies, but owing to the system of accountancy, and the allocation of expenditure under the different vote heads, the unfortunate taxpayer seldom realises the extent to which he is being mulcted by a system which, though quite honest, is not the less inefficient on that account. However, we are not concerned here with the question whether the expenditure which it is suggested we ought to devote to civil aviation, should be controlled by a State organisation or by private organisation. All that I do say is that experience in State shipping enterprises in the United States, Australia, and other countries leads one to believe that if our air lines are run by a Government Department we shall, to obtain the same result, require perhaps twice the money. That question we can leave to be decided by Mr. Baldwin and Mr. Ramsay McDonald or their successors, and turn to the more practical question of considering the results we wish to achieve by this expenditure.

If the world passenger routes are studied, it will be seen that the North Atlantic ocean between Europe and North and South America, and the Pacific from the New World to Australia and Asia, provide the only really long routes in the world—and by long route, I mean a route upon which there is no intermediate land base. Upon the England-Egypt-India-Australia route, or the England-South Africa route, we are fortunate in having no very long flights without intermediate bases. Accordingly, the logical course would seem to be to utilise the long-distance airship for the Atlantic and Pacific routes, connecting in the one case, England with Canada and the U.S.A., and in the other Canada with China, Japan and Australia, and to use aeroplanes and flying boats for the routes to India, Australia, and South Africa. A further fact to be considered is this. An airship route requires a greater traffic density than does

ADMINISTRATION AND POLICY

a flying boat route owing to the airship having so much the greater carrying capacity; and as of all long-distance routes, that between Europe and North America is by far the most frequented, it is clearly upon this route that a regular airship service is most likely to prove a profitable speculation.

For this purpose of developing our Empire air lines I have not hesitated to advocate a Government expenditure of £10,000,000 a year. I think, however, that if this expenditure is wisely made, much of it should be recoverable by the taxpayer within a reasonable period, and the following tentative suggestions are thrown out with a view to indicating what seems to me the line of policy best calculated to achieve this desirable result; though it must be understood, of course, that I have no wish to dogmatise on so speculative a matter.

Let the Government lend three-quarters of the total capital required for such enterprises as are decided on, at no fixed interest charge, but with the obligation that within one year of any service being started, the total profits of the concern shall go to the Government until it is receiving 5 per cent. interest plus 1 per cent. sinking fund on the moneys advanced, after which they go to the remaining or non-Government shares. In addition to this, and from an entirely separate fund, the Government to guarantee the companies a considerable proportion of the accommodation and freight at the normal charges for a period of years. Now the justification for this somewhat unorthodox suggestion lies in the fact that we are under the necessity of having to develop our air communications on a big scale, when, from a commercial point of view, conditions are hardly yet ripe for such a development. From a national and imperial point of view we want to force the growth of our air communications. To do so we must enlist capital and brains, and we must hold out sufficient prizes and in-

ducements to attract both. Even then, there will be many failures of aviation companies to offset what may be the spectacular successes of the few.

The implication of the financial proposals can now be perceived. From a practical commercial point of view, a 60 per cent. available capacity occupied is the highest that can be contemplated. A considerable proportion of these receipts is guaranteed. If, with these receipts guaranteed, there are not sufficient profits to pay more than the debenture interest and sinking fund to the Government, then the private capital subscribed gets nothing. On the other hand, with a considerable proportion of its revenue assured, it should be possible for any Air Line, if competently planned and ably managed, to make sufficient profit upon the private capital invested not only to pay dividends, but also to build up reserve and depreciation funds for re-equipping the service with the latest type of craft at frequent intervals.

The same conditions should apply to all operating lines, and the companies should be free to utilise airships, flying boats, or land planes at their own discretion. Our analysis in the last chapter has shown that the long-distance routes will be covered exclusively by airships and flying boats, but the operators of the long-distance routes should have the wording of their subsidy contracts so drawn up as to enable them to establish aeroplane feeder lines wherever such a course may be profitable. One obvious criticism of these proposals is—why should other forms of transport, such as steamship lines, be taxed in their position as a portion of the general body of taxpayers, to subsidise air lines that are competing for the traffic that they themselves carry? The answer is, I think, that if it be true that our position in the world and our capacity to pay for our defence are dependent upon our being able to establish a speedy

ADMINISTRATION AND POLICY

system of Imperial communications such as will give the British Commonwealth the consolidated strength of a single united Nation, then such taxation is justified in the same manner and for the same reason that taxation is approved for the upkeep of a Navy or Army.

Furthermore, it is unlikely that shipping companies will be adversely affected except temporarily. As soon as air traffic can take the more expensive class of passenger and the mails, the sea-going liners will be able to consider the question of reducing their speed. This will bring down costs, and make travelling cheaper, so that a new class of traveller will be attracted to the steamship.

Finally, there is the question of research. Except for a number of small private wind tunnels, most of the research work is done at the National Physical Laboratory. This department is grossly overloaded, and, moreover, its equipment does not compare with that available in the United States. A portion of the £10,000,000 a year could be spent with advantage in equipping either the National Physical Laboratory or some new laboratory, with the finest appliances available, and in sufficient quantity to obviate the serious delays that now exist whenever any research work has to be carried out. But the whole subject of experiment and research might well be put under a special sub-department, somewhat similar in character to the present Ordnance Board, the existing department of the Air Ministry, under the Air Member for Supply and Research, forming the nucleus of such a body. This sub-department would then have as its main functions to co-ordinate the technical activities of the military and civil sides of aviation, and to ensure the immediate application of any and every improvement that careful experiment had shown to be of practical advantage.

Now the programme outlined above is an Imperial

THE WORLD, THE AIR AND THE FUTURE

programme—of no less value to our Dominions and Dependencies overseas than to Great Britain herself. It is neither reasonable nor desirable, therefore, that the whole cost should be borne by Great Britain alone. At the same time, the Empire looks and rightly looks to Great Britain for a lead. Suppose, then, Great Britain were to invite the outer Empire to collaborate with her in setting up an Imperial Communications Department which should co-ordinate all methods of air communication within the Empire, she herself offering to devote £10,000,000 annually towards the scheme, and leaving it to the sister nations to contribute such amounts as seemed good to their respective Governments—how would such a proposal be received by the various States of the Commonwealth? I venture to think that the response would be immediate and generous.

For to-day there is growing up in every corner of the Empire a proud consciousness of the mighty destiny that awaits the British Commonwealth if only the leadership proves worthy of the cause. And only Great Britain can provide that leadership. It is the bitter truth that so far she has failed to do so. Perhaps it is due to the unsettling effects of the war, but from whatever cause, we seem somehow to have lost that vision and leadership in high places which the direction of a great Empire demands—especially in our complicated and highly-specialised modern world, where it is more than ever difficult to see the wood for the trees. But the temporary failure of our statesmanship does not imply any falling off in the spirit of our people. The pulse of Britain still beats strong and true. Neither in the home country, nor in any part of the world where it has settled, has the British race lost the enterprising spirit and romantic ardour of Elizabethan days, or the trading and pioneering instinct which underlay the commercial expansion of the nineteenth century. The

ADMINISTRATION AND POLICY

stock that created the Empire is still worthy to carry it on, and there are welcome signs that our younger statesmen of all parties have come under the inspiration of the task that lies before us, and are determined to grapple with the Imperial issue in a broad and constructive spirit.

May we not hope, then, that we are on the threshold of a new era in the history of British Imperialism, and that the advent of the air age will see the inauguration of a bold and comprehensive policy of Empire development worthy of the glorious traditions of our race? Perhaps the British Government of 1930 will make a beginning, and give us a policy that will be at once broad in conception, firm and vigorous in its application, lofty in its imaginative appeal; a policy that will hearten all the peoples of the Empire, giving to each a new hope for the furthering of its national aims, and strengthening the material and spiritual ties that bind us all together; a policy, in a word, that will enable us to achieve that grand ideal of a world-community of free British peoples which our fathers dreamed of, and which it lies with us to bring to fulfilment.

THE END

INDEX

- Admiralty, the, 70, 80, 115, 116, 153, 257; need for combination with Air Ministry, 294, 332
- Adriatic, the, 166
- Aegean Sea, the, 166
- Aeronautical science, the evolution of, 199
- Aeroplane, the land, 21, 167, 259*ff*; aerodynamical considerations of, 272; the *Argosy*, 267*ff*; Atlantic crossing with, 302; the Autogiro, 278*ff*; compared with airship, 297; development, post-war, 259, 279*ff*; future, 268*ff*; 299; in naval warfare, 119; largest practicable, 277*ff*; Lindbergh's monoplane, 266; minimum speed of, 269*ff*; overloading, effect of, 265; performance of, 244, 261*ff*, 264*ff*, 277*ff*, 302, 315; railway competition with, 276; range, 264*ff*, 294*ff*, 296, 302; routes, possible, 315; safety in, 271; size of, 268*ff*, 277*ff*, 299; the specialised, 263; speed of, 244, 261*ff*, 277*ff*, 301; the taxi, 300, 315*ff*; weight of, 274; wing reduction, 269*ff*
- Aeroplane, The*, 266, 299
- Africa, 317
- Air, the, as means of communication, 163, 167
- Air administration, 319*ff*
- Air-centrality, 93, 292
- Aircraft (see also aeroplane, airship, flying boat, seaplane) uses in Empire development, 35*ff*; in attack, 74; compared with seacraft, 104; as a factor for peace, 156; and United States of Europe, 178*ff*; comparison of types, 291*ff*, 298*ff*; general considerations, 294*ff*; marketable value, 298*ff*; four classes of, 300, 315; conclusions, 314*ff*; airworthiness of, 319*ff*; cost of manufacture, 320*ff*; war supply of, 328
- Aircraft carrier, the, 119
- Air defence, 61*ff*
- Air Estimates, the, 65, 73, 155
- Air Force (see Royal Air Force)
- Air Mail, 297, 311*ff*, 322, 336
- Air Ministry, the, 80, 207, 209, 233, 256, 257, 321, 337; need for combination with Admiralty, 294, 332, 335
- Air Ministry Regulations, 320
- Air patrol, 164
- Air photography, 35
- Air politics, 319*ff*
- Air Power, relation to Sea Power, 80, 97, 100*ff*, 168
- Air psychology, 97
- Airship, the; Admiralty control of, 324; as aeroplane carrier, 112; Atlantic crossing with, 302; frequency of service, 310; ballasting of, 226; commercial prospects of, 248, 256, 310*ff*; compared with other aircraft, 21, 297, 300*ff*; cost of, 116, 256, 310*ff*; some conclusions, 257*ff*; cruisers, as substitutes for, 112*ff*.

INDEX

- Airship, the—*contd.*
 114*ff.*, 247; demurrage, 230*ff.*;
 development, 206, 207, 243*ff.*,
 247; docking, 222*ff.*, 231, 235*ff.*;
 in England, 207; the elliptical,
 237*ff.*; evolution of, 200*ff.*; fin-
 ance and fares, 256, 310*ff.*; fire,
 danger of, 216; the first, 204;
 fuel, 234*ff.*; future of, 243*ff.*,
 247, 306*ff.*; gas-bags of, 209,
 255; German, 205, 207, 209,
 219; handling, difficulties of,
 213*ff.*, 231, 250*ff.*; Howden
 Propulsion System in, 233*ff.*;
 a justification of, 249*ff.*; landing,
 112, 222*ff.*, 235*ff.*; *Los Angeles*,
 the, 209, 218, 220, 227, 254,
 303; mooring masts for, 224*ff.*;
 mooring and docking raft, 235*ff.*;
 naval, 117, 247, 334; overhaul
 and repair of, 230; post-war
 situation of, 250*ff.*; problems
 of, 12, 213*ff.*, 232*ff.*, 250*ff.*,
 292; prospects, commercial, 248,
 310*ff.*, punctuality of, 309; *R33*,
R34 and *R38* (see separate
 references); range of, 243*ff.*,
 297; routes for, 315, 338; as
 sea-craft, 13; *Shenandoah*, the,
 207, 208, 214, 215, 233; size
 of, 213*ff.*, 241*ff.*; snow and, 229,
 304*ff.*; Spanner, E. F. S., quoted
 on, 224*ff.*, 226*ff.*; speed of, 218,
 242, 243*ff.*, 302*ff.*; Trans-
 atlantic service of, 306*ff.*; in
 United States, 207*ff.*, 227, 257,
 306; weather conditions and,
 215, 238, 229, 307*ff.*; the
 Zeppelin, 204*ff.*, 219, 229, 254,
 310
- Airship, the Elliptical, 120, 167,
 233, 237*ff.*, 253, 292, 310;
 operation on water, 238*ff.*; com-
 pared with flying boat, 239; in
 the air, 240*ff.*; pay load, 240*ff.*
- Airship Guarantee Company, the,
 209
- Air Service, Inter-European, 325
- Air sickness, 299
- Air survey, 35
- Air transport, 245; effect on Great
 Britain and the Empire, 139*ff.*,
 and International Peace, 141*ff.*;
 its main advantages, 179; effect
 on Europe, 181*ff.*; cost of, 297*ff.*
- Airworthiness, of Airships Pancl,
 255; Certificates of, 319*ff.*, 321,
 331; Committee, the, 331
- Alaska, 38
- Alberta, 30
- Alcock, Sir John, 249
- American-Canadian frontier, the,
 194
- American colonies, the, 42
- Amery, Rt. Hon. L. S., 32, 43
- Anglo-American relations, 192*ff.*
- Anglo-French Naval Compromise,
 136
- Anglo-Persian Oil Company, 172
- Anglo-Saxon race, the, 191
- Annonay, 200
- Antoinette, Marie, 201
- Appenrod, 172
- 'Aquadromes,' 293
- Argosy*, the, 267*ff.*, 270, 273, 275,
 288
- d'Arlandes, Marquis 201
- Armada, the, 71
- Armaments, 63, 134
- Armentières, 75
- Armistice, the, 65
- Army, the, 102, 326, 333
- Assistant Secretary, U.S. Navy, 302
- Athens, 52, 164
- Atlantic Air Service, 249, 253, 301,
 306; with airships, 306*ff.*

INDEX

- Atlantic crossing, the, 196, 209, 222, 241, 248, 249, 302, 303, 313; causes of possible failure, 303ff
- Atlantic Liners, the, 307, 309
- Atlantic Ocean, 108
- Atlantic steamship passengers, 311
- Auckland, 46
- Australia, 21, 27, 30, 36, 40, 50, 58, 122, 130, 132, 258, 317, 336, 338; population, 24
- Australasia, 315
- Austria, 175
- Austro-Hungarian Empire, the, 175
- Autogiro, the, 278ff, 318
- Aviation (see also flying, aircraft, etc.), civil and military, 9; problems, 11, 23; as an aid to structural unity of Empire, 41ff; influence on National and Imperial Defence, 54ff; Civil Vote, 138; a force for Internationalism, 161, 198; administrative problems, 319ff; share in defence budget, 327; the necessary subsidy, 335ff; a programme, 336; paying passenger routes, 338; financial proposals, 339ff
- Azores, the, 307, 308, 310
- Babylonia, 82, 86
- Bailey, Lady, 317
- Balance of Power, 64
- Baldwin, Rt. Hon. Stanley, 92, 130, 196, 256, 338
- Balloon, 200
- Baltimore, 314
- Bamber, C. S., ix
- Basra, 68
- Beet Industry, German, 95
- Beethoven, 46
- Bergerac, Cyrano de, 201
- Berlin, 74
- Bermuda, 222, 223, 307, 308, 310
- Blackburn *Iris* flying boat, 287
- Black Forest, the, 46
- Board of Trade, the, 321
- Bois de Boulogne, 201
- Bolshevism, 142
- Bomb, gas, 76
- Bombay, 21, 33, 336
- Bonacina, Conrad, ix
- Bowles, George F. S., 81, 84, 85, 89, 94
- Brahms, 46
- Bremen*, the, 307
- Brest, 89
- Bridgeman, Rt. Hon. W. C., 111
- British Army of Occupation, 188
- British Aviation Group, the, 321
- British capitalist, 30
- British Columbia, 30, 37
- British Empire, The*, 18
- British Empire, 18ff; its distances, 20, 22; population, 24; commercial and economic expansion, 32ff, 126; problems of unity and defence, 122ff; interdependence of Imperial and European affairs, 131ff; necessity for greater political and economic cohesion, 138; effect of air transport, 139; as example of Internationalism, 144; relations with Western Europe and U.S.A., 191; flying services, 289, 319; air development within, 325, 339
- British flying boat practice, 288
- British Government, the, 250, 297, 321, 331, 339, 343
- Brown, Sir J. Whitton, 249
- Bruce, Rt. Hon. Stanley, 122, 126, 128
- Burney, Commander C. D., 256
- Burma, 27
- Busteed, Squadron-Leader H. R., 68

INDEX

- Cairo, 34
Calcutta, Short flying boat, 287, 288
 Canada, 21, 27, 30, 36, 44, 48, 58, 122, 132, 229, 257, 314, 324, 336, 338; population, 24
 Canadian mining, 36
 Cane sugar trade, 95
 Cannae, 87
 Capetown, 21, 34
 Cardington, Government Airship Works at, 207, 209, 329, 330; mooring mast, 231
 Carthage, 52, 86
 Cattewater Marine Air Station, 68
 Cavendish, Henry, 202
 Chamber of Shipping of the U.K., 84
 Chamberlain, Rt. Hon. Sir Austen, 124, 129, 135
 Champs de Mars, the, 202
 Channel, the, 6, 72, 88, 89
 Channel Tunnel, the, 72, 105, 153
 Charlière, the, 203
 Charles, Professor, 202
 Chatham, 106
 Chicago, 305
 Chicanot, E. L., 36
 China, 189, 338
 Christian Religion, the, 187
 Cinematograph, the, 156
 Civil Servant in India, the, 28
 Civilisation, and the development of communications, 157*ff*, 161*ff*
 Cleveland Bridge Engineering Company, the, 235
 Coates, Rt. Hon. J. G., 125
 Colchester, 207
 Comfort, in air travel, 212, 243, 300, 316
 Commonwealth, the British, 57, 90
 Commonwealth Parliament, 50
 Communication, improvement in the means of, 157
 Communications, Ministry of, 329
 Competition, in armaments, 63, 134
 Conservatives, the, 130
 Constance, Lake, 204
 Constantinople, 305
 Cook and Sons, Ltd., Thomas, 172
 Crown Colony, 336
 Cruisers, light, 109*ff*; compared with airships, 114*ff*; in range 115, in cost, 116; and future airships, 247
 Cunard Line, the, 248
 Customs, the, 180*ff*, 324
 Cyrano de Bergerac, 201
 Czecho-Slovakia, 175*ff*
Daily Express, The, 63
 Daimler motors, 204
 Danube, the, 175
 Davis, Mr., 235
 Dawes, General, 192
 Dawson, Sir Trevor, ix
 Dease Lake, 38
 Defence, problems of, 54*ff*, 335; Great Britain, 56*ff*; contemporary aspect of, 103*ff*; Imperial and International aspects, 121*ff*; British Budget for, 326; a Ministry of, 331, 333
 De Havilland Aircraft Company, the, ix
 Diesel, engines, 210, 217, 304; oil, 234, 247
 Disarmament, 61, 152*ff*; political effects of, 154
 Disraeli, 18
 Disposals Board, the, 250
 Distance, as a bar to emigration, 27; to trade, 33; in air warfare, 77; its annihilation in the progress of civilisation, 157
Dixmude, the, 214

INDEX

- Dockyards, Naval, 105; expenditure on, 106
- Dominions, the, 6, 17, 30, 32, 34, 52, 57, 121, 325, 336; and Empire trade, 126*ff*; and Empire Defence, 129; ultimate reaction on European rivalries, 133; collaboration in Empire air development, 342
- Dornier *Supercub* flying boat, 287
- Dove, W. A., ix
- Dumont, Santos, 203
- Durban, proposed airship base at, 258
- Durr, Dr., 255
- Dutch-British Oil Company, the, 172
- Eckener, Dr., 310
- Economics, modern, 170
- Economic necessity, the results of, 177*ff*
- Economic systems, the six great, 189*ff*
- Edmonton, 38
- Educational exchanges, 49
- Egypt, 82, 86, 220, 257, 315
- Elliptical Airship, the (see Airship, the Elliptical)
- Emden*, the, 111
- Emigrant, the, 27
- Emigration, 25*ff*
- Empire Review*, *The*, 26, 31
- Empire Settlement Act, the, 25; Bill, 30
- Encyclopædia Britannica*, *The*, 208
- Engines, aeroplane, 272, 275; racing, 263; airship, 209, 210, 234; air cooled radial, 234; possibilities, 244
- England (see also Great Britain), 293, 318, 319
- English flying boat practice, 286*ff*
- Europe, 59, 96, 98, 311, 323; and British policy, 124*ff*; and its internal trade, 170, 173; and tariffs, 177; a common currency for, 178; its barriers to air travel, 180; the case for air development, 183*ff*; and America, 197
- Europeans, Western, 186
- Evening Standard*, *The*, 91
- Falmouth, 89, 293
- Federal Reserve Bank, the, 178
- Fighting Forces*, *The*, 116
- Fire, in the air, 216, 304
- Flight*, 266
- Flying (see also aircraft, aviation, float seaplanes, flying boats, airships, aeroplanes), general attitude towards, 2, 10; British attitude compared with European, 98; effect in quickening tempo of life, 159
- Flying boat, the, 21, 68, 77, 167, 245, 280*ff*, 334; future, 282*ff*; basic assumption, 282; minimum flying speed, 283*ff*; Schneider Trophy machines, 284; seaworthiness, 285; German and English designers, 286; table of comparison, 287; probable future performance, 288*ff*; compared with land machines, 300*ff*; and Atlantic crossing 305; possible routes, 315; prospects, 316; nucleus of flying Navy, 334
- Foch, Marshal, 75
- Fog, 296
- Foreign Office, the British, 57, 124, 128
- Foreign Policy, Imperial, 58, 123
- Fort Fitzgerald, 38
- France, 52, 60, 74, 83, 98, 203, 323

INDEX

- Free trade, 170, 173
 Freedom of the Air, the, 325
 Freedom of the Seas, the, 7, 163, 185, 194
 Freight, land and water, 84
 French, the, 188
 Fuel consumption, aircraft, 295; aeroplane, 264, 266, 269, 275; airship, 234; flying boat, 290
 Fuel gas, 234, 246
 Fulton, Commander Garland, 115

 Gasbags, the, 209, 255
 Geneva, 50, 111, 152, 178
Gentlemen Prefer Aeroplanes, 228
 German flying boat practice, 287ff
 Germany, 4, 17, 34, 60, 64, 74, 98, 144, 158, 174, 188, 205, 323; the first airships in, 205; Treaty with South Africa, 128; present aircraft position in, 322
 Gliding-angle, the, 283ff
 Goodyear Zeppelin Company, the, 208
 Government Airship Works, the, 209
 Government Departments, 338
Graf Zeppelin, the, 196, 218, 219, 220, 229, 254, 310; its flight of *May 1929*, 258
 Gramophone, the, 156, 244
 Gravesend, 107
 Great Britain, 250; present position, 4, 16; attitude to aviation, 22; ties to Europe compared with Imperial relations, 59; present air policy, 64; freedom from invasion, 69; naval supremacy, 71; exposure to air attack, 74ff; sea-centrality, 81ff; natural harbours, 89; salvation lies in Empire, 90; policy of drift, 93; lessons from maritime supremacy, 92ff; air miles flown compared, 98; trade routes, 110; economic development, 126; European against Imperial interests, 128; effects of air transport, 139; nerve-centre of each of three economic systems, 191; relations with U.S.A., 194ff; and the first airships, 206; and future airships, 247; importance of water landing for aircraft in, 292; cost of aircraft manufacture in, 320ff; present aircraft position, 322; a failure of leadership, 342
 Great Powers, post-war relations of the, 176
 Great War, the, 1, 65, 70, 74, 75, 110, 134, 137, 146, 150, 153, 207
 Greek Culture, 186
 Guyot, 203

 Haileybury, 37
 Haldane, Lord, 155
 Halsbury, the Earl of, 96
 Hannibal, 87
Hansard, 58, 65, 66, 74, 96, 102, 105, 107, 120, 127, 136, 155
 Harbours, 293
 Hawker Company, The, 321
 Heavier-than-air machines (see also aeroplane, flying boat, etc.), 199
 Helium, 208, 216
 Hellespont, the, 165
 Helmore, Squadron Leader, 233
 Hertzog, General, 125
 Hinkler, B., 317
 Hoare, Rt. Hon. Sir Samuel, ix, 22, 67
 Holland, 83, 94, 166
 Horrocks, W., ix
 House of Commons, the, 5, 65, 73, 102, 105, 127, 332, 336

INDEX

- House of Lords, the, 256
 Howden, ix, 330
 Howden Propulsion System, The, 233*ff*, 253
 Hungary, 175
 Hydrogen, 202, 216, 244
 Hydrogen Kerosene engine, 210, 217
 Imperial Air Communications, Report of Special Sub-Committee, 35
 Imperial Airways Limited, 270, 288, 297, 315, 324, 336
 Imperial Chemical Industries, 172
 Imperial Conference, 22, 49, 125; Report of, 19, 122
 Imperial Defence, 55*ff*, 326; Budget, 57, 129; Committee of, 66, 332
 Imperial Preference, 33, 127
 India, 21, 27, 95, 256, 257, 315, 333, 338
 Indian Air Mail, 288
 Indian air route, 98
 Indian Ocean, 108
 Indigo trade, 95
 Industry, the mechanisation of, 170*ff*
 Ingleby, Mr., 235
 Intellectual collaboration, 50
 Internal Combustion Engine, 203, 209
 International Air Congress 1923, 227
 International Combine, the, 172
 International Nickel Corporation, 172
 Internationalism, 8, 142*ff*, 160*ff*, 175
 Inventions and the State, 330
 Iraq, 333
 Ireland, 177, 249
 Irix, Blackburn flying boat, 287
 Italy, 86, 98
 Ismailia, airship base at, 257
 Jamboli, 209
 Japan, 17, 189, 338
 Karachi, airship base at, 257
 Kellogg Pact, the, 57, 132, 134, 152, 178
 Kelly, Mr., 311
 King, Rt. Hon. W. L. Mackenzie, 125
 Kenworthy, Commander J. M., 332
 L33, 207
 L57, 209
 Lakehurst, 222, 227, 228, 229
 Lakes, future importance of, 293
 Land, the, as means of communication, 161
 Landing, method of aircraft, 283; on water, 237*ff*, 293; permits, 324
 Latin America, the States of, 189
 Law of the Air, the, 186, 325
 Law of the Sea, the, 185
 Lawrence, Sir Herbert, ix
 League Covenant, the, 61, 69
 League of Nations, the, 50, 64, 132, 134, 137, 178; and licensing of aircraft, 323; to be in control of civil aviation, 323*ff*
 Lighter-than-air machines (see also airships, balloons), 199*ff*
 Lindbergh, Colonel, 265, 320
 London, 21, 33, 74*ff*, 91, 108, 303; Port of, 107
 London—Egypt route, 220, 235
 London—New York, 308*ff*
 London—Paris route, 269*ff*, 280, 287, 295
 London—Rome route, 276
 Los Angeles, the, 209, 218, 220, 227, 254, 303
 Louis XVI, King, 201

INDEX

- Romar*, the Rohrbach flying boat, 287
- Rome, 33, 46, 53, 82, 86*ff*
- Rosendahl, Commander Charles, 227, 228
- Rouyn Goldfield, the, 37
- Royal Air Force, the, 65*ff*; 68, 100*ff*, 113, 326, 327; compared with Navy, 102, 332*ff*
- Roumania, 175
- Rubber, solubility discovered, 202
- Runciman, Rt. Hon. Walter, 84
- Russia (see also Soviet Russia), 18, 77, 98, 174, 179, 189
- Ryan monoplane, the, 266, 273, 274, 278, 282
- 'Safe-guarding,' 170, 173
- San Francisco, 305
- Schneider Trophy monoplanes, the, 284
- Science and Invention*, 228
- Scott, Major, 227
- Sea, the, 83, 96; as means of communication, 162*ff*, 166
- Sea-centrality, 71, 80*ff*, 81a and 81b (maps), 121, 164, 292; and trade centrality, 88
- Seaplane (see also flying boat), float, 280*ff*; racing, 263
- Sea-power, 7, 71, 92*ff*, 97, 100*ff*
- Secretary of State for Air, 66, 256, 297, 330, 331
- Secretary of United States Navy, 271
- Seeley, 93
- Self-interest, as a bond of unity, 42*ff*
- Sentiment as an aid to Empire development, 41
- Sheerness, 106
- Shell, gas, 75*ff*
- Shenandoah*, the, 208, 214, 215; 233
- Shipping enterprises, State, 338
- Short *Calcutta* flying boat, the, 287, 288
- Sicily, 46
- Sigrist, Mr., 321
- Singapore, naval base at, 106*ff*, 130
- Slave Lake, 38
- Snow, and airships, 229, 304, 308, 314
- Society of Naval Architects, the, 115
- Somerville, A. A., 31
- South Africa, 27, 58, 122, 125, 128, 132, 315, 336, 338
- South America, 324
- Southampton Water, 282
- South Atlantic, the, 315
- Southern Railway, the, 183
- Soviet Russia, 143, 152, 176
- Spain, 46, 52, 82, 87, 94
- Spanner, E. F. S., 226, 227, 228
- Sparta, 164
- Speed of aeroplanes, 261*ff*, 267, 275, 277; of airships, 218, 242, 243*ff*, 306; of flying boats, 283*ff*, 288*ff*; minimum flying, 269*ff*, 284*ff*
- Sphere, The*, 229
- Steam engine, the, 204
- Steel Cartel, the, 172
- Straits of Gibraltar, 165
- Strength of England, The*, 81
- Submarine, the, 71, 102, 116, 151
- Subsidies, 297, 336
- Sudan, the, 333
- Sugar-beet industry, the, 336
- Sunday Express, The*, 96
- Sunday Times, The*, 68
- Supermarine Napier flying boats, 68
- Superwal*, the Dornier flying boat, 287
- Sydney Morning Herald*, the, 130

INDEX

- Pacific Ocean, the, 107, 130, 315
 Pacifist Group, the, 62
 Palmer, A. E., ix
 Paris, 74, 75, 201, 202, 203, 265, 276, 305
 Parliament, 65, 79, 335
 Passenger routes, world, 338
Patoka, the, 257
 Pay load, the, 241, 242, 295; for *R100* and *R101*, 220; for elliptical airship, 240*ff*; airships, 306*ff*; aeroplanes, 274, 277; flying boats, 301
 Peace, as a positive issue, 155; modern assets, 156
 Peace River District, 30
 Peloponnesian War, the, 164
 Pembroke, 293
 Pennsylvania, 311
 Performance, aircraft, reduction from theory to practice, 294*ff*
 Pericles, 52
 Persian Gulf, the, 68
 Petrol, as airship fuel, 216*ff*, 234
 Pig-iron, comparative production
 Pilâtre de Rozier, 201 [of, 17
 Pirandello, 47
 Poison gas, 76, 151
 Poland, 132
 Poole, 293
 Pope, the, 323
 Population, redistribution of, 24*ff*
 Port of London Authority, 106
 Portland, 293
 Portugal, 83, 94, 166
 Postmaster-General, British, 311*ff*; United States, 312
 Prague, 176
 Prime Minister of Australia (see Bruce); of Canada (see King, Mackenzie); of New Zealand (see Coates); of Union of South Africa (see Hertzog, General)
 Prince Rupert, 38
 Private aeroplanes, 300, 301, 315, 316*ff*
 Prospecting by air, 37*ff*
 Queensland, 31
 Queensland and Northern Territory Aerial Services, Limited, The, 36
R33, 120, 307, 227
R34, 207, 249
R38, 207, 214, 250
R100, ix, 11, 115, 196*ff*, 234, 241, 243, 250, 251, 254, 310, 330; description of, 208*ff*; measurements, 210; capacity, 212; handling, 213; strength, 215; fire resistance, 216; speed, 218*ff*; paying load, 220*ff*, 240; result of increasing speed, 221*ff*; effect of change of temperature on, 224; and snow, 229; handling on ground, 231; problem of its construction, 252*ff*; the envelope, 254; gasbags, 255; finance, 256; conclusions, 257*ff*; cost of, 337
R101, description of, 209*ff*; paying load, 220*ff*; cost of, 337
 Railways, 158, 179, 309, 316
 Range, of aircraft, commercial against designed, 296*ff*; airship against flying boat, 297, 315*ff*
 Rationalisation, 92
 Ravenna, 46
 Regulations, Air Ministry, 320*ff*
 Research, 341
 Rhine, the, 132
 Rhodesia, 27, 40, 44
 Robert (the mechanics), 202
 Rohrbach *Romar* flying boat, the 287
 Rolls Royce engines, 209, 210
 Roman Empire, the, 87, 165, 166
 Roman Law, 186

INDEX

- Pacific Ocean, the, 107, 130, 315
 Pacifist Group, the, 62
 Palmer, A. E., ix
 Paris, 74, 75, 201, 202, 203, 265, 276, 305
 Parliament, 65, 79, 335
 Passenger routes, world, 338
Patoka, the, 257
 Pay load, the, 241, 242, 295; for *R100* and *R101*, 220; for elliptical airship, 240*ff*; airships, 306*ff*; aeroplanes, 274, 277; flying boats, 301
 Peace, as a positive issue, 155; modern assets, 156
 Peace River District, 30
 Peloponnesian War, the, 164
 Pembroke, 293
 Pennsylvania, 311
 Performance, aircraft, reduction from theory to practice, 294*ff*
 Pericles, 52
 Persian Gulf, the, 68
 Petrol, as airship fuel, 216*ff*, 234
 Pig-iron, comparative production
 Pilâtre de Rozier, 201 [of, 17
 Pirandello, 47
 Poison gas, 76, 151
 Poland, 132
 Poole, 293
 Pope, the, 323
 Population, redistribution of, 24*ff*
 Port of London Authority, 106
 Portland, 293
 Portugal, 83, 94, 166
 Postmaster-General, British, 311*ff*;
 United States, 312
 Prague, 176
 Prime Minister of Australia (see Bruce); of Canada (see King, Mackenzie); of New Zealand (see Coates); of Union of South Africa (see Hertzog, General)
 Prince Rupert, 38
 Private aeroplanes, 300, 301, 315, 316*ff*
 Prospecting by air, 37*ff*
 Queensland, 31
 Queensland and Northern Territory Aerial Services, Limited, The, 36
R33, 120, 307, 227
R34, 207, 249
R38, 207, 214, 250
R100, ix, 11, 115, 196*ff*, 234, 241, 243, 250, 251, 254, 310, 330; description of, 208*ff*; measurements, 210; capacity, 212; handling, 213; strength, 215; fire resistance, 216; speed, 218*ff*; paying load, 220*ff*, 240; result of increasing speed, 221*ff*; effect of change of temperature on, 224; and snow, 229; handling on ground, 231; problem of its construction, 252*ff*; the envelope, 254; gasbags, 255; finance, 256; conclusions, 257*ff*; cost of, 337
R101, description of, 209*ff*; paying load, 220*ff*; cost of, 337
 Railways, 158, 179, 309, 316
 Range, of aircraft, commercial against designed, 296*ff*; airship against flying boat, 297, 315*ff*
 Rationalisation, 92
 Ravenna, 46
 Regulations, Air Ministry, 320*ff*
 Research, 341
 Rhine, the, 132
 Rhodesia, 27, 40, 44
 Robert (the mechanics), 202
 Rohrbach *Romar* flying boat, the, 287
 Rolls Royce engines, 209, 210
 Roman Empire, the, 87, 165, 166
 Roman Law, 186

INDEX

- Tariff barriers, 170, 173*ff*; their abandonment, 177
- Taxi' machines, 300, 301, 315, 316
- Teed, Major, ix
- Telegraph Creek, 38
- Temiskaming, Lake, 37
- Temple, J. E., ix
- Tennyson, 146
- This Airship Business*, 226
- Thomson, Lord, ix, 256
- Tilbury, 197
- Times, The*, 321
- Trade-centrality, 88, 92
- Transatlantic crossing, the, 196, 209, 222, 241, 248, 249, 302; causes of possible failure, 303*ff*; prospects of airship service, 306*ff*; weather conditions, 307*ff*; punctuality, 309; frequency, 310; fares and finance, 310*ff*; mail, 311*ff*
- Transport, cost by water and by land, 84
- Treasury, the British, 57
- Treaty of Versailles, the, 64
- Trust, the, 172
- Turin, 276
- Unemployment, 26, 127
- United States, the, 4, 17, 18, 34, 40, 52, 88, 90*ff*, 98, 110, 126-7, 152, 158, 171, 173, 190, 209, 216, 253, 254, 297, 303, 311, 318, 323, 338; population, 24; buying power, 91; attitude to Europe, 136; and the Great War, 137; as example of Internationalism, 144; naval policy, 194; airship development in, 207, 227, 257; Congress, 311; Meteorological Board, 308; Mail, 312*ff*; airship service to, 306*ff*; cost of aircraft manufacture in, 320; present aircraft position in, 321, 324
- United States of Europe, A, 7, 145, 157, 175, 177*ff*, 182, 187
- Venice, 46
- Vickers, Douglas, ix
- Vickers Limited, Messrs., 209
- Vickers Variable Speed Gear Company, the, 235
- Vienna, 175
- Virgil, 53
- Wagon-Lit Company, the, 172
- Wallis, B. N., ix, 251
- War, modern attitude towards, 146, 153
- War, The Great, 1, 65, 70, 74, 75, 110, 134, 137, 146, 150, 153, 207
- War Office, the, 80, 153
- Wardlaw-Milne, Mr., 30
- Warfare, modern, its development, 146*ff*
- Washington, 136
- Washington Conference, the, 109, 112
- Watson, J., ix
- Way the World is Going, The*, 180
- Weigall, Sir Archibald, 26
- Wellington, 46
- Wells, H. G., 180
- West Indies, 95
- Western Australia, 24, 32
- Williams, Basil, 18, 19
- Williamson, Brig.-Gen. F. H., 226
- Wind Tunnels, 341
- Wireless, 156, 244
- Woolworth's, 172
- World To-day, The*, 36
- World-State, the, 142, 157, 198
- Wrangel Island, 38

INDEX

Yugoslavia, 275
Yukon, 37

Zeppelin, Count von, 204
Zeppelin Company, the, 255

Zeppelin, the first, 204; the second,
third and fourth, 205; com-
parison of war-time with modern,
219
Zodiac Company, the French, 207
Zürich, 293

~~CHECKED~~
~~200304~~