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No. 9218

REPORTS
OF
THE CIVIL AERIAL TRANSPORT COMMITTEE
WITH
APPENDICES.

Presented to Parliament by Command of His Majesty.



LONDON:

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NOTE.

Owing to the fact that much of the information upon which the Reports both of the Committee and of its Special Committees were based, was confidential or secret, it has been found impossible to present the Reports to the public in their original and complete form. Excisions of passages in the Reports or of Appendices are indicated by asterisks and footnotes.

CIVIL AERIAL TRANSPORT COMMITTEE.

This Committee was appointed on May 22nd, 1917, to consider and report to the Air Board* with regard to:—

1. The steps which should be taken with a view to the development and regulation after the War of aviation for civil and commercial purposes from a domestic, and imperial, and an international standpoint.
2. The extent to which it will be possible to utilise for the above purpose the trained personnel and the aircraft which the conclusion of Peace may leave surplus to the requirements of the Naval and Military Air Services of the United Kingdom and Overseas Dominions.

*At the dates on which the Reports of the Committee were presented the Air Council had replaced the Air Board.

LIST OF MEMBERS.

The following list gives the names of the members of the Committee as originally appointed, and of the Departments, etc., represented by them.

*Viscount Northcliffe	Chairman.
Major Baird, C.M.G., D.S.O., M.P.	Deputy Chairman.
The Duke of Atholl, K.T., D.S.O.	
Mr. A. E. Berriman, O.B.E.	
Major-General W. S. Brancker, A.F.C.	Air Ministry.
Mr. J. H. Balfour Browne, K.C.	
Sir M. D. Chalmers, K.C.B.	Home Office.
Mr. G. B. Cockburn, O.B.E.	
†The Earl of Drogheda	Foreign Office.
Mr. G. E. A. Grindle, C.M.G.	Colonial Office.
Sir Laurence Guillemard, K.C.B.	Board of Customs and Excise.
Mr. G. Holt-Thomas	
Mr. Claude Johnson. (Resigned 11th March, 1918.)	
Mr. W. Joynton Hicks, M.P.	
Mr. F. W. Lanchester. (Resigned 21st February, 1918.)	
Sir Thomas Mackenzie, K.C.M.G.	Dominion of New Zealand.
Brig.-General E. M. Maitland, D.S.O.	
Major-General Sir J. W. McCay, K.C.M.G., C.B.	Commonwealth of Australia.
Brig.-General Lord Montagu, C.S.I.	India Office.
Mr. G. E. P. Murray, C.B.	General Post Office.
Lieut.-Colonel M. O'Gorman, C.B.	
†The Hon. Sir G. H. Perley, K.C.M.G.	Dominion of Canada.
*Colonel J. C. Porte, C.M.G.	
Col. J. W. Pringle	Board of Trade.
Major-General Ruck, C.B., C.M.G.	
Rt. Hon. W. P. Schreiner, C.M.G., K.C.	Union of South Africa.
Sir Napier Shaw, LL.D., F.R.S.	Meteorological Office.
Mr. J. D. Siddeley, C.B.E.	
Mr. T. Sopwith, C.B.E.	
Lord Sydenham, G.C.S.I., G.C.M.G., G.B.E. (Resigned 11th February, 1918.)	
Brig.-General A. V. Vyvyan, D.S.O.	Admiralty.
Mr. H. G. Wells	
Mr. H. White-Smith	
Mr. W. Tyson Wilson, M.P. (Resigned 16th June, 1917.)	

*Viscount Northcliffe was called away on a mission to the United States after the First Meeting, May 31st, 1917, and from that time down to the date on which the Final Report was presented, Major Baird acted as Chairman of the Committee.

† Lord Drogheda resigned on January 31st, 1918, and the Hon. C. H. Tufton, C.M.G., was appointed in his place to represent the Foreign Office.

‡ Lieut.-Colonel E. R. Wayland represented Sir G. Perley on all the Special Committees, and, when necessary, at meetings of the Main Committee.

The following, who had been co-opted as members of the Special Committees, were appointed members of the Main Committee on December 12th, 1917:—

Mr. Butler Aspinall, K.C.	Sir Frank Heath, K.C.B.
Mr. Leonard Bairstow, C.B.E., F.R.S.	Colonel H. G. Lyons, F.R.S.
Major the Right Hon. H. T. Baker, M.P.	Mr. Arthur Morley.
Captain F. S. Barnwell, O.B.E.	Professor J. E. Petavel, F.R.S.
Mr. R. O. Cary, O.B.E.	Mr. Frank Pick.
Mr. A. E. L. Chorlton, C.B.E.	Major E. Elvey Robb.
Mr. W. Barnard Faraday.	Colonel the Master of Sempill.
Sir R. T. Glazebrook, C.B., F.R.S.	Major T. Vincent Smith, M.C.
Brig.-General R. M. Groves, C.B., D.S.O., A.F.C.	Major G. I. Taylor.
Mr. Neville Gwynne.	Mr. A. E. Turner.
	Mr. H. J. Wilson.

The following were also appointed members of the Main Committee:—

December 1st, 1917.	The Right Hon. Lord Morris, K.C.M.G. (representing Newfoundland).
March 9th, 1918.	Colonel P. N. Buckley (additional representative of the Commonwealth of Australia).
March 13th, 1918.	*Lieut.-Colonel D. H. Hyde Thomson.
" "	Lieut.-Colonel J. T. C. Moore-Brabazon, M.C.
" "	Lieut.-Colonel W. Lockwood Marsh.
February 5th, 1918.	The Hon. C. H. Tufton, C.M.G. (See note † above.)

*Colonel Hyde Thomson was killed in a flying accident on May 21st, 1918.

SECRETARIAT.

Mr. D. O. Malcolm, Secretary.
 Captain E. H. Tindal Atkinson, Assistant Secretary.
 Mr. H. Harper, Assistant Secretary (Technical).

TABLE OF CONTENTS.

	PAGE.
Interim Report of the Committee on International Questions	5
† Appendix to Interim Report (Draft French Postal Agreement)	—
Final Report of the Committee	7
Reservation to the Final Report, by Major Baird	16
" " " " " , Mr. Frank Pick	16
APPENDIX I.: Report of Special Committee No. 1 on Law and Policy.	
Part I. International Law	19
Part II. Municipal Control and Legislation	20
Appendices to Report of Special Committee No. 1:	
Appendix A: Draft International Convention, 1910	25
Appendix B: Aerial Navigation Bill, 1911	36
Appendix C: Recommendations as to drafting amendments to the Aerial Navigation Bill... ..	40
APPENDIX II. Interim Report of Special Committee No. 2 on technical and practical questions of aerial transport	41
Appendices to the Interim Report of Special Committee No. 2:	
† Appendix A: Report of Col. O'Gorman and Mr. Bairstow on four types of aeroplane	—
† Appendix B: Report by Brig.-General Maitland on the rigid airship	—
† Appendix C: Report by Col. O'Gorman and Mr. Bairstow as to the effect in a thousand-mile journey of an adverse wind in the case of aeroplanes	—
Appendix D: Report by Brig.-General Maitland as to the effect in a thousand-mile journey of an adverse wind in the case of rigid airships	—
Appendix E: Report by Mr. Harper on an experimental air mail service	49
Appendix F: Flying rules of the Royal Aero Club	50
Appendix G: Report on weather service by Brig.-General Lord Montagu and Major Taylor	50
Appendix H: Report on wireless communication, by Col. O'Gorman and Major Vincent Smith... ..	—
Appendix I: Report by Brig.-General Maitland and Col. O'Gorman on safety appliances	52
Appendix J.: Report by Col. O'Gorman, Mr. Holt Thomas, and Mr. Lanchester as to a main or terminal aerodrome	53
Appendix K: Report by Major Robb on intermediate landing grounds	54
APPENDIX III. Final Report of Special Committee No. 2.	55
Appendices to the Final Report of Special Committee No. 2:	
Appendix A: The Airship for Commercial Purposes, by Brig.-General Maitland	57
Appendix B: Correspondence respecting fog on the coast of Newfoundland	58
Appendix C: Revised memorandum by Mr. Harper on an experimental air mail service	58
† Appendix D: Diagram of lighting of landing grounds	—
Appendix E. (Now incorporated in Appendix A to Report of Special Committee No. 1.)	
APPENDIX IV. Report of Special Committee No. 3 on business questions relating to the aircraft industry and aerial services	60
† Appendix to the Report of Special Committee No. 3. Memorandum by Mr. Turner on the position of the Aeronautical Industry on the termination of hostilities	—
APPENDIX V. Supplementary Report of Special Committee No. 3	63
Summary of Reports of Special Committee No. 3	65
APPENDIX VI. Report of Special Committee No. 4 on Labour	66
Minority Report by the Chairman, Mr. H. G. Wells	68
APPENDIX VII. Interim and Final Reports of Special Committee No. 5 on Research and Expert Education:	
Part I. Research	71
Part II. Education	74
Appendices to the Reports of Special Committee No. 5:	
Appendix A: Report by Sir R. T. Glazebrook and Professor Petavel on the preparation of an Aeronautical Treatise	77
Appendix B: Memorandum by Lt.-Colonel Lyons on Research in regard to Meteorology	78
Appendix C: Letter from Sir Napier Shaw to the Secretary as to meteorological services in aid of aerial transport	79
† Appendix D: Letter from the Secretary to Sir Napier Shaw and his reply thereto as to Meteorological Establishments	—
Appendix E: Memorandum by Captain Hucks and Mr. Harper as to accidents and accident investigation... ..	80

CIVIL AERIAL TRANSPORT COMMITTEE.

INTERIM REPORT OF THE COMMITTEE AS TO THE INTERNATIONAL ASPECTS OF CIVIL AERIAL TRANSPORT.

To the Air Council:—

1. By our terms of reference we were invited *inter alia* to consider the development and regulation of civil aerial transport from an international standpoint. We have been informed by the Foreign Office that in the opinion of that Department, if it is desired to set on foot negotiations for the conclusion of an International Aeronautical Convention, no time should be lost in approaching certain Allied and friendly Governments. We therefore think it desirable to submit an Interim Report on this branch of our subject at once.

2. At the outset of our enquiry we found it necessary to divide the subjects covered by our terms of reference under various heads, and to refer these different heads to special committees for detailed investigation. One of the branches of enquiry so referred comprised international and legal problems, and Special Committee No. 1, who have dealt with these problems, have presented a report* which, as far as it concerns international questions, has generally been approved by us. We think it will be found convenient that we should enclose herewith this Report in its entirety, and that we should draw attention to certain salient points which seem to us to call for emphasis or comment. We shall deal in a further report with the latter part of the report of Special Committee No. 1, which is concerned with questions of municipal legislation.

3. It will be observed that the Special Committee, in considering the first part of their subject, have taken as a basis the Draft International Convention drafted by the Conference held at Paris in 1910 (Appendix A to their report). This Conference was unable to complete a draft convention for ratification by the Contracting Powers, mainly owing to a conflict of opinion between the British and German delegations as to the right of each State to the sovereignty (or to the exercise of control and jurisdiction, whichever term be preferred) in the air space over its territories. In our opinion this question of sovereignty is one upon which agreement between the Contracting Powers is vital in the future interests of civil aerial transport.

4. It is a question on which it is possible to hold different opinions: indeed, some divergence of view with regard to it has manifested itself on our Committee. It must, of course, be admitted that a State must assert some rights of sovereignty in the air space over its territories, since otherwise no legal control could be exercised over aircraft in flight at however low an altitude, but it is possible to take the view either (a) that State Sovereignty should be asserted *usque ad coelum*, or (b) that State sovereignty should be asserted only up to some prescribed level of altitude, above which the flight of aircraft would still be practicable, and that above that altitude the air should be free to all, just as the high seas outside the limits of territorial waters are free to all.

5. From the purely business point of view of the prospects of civil aerial transport in times of peace, the latter view has much to recommend it. The commercial advantages of air traffic are to be expected mainly from rapid uninterrupted flights over long distances, and these advantages would be clearly best secured if aircraft above a certain altitude were allowed to fly freely in any direction without let or hindrance imposed upon them by the municipal legislation of the States over whose territories they might pass.

* * * * *

6. The argument, however, for the doctrine of State sovereignty in the air space *usque ad coelum* is in the main a military one. Military considerations dictated the opposition of the British delegates to the proposals pressed by the German representatives at the Conference in Paris in 1910, and we understand that the views of the Foreign Office and of the naval and military advisers of the Crown are unchanged. To give to foreign aircraft, as a matter of acknowledged international law, the right to fly at will over the territory of the State would be to give them undesirable opportunities for espionage, and generally to limit "the elementary right of a State to take each and every measure which it considers necessary for self-preservation."† In time of war, moreover, the doctrine of the "freedom of the air" above a certain altitude would give rise to most embarrassing questions for neutral States. They would actually be exposed to the risk of having aerial battles fought over their territory without being able to claim that their neutrality had been infringed. The case of the upper air presents no true analogy to the case of the high seas outside the limits of territorial waters.

7. The experience of the present war has merely served to increase the force of these considerations, and we agree with the Special Committee that the doctrine of State sovereignty in the air space *usque ad coelum*, on which this country acted before the war, and on which, along with neutral countries, it still acts, is sound, and should be adopted as the basis alike of international agreement and of municipal legislation.

8. As far as the doctrine of sovereignty may be applicable to territorial waters, we agree with the conclusion of the Special Committee that the air space over such waters must be considered from the same

* See Appendix I. p. 19.

† Foreign Office memorandum enclosed in despatch to H.M. representatives abroad of 29th July, 1910.

point of view as the air space over the land of the State. We desire, however, to point out that the questions of sovereignty over and of any extension of the limits of territorial waters are primarily the concern of the Admiralty, and that military rather than civil considerations must be regarded as of major importance in this connection.

* * * * *

10. We approve the detailed conclusions of the Special Committee set out in Appendix A to their report. The technical regulations contained in Annex C of the Draft International Convention (see Appendix A) were referred to Special Committee No. 2 of our Committee, and we further approve their detailed recommendations. Recent developments in the science and practice of aeronautics have rendered necessary some amendments of regulations agreed to in 1910, more particularly since such regulations were at that date considered from the aspect of the use of airships rather than of aeroplanes.

11. In paragraph 10 (i) of Part I. of their Report the Special Committee have touched upon an important question which was not considered by the Conference held in Paris in 1910. We think that the possibility of damage done by foreign aircraft visiting this country is a matter for careful consideration when it is remembered that, unless an aircraft is itself damaged, the owner of it is in a peculiarly advantageous position as regards escape from the legal consequences of his act. We agree with the Special Committee that, if some system of insurance could be mutually arranged between the Contracting Powers, or at least between H.M.G. and the States whose aircraft are most likely to visit this country and over whose territories our own aircraft are most likely to fly, such an arrangement would be of distinct advantage to civil aerial transport.

12. Having regard to paragraph 10 (ii) of the Report of Special Committee No. 1, we hold a strong view that some international agreement which will permit of the utilisation of aerial routes immediately after the war is of urgent importance for the purpose of encouraging civil aerial transport, and that therefore early steps should be taken to enter into the necessary negotiations.

13. * * * * *

* * * * *

For the Civil Aerial Transport Committee.

(Signed) JOHN BAIRD,

(Acting Chairman)

7th February, 1918.

(Signed) D. O. Malcolm,

(Secretary.)

APPENDIX.*

* Not printed, see note on p. 2.

CIVIL AERIAL TRANSPORT COMMITTEE.

FINAL REPORT OF THE COMMITTEE.

To The Air Council.

INTRODUCTION.

1. The terms of reference under which we, the Civil Aerial Transport Committee, were appointed are as follows :—

To consider and report to the Air Board with regard to :

1. The steps which should be taken with a view to the development and regulation after the War of aviation for civil and commercial purposes from a domestic, and imperial, and an international standpoint.
2. The extent to which it will be possible to utilise for the above purpose the trained personnel and the aircraft which the conclusion of Peace may leave surplus to the requirements of the Naval and Military Air Services of the United Kingdom and Overseas Dominions.

2. As explained in paragraph 2 of our Interim Report on International Questions, the subjects covered by these terms of reference were of such a wide character and required so much detailed investigation that we thought it advisable to divide them into five headings, which were referred to five Special Committees. These headings were broadly as follows :

1. Questions of Law and Policy.
2. Technical and practical questions as to the possibilities of performance of aircraft and as to the requirements of aerial services.
3. Business questions relating to the position of the aircraft manufacturing industry after the war, the probabilities of the establishment of aerial transport services and the steps which would be necessary for the maintenance of this industry and for the development of these services.
4. Questions of Labour arising in the aircraft manufacturing industry and in aerial transport services.
5. Problems of scientific research and the special education of expert designers, engineers, and pilots.

The successive chapters of this Report follow the above headings.

3. These five Special Committees have all presented reports to us, and these reports have been carefully considered. They contain the results of much labour and careful enquiry, and though our general conclusions in the present report may not always be wholly in agreement with those expressed in the Special Committees' reports, we have attached them as *Appendices to this Report, in the belief that they will be of great assistance to the Air Council in the study of the various problems connected with civil aerial transport.

4. In view of the fact that our Interim Report on International Questions dealt with the first part of the report of Special Committee No. 1, it would seem the most convenient course to commence the present report by setting out our conclusions on the problems of municipal control and legislation treated of in the second part of that Special Committee's report. Many of the regulations which will govern aerial transport will be applicable to foreign aircraft as well as to our own, and regulations of this character should, in the event of some International Convention being arranged, be in accord with the terms of such Convention.

CHAPTER I.

Municipal Control and Legislation.

1. The necessity for some legislation as to aerial transport is sufficiently indicated in the report of Special Committee No. 1.† We adopt the view of that Special Committee in approving the general lines upon which the Aerial Navigation Bill (see Appendix B to their Report) is drawn. Before proceeding to a detailed consideration of its Clauses we offer the following general observations.

2. We think that the claim to full and absolute sovereignty should be emphasised in the preamble to the Bill for the reasons already suggested in our Interim Report.

3. The Bill itself is drawn in such a manner as to leave to Government Departments power to issue regulations and to clothe them with a considerable discretion as to the scope of these regulations. The Bill as drawn has taken the Merchant Shipping Acts as the model for many of its Clauses, *e.g.*, as to registration, certificates of airworthiness, and collision regulations. For this reason it is proposed in the Bill that the Home Office should be responsible for general regulations as to flying and for matters in which the police are concerned, and the Board of Trade for administrative regulations of the kind indicated above.

4. The Special Committee have expressed a definite opinion that all the powers and duties of regulating aerial transport should be assigned to the Air Ministry. This proposal offers certain advantages in grouping in one Department officials and experts responsible for the issue and administration of regulations, which in the present case must to a great extent be governed by naval and military considerations. As an illustration, it is only necessary to refer to the close connection between prescribed landing places for foreign aircraft and prohibited areas. As against the proposal the analogy of railways and shipping seems logically to point to the desirability of assigning aerial transport to the Government Department primarily concerned with trade and commerce, *i.e.*, to the Board of Trade. If the former view, which we consider the

* These follow the Final Report and reservations as Appendices I.—VII. on pp. 19 *et seq.* Appendices to the reports of the Special Committees follow each of these reports and are lettered A, B, etc.

† See Appendix I. p. 19.

preferable one, be adopted, some legislation in extension of the Air Force (Constitution) Act, 1917, would seem to be necessary to enable the Air Ministry to create the organisation required to deal with civil as distinct from military flying.

5. The Clauses of the Aerial Navigation Bill itself have been closely examined by Special Committee No. 1. We do not propose to deal with them *seriatim*, and think it better to state that, generally speaking, subject to two modifications noted below, we approve of the detailed conclusions arrived at by the Special Committee.

6. Of the general regulations contemplated in Clause 1, those which will prescribe prohibited zones and landing areas for foreign aircraft are probably the most important. We have already referred (in our Interim Report, paragraphs 5 and 9) to the desirability of liberal treatment in the admission of foreign aircraft to this country.

7. The Bill adopts as the criterion of British nationality in the case of aircraft the nationality of the owner. (See Clause 2.) Probably the most difficult problems as to nationality will arise in relation to ownership by companies, and we desire to draw particular attention to the recommendations of Special Committee No. 1 as to the conditions on which aircraft owned by Companies should be deemed to be British aircraft. The provisions as to registration do not call for comment.

8. We note with approval the recommendations of Special Committee No. 1 as to limiting the necessity for certificates of airworthiness (see Clause 4 of the Bill). The Clause as originally drawn would involve the possibility of individual aircraft being subjected to stringent tests and examinations, which in our view would be unnecessary, and which, to be of any use, would require to be repeated at very frequent intervals. The question is one of considerable importance, since the recognition of foreign certificates in the case of international flying is a matter which must be dealt with in any International Convention.

9. As to certificates of competency for navigators (see Clause 5), we find ourselves not in entire agreement with Special Committee No. 1, who in their report approved Clause 5 of the Bill as originally drawn. We think that, while it should be obligatory on all navigators in charge of aircraft carrying goods or passengers to possess certificates of competency, and while the appropriate Government Department should have power to require certification of navigators in all cases, it should be left to such department to decide whether or not certification of navigators of, *e.g.*, private aircraft should be enforced by regulation. It seems to us that the safety of the public will probably be sufficiently ensured by the interest of the private navigator in acquiring sufficient skill to ensure his own safety. Since certificates of competency will be required on all occasions when aircraft of any kind are used in flying over foreign territory, the number of private navigators not taking out certificates will probably be small, in the event of no regulations being issued applicable to them. The absence of obligatory certificates, in the first instance, in the case of the private navigator, seems to us to be reasonable in the interests of the early development of civil flying.

10. The collision and signals of distress regulations, to the provision of which Clauses 6 and 9 of the Bill are directed, have already been referred to in Paragraph 10 of our Interim Report. We have approved the view there expressed that the collision rules of the Royal Aero Club should be taken as a basis for the collision regulations. Signals of distress regulations are at present the subject of expert enquiry. In view of the fact that regulations of both these kinds must be discussed primarily from the international point of view, we do not think it advisable to offer recommendations of a more detailed nature than those contained in Appendix A to the Report of Special Committee No. 1.

11. The recommendations of Special Committee No. 1 as to regulations relating to identification and aircraft papers (see Clauses 7 and 8 of the Bill) and as to Clauses 10 and 11 of the Bill do not appear to call for any comment.

12. Clause 12 of the Bill is of the greatest importance as affecting the general rights of landowners in the air space over their land. This right has generally been recognised in English law to extend *usque ad coelum*, and, although some authorities have held that the right only extends to a height sufficient for the reasonable enjoyment of the land, any application of the *usque ad coelum* doctrine in its entirety would be fatal to the development of aeronautics. The Clause as originally drafted in the Bill relieved the owner of aircraft from liability for trespass in respect of his flight over land in the British Islands, but preserved the common law rights and remedies of persons in respect of injury to property or person caused by the aircraft or by any person carried therein. We agree with Special Committee No. 1 that the clause does not proceed far enough in determining the respective rights and liabilities of the owner of aircraft and the landowner, and we adopt the suggestions of the Special Committee to extend the provisions of the Clause in the manner indicated in their report. These suggestions may be looked at from two points of view, *viz.*, the remedies of persons on land for trespass or material damage to their property and their remedies for nuisance.

Admittedly persons on land are practically powerless to ensure their own safety by precautionary measures against damage caused by the fall of aircraft or of objects carried therein. It is a matter of some doubt whether under existing principles of law persons suffering such damage would be called on to prove an affirmative case of negligence or intentional trespass. It is possible that the Courts might hold aircraft to be within the class of those things which the owner keeps or uses at his peril. We think it preferable that the principles applicable should be defined by legislation rather than that they should be left for solution by a series of judicial decisions; we think, too, that as far as damage done by aircraft is concerned the deprivation of the landowner of what is almost certainly an existing right of property should be compensated by what will be in effect an insurance of himself and his property against such damage. Nor do we think that in practice the expense of insuring himself against third party risks will prove very burdensome to the owner of aircraft.

As affecting the question of nuisance or trespass to the property of the landowner in the air space above his land, we have given careful consideration to the possibility of defining some altitude, flying below which would involve a civil liability on the owner of aircraft. We have come to the conclusion that to attempt to prescribe any such altitude is impracticable, and that it will be sufficient to protect the landowner by giving him a specific right of action for damages for actual nuisance caused in breach of flying regulations in the manner suggested by Special Committee No. 1. Since nuisances by aircraft are most likely to arise in connec-

tion with the ascent from and landing at aerodromes, we recommend that special attention should be paid to the flying regulations applicable to such ascent and landing.

13. We do not desire to add anything to the recommendations of Special Committee No. 1 as to Clauses 13-22 inclusive and Clause 24 of the Bill.

14. With regard to Clause 23, which defines, as between the United Kingdom and the remainder of the Empire, the extent to which the provisions of the Bill are to apply, we desire to emphasise alike the importance of uniform legislation, so far as possible, throughout the Empire on aeronautical matters, and of avoiding any appearance of dictating to the Dominions or of infringing in any way their local autonomy. In our view, the clause rightly applies universally throughout the Empire the provisions of an international character—namely, those relating to registration, collisions, aircraft papers, and signals of distress—and we hope that H.M. Government will take steps to circulate the Bill, in the form in which they may themselves adopt it, to the various Dominion and Colonial Governments, so that the latter may have an opportunity of considering whether they will adopt it, with or without modifications to suit local conditions, for their own territories, and, if so, of expressing their views as to the means to be employed for applying it to those territories.

15. In the remaining paragraphs of their Report Special Committee No. 1 have dealt with various questions relating to aerodromes. We approve their recommendations, and we would emphasise the suggestion made in paragraph 11 of Part II. of their Report that the clauses necessary to give effect thereto should be added to the Bill.

CHAPTER II.

Technical and Practical Questions as to the Possibilities of Performance of Aircraft, and as to the Requirements of Aerial Services.

1. The reports of Special Committee No. 2*, which are primarily concerned with the practical possibilities of aeronautics from a scientific and technical point of view, are in the main of so highly technical a character as to make them unsuitable for detailed examination in this Report. Attached to them will be found a series of appendices the generl effect of which has been summarised, so far as it appears possible to summarise it, by the Special Committee. We desire to record our view that the detailed reports contained in these appendices represent the results of much experience and of much research by those most competent to express authoritative opinions on the subjects with which they deal, and that the conclusions at which they arrive are based upon the most reliable data ascertainable at the present time.

2. We agree generally with these conclusions, and strongly support the view that the carriage of mails, of passengers, and of certain classes of goods by aircraft will present no difficulty from the technical point of view. We are confident that demands for aerial services to provide such carriage will arise immediately at the conclusion of the war, and that it is imperative that every endeavour should be made to prepare for these demands.

3. It is scarcely necessary to point out the extreme importance to this country of being first in the field in the matter of aerial transport. We concur with Special Committee No. 2 in thinking that an experimental service should be organised as early as possible, but this recommendation should not be understood as implying that all other aerial services that may be suggested should await the final results of the experiment. On the contrary, we think that special measures should be taken, whether by direct State effort or by the encouragement of individual enterprise, with the object of commencing the schemes of transport mentioned by Special Committee No. 2 at as early a date as possible on the conclusion of the war.

4. Owing to the absence of any reliable data to serve as a guide, it has been impossible for Special Committee No. 2 to frame any estimate of the running costs of aerial services under peace conditions, and consequently of the volume of aerial traffic likely to be forthcoming. The reasons for their inability to deal fully with this part of their subject are clearly given in their final report, and we recognise that they are conclusive, and that no good purpose would have been served by putting forward estimated figures of running costs which, from the nature of the case, would necessarily have been almost wholly the results of guesswork. Nevertheless, it seems worth while to draw attention to certain considerations affecting the matter, if only with a view to pointing out the factors which must limit the costs of aerial services if they are to hold their own in competition with alternative means of transport, and which are likely to limit the demand for them.

5. It is necessary to distinguish with reference to alternative means of transport (the alternative means being surface transport) between developed and undeveloped countries. In developed countries the governing advantage of aerial over surface transport must be speed. The extent of the advantage will vary with the effectiveness of the alternative means, but where alternative means exist it must be assumed that they will be improved and rendered fully effective. In undeveloped countries the advantage will lie with the means of transport best calculated to provide access to points previously inaccessible, and the absence of road or railway communication must add vastly to the commercial importance of the ubiquitous flightways of the air. In the case of countries in or between which surface transport facilities are interrupted, as, for example, where there is the interruption of a sea passage, both the factors above mentioned should operate to the advantage of aerial transport.

6. In the paragraphs which follow we have regard chiefly to developed countries where aerial transport is called on to eclipse the speed of surface transport.

7. High load and speed are antagonistic elements in the problem. To secure high speed, the commercial load must be kept within narrow limits. From the figures submitted to us it would appear not to exceed 25 per cent. of the total loaded weight of an aeroplane. That is to say, that the loading efficiency

* See Appendices II. and III p. 41, 55

or the ratio of useful load to gross weight in an aeroplane is only poor. On this account it would seem as though aeroplane transport must always remain auxiliary to surface transport, and that speed must always be in the end the predominant factor of advantage.

8. Comparing the train with the aeroplane, the train as a traffic unit of movement is large. There must, therefore, be wider intervals of delay for the accumulation of loads between successive units than in the case of the aeroplane. The aeroplane is a small unit, and therefore a flow of urgent traffic can be given by a constant succession of units from the aerodrome, with consequent time economy. The aeroplane affords the better time-saving the longer the journeys, because in long journeys the time lost between the home and the aerodrome is a less appreciable factor; the saving of time from speedy flight only counteracts this loss for journeys in excess of some minimum distance.

9. The absence of a track is a great financial advantage. The expenses standing in lieu thereof are far less, viz., the cost of landing grounds, wireless installations, weather-reporting services, and signalling of routes at night or in fog. The cost of landing grounds will only be a small factor per "aeroplane mile" in any reasonable commercial scheme of transport, but as aeroplanes become increasingly reliable the need for alighting grounds will not be wholly removed, since safety is a paramount condition; moreover, multiple-engined machines, desirable as they are from the point of view of safety, are commercially justified only when the loads are great enough to warrant aircraft of this size.

10. In canvassing the traffic expectations of the immediate future, a distinction may be drawn between passenger and goods traffic.

Passenger traffic divides itself into two distinct sections, that which moves for business and that which moves for pleasure. Business traffic will turn primarily on speed and reliability, and will consist of inward and outward traffic where rapidity of movement is an important consideration. Economy of time is of great importance to many business men who find absence from their regular place of work disadvantageous. As it becomes possible by aeroplane to fly 400 to 500 miles out and home within the day, and to give a reasonable interval for the conduct of business between the flights, so it becomes likely that many business men will avail themselves of the opportunity.

The occasional use of single machines for rapid journeys in any direction rather than along a fixed route, carrying occupants who pay special fees for the high speed, will probably be one of the early and increasing lines of development. It will educate the public and prepare them for regular services. This could be undertaken immediately peace comes, and would not be open to the same objection as any premature attempt to run a daily service to scheduled time.

With regard to passenger traffic generally, the question of safety in connection, more particularly, with aeroplanes will be of the highest importance. The large number of accidents which occur at the present time are, in our opinion, chiefly due to inexperience and taking risks during training and practice which would not be justified in ordinary times. This subject is no doubt constantly before the authorities in the experimental departments connected with aeronautics, and investigations are, it is understood, being constantly made into the cause of accidents by the Accidents' Investigation Department of the Air Ministry. Improvements are continually being made with the object of reducing accidents, and in the ordinary course of events it is not too much to expect a large reduction in their number at the conclusion of the war. Thus the chief deterrent to flying becoming universal will be removed without any remarkable invention being made.

11. Pleasure traffic will depend on novelty, comfort and safety. Flight may afford pleasure in itself, but pleasure traffic will be seasonal in character, will depend largely on weather, and will be more costly the more irregular it is. There is likely to be small regular demand, which will grow as flight movement becomes a habit. The demand in the immediate future will probably not be extensive, owing to the cost, but it would appear practicable to open routes from well chosen centres.

12. Goods traffic will be for (a) mails and (b) general goods. Commercial considerations are not the only ones to be taken into account in determining upon an aerial mail. It is not indispensable that the cost of a letter by aerial mail should be fully borne by the service, if Imperial or other reasons demand that the use of aircraft shall thus be developed. Mails offer a most promising class of traffic, because the load to be carried is reasonably uniform, the weight small, and the demand for speed great. The prospects of an aerial mail will be best when the conditions referred to in paragraph 5 above as operating to the advantage of aerial transport make themselves most markedly felt.

It has been shewn in the interim report of Special Committee No. 2 and in Appendix E appended thereto that in the case of services between London and large provincial towns a flight of at least three hours, at an average, say, of 100 miles an hour, is required for the speed of an air-mail service to reveal itself, and to offer a sufficiently marked saving of time over land transit; on an oversea journey, such as the passage to Dublin, the saving of time is much more evident. It would appear necessary to charge some such fee as 1s. or more per letter for an inland air-mail to prove remunerative.

The cost of electric cable communication, say, to Johannesburg, at £8 10s. per 100 words (a message taking about 24 hours to reach its destination), can be contrasted with the cost, say 2s. 6d., of sending a letter of 5,000 words to the same spot in six days by aeroplane. The London mail could in the future be conveyed to Calcutta in four days, as against 16 days, the minimum at present. These instances illustrate the intrinsic utility of air services, apart from the value of making closer links within the Empire and of giving support to the construction of aircraft so as to be ready for war emergencies.

It is more difficult to settle the reasonable expectation of general goods traffic, which must take the form of express parcels, usually of small weight. Furs, lace, jewels, precious metals, extracts, essences, valuable feathers, etc., might be carried by air because of their high value; also rare and out of season fruits and

vegetables, flowers, and perishable articles generally. Newspapers and periodicals afford scope for aerial services, because news grows stale quickly. Drugs, dyes, chemicals, medicines, optical and surgical and other instruments will be so carried, as often these are wanted quickly. Wherever, for want of some article, life is endangered or industry is at a standstill, as where some spare part or tool is required for a machine, the aeroplane will afford the quick remedy, and its flight will be profitable. Cinematograph films, gramophone records and commercial samples may figure in the class of goods carried by aircraft. Their rapid distribution will quicken exchange, and this will react to increase the volume of traffic, but the whole series of illustrations above given tends only to show how limited the total volume or weight of aerial goods traffic is likely to be in developed countries.

13. The technical appendices to the reports of Special Committee No. 2 contain interesting information as to the respective capacities of the airship and the aeroplane. We think it advisable to make some general comparison, from the commercial point of view, between the two classes of aircraft based upon this information. For this purpose the largest type of airship is taken as an example, since it is found that as the size of an airship increases the ratio of its useful load to gross weight improves, e.g., for a ship of sixty tons gross, thirty tons of disposable load are available. This represents roughly nine times the load carrying capacity of the largest modern aeroplane. The prime cost per lb. of disposable load in the case of an airship is estimated at almost one-half the prime cost per lb. in the case of an aeroplane. The economic limit of the journey without landing is about 1,000 miles in the case of an airship, as against 500 miles in the case of an aeroplane. The airship, therefore, has the advantage of a greater load capacity; but its speed, under present conditions is slower, being probably not more than 60 m.p.h. In this respect the performance of the airship on overland routes would appear in general to be open to keener competition from rail transport. On the other hand, on sea routes the airship will, save in contrary winds, have a marked advantage over steamships as to speed. As compared with the aeroplane, the cost of handling and housing airships will be higher, and, until open air mooring is fully developed, the regularity of airship services will be more adversely affected by high winds than that of aeroplane services. In journeys in which speed is not the most material factor, and particularly where passengers are being carried, and safety is consequently a paramount consideration, the airship offers advantages over the aeroplane in the way of comfort, ease of navigation, capacity for safe flight at low altitudes, and high ratio of disposable load.

14. On the question of landing grounds along aerial routes, there was some divergence of opinion in Special Committee No. 2, and it will be observed that the interim report of that Committee is only signed by Mr. Holt Thomas subject to a reservation on this point. While we agree with the majority of the Special Committee in not feeling able to recommend that chains of landing grounds should necessarily be laid out at regular and comparatively short—say ten-mile—intervals along aerial routes, especially in developed countries, we consider, nevertheless, that the advantages of lines of landing grounds on certain main routes hereafter to be laid out would be very great, and that such lines would largely assist the development of civil aerial transport. In undeveloped countries regular chains of landing grounds at suitable intervals along aerial routes will be indispensable; and in such countries the consequent expense will be less material in view of the comparative advantages which aircraft will enjoy in competition with other forms of transport. Regular sea stations for the landing of aircraft are at the outset essential if trans-oceanic aerial transport is to be seriously attempted. It is recommended that when questions of laying out, maintaining or abandoning landing grounds for military purposes have to be considered, regard should be had, if possible, to the probable needs of civil aerial transport hereafter. The establishment of landing grounds within urban areas should not necessarily be precluded, and the institution of rapid transit schemes between aerodromes and town centres, such as Post Offices, would be of great value. Developments in aeroplane design may permit of landing safely and conveniently within a narrow compass in the future; and as has already been indicated, a central situation for an aerodrome for civil aerial traffic has considerable importance.

15. We recognise, however, that military considerations must override all others, and, though we have necessarily dealt with our subject matter mainly from a commercial point of view, we would emphasise the importance: first, of the need that all established commercial air routes with their aerodromes and landing places should be suitable for strategical and tactical use in the event of war; and, secondly, of the need for the rapid convertibility in the same event of some types of commercial aircraft to military uses. We do not offer detailed suggestions on these points, which appear to be peculiarly within the province of the Air Ministry; but we record our strong opinion that it is vitally necessary, in the interests of national safety, that all air routes established should conform fully to military requirements, and that the development and manufacture of types of commercial aircraft should for a long time be governed by the requirement that they should be in some manner of effective military use, and that this requirement should be satisfied even at the cost of a serious diminution in the commercial value of both routes and craft.

16. With regard to the marking of aerial routes we agree with the practical suggestions of Special Committee No. 2. It will be observed that the Special Committee do not recommend the institution of a general system of marking for the whole country, but suggest that if companies operating commercial routes provide their own schemes of marking, these should be subject to some central control for the purpose of avoiding a possible confusion arising from the employment of different schemes. We are of opinion that it will not be necessary for the State to lay down any definite scheme for the provision of route marks. Probable improvements of signalling by directional wireless and of other methods of signalling from aerodromes by night and day would seem to make it inadvisable to embark upon the organisation of any universal system of arbitrary markings.

17. In concluding that part of our report which deals with the practical possibilities of aerial transport we desire to draw attention to the great importance of Meteorology in connection with aerial routes and services generally. The interim report of Special Committee No. 2 deals more particularly with the dissemination of meteorological information, and we propose to touch upon the problems of meteorological research at a later stage in the present report. The practical suggestions contained in the interim report of Special Committee No. 2 and in Appendices G and H to that report can be used as a basis for a system of meteorological stations which, in our opinion, should be organised immediately after the conclusion of the war. The provision and management of such a system are matters which we think should be left to the State and not to private enterprise.

CHAPTER III.

Business Questions Relating to the Position of the Aircraft Manufacturing Industry after the War, the Probabilities of the Establishment of Aerial Transport Services, and the Steps which would be Necessary for the Maintenance of this Industry and for the Development of these Services.

1. Special Committee No. 3* were concerned primarily with business questions relating to the position of the aircraft manufacturing industry after the war, with the probability of the establishment of aerial transport services and with the effect which the establishment of such services might have on the maintenance of the manufacturing industry.

2. The Special Committee were impressed with the importance of keeping alive the aircraft manufacturing industry in the interests of National Defence. In order to enable the industry to respond to war emergencies, they expressed the view in their first report that the services of the industry should continue to be employed for the design and development of Naval and Military aircraft and for the carrying out of the national construction of aircraft for the future, and that this would enable the design and construction of aircraft for civil transport purposes to grow on a sound and permanent basis. At the same time, in their first report they gave their reasons for believing that the development of civil aerial transport services reasonably to be anticipated at the end of the war, if no special steps are taken to foster it, will not be sufficient to keep the manufacturing industry alive, and will not for some years to come involve any appreciable volume of orders being placed with the producers in this country.

3. We see no ground for disputing this conclusion, for though, as we have said in paragraph 2 of Chapter II. of this Report, we are confident that demands for aerial services to provide for carriage of mails, passengers, and of certain classes of goods will arise at the end of the war, we apprehend that, as we have said at the end of paragraph 12 of the same chapter, the total volume of aerial goods traffic to be anticipated will be very limited, and that even on the most hopeful view of the probable extent of the demand for aerial carriage of mails and passengers, the number of aircraft required to meet it will be small in comparison with the vast number now being produced for the purposes of the war.

4. The aircraft producing industry in this country has developed during the war in a phenomenal manner, solely owing to the unexampled demands of the naval and military authorities, and has grown to considerable dimensions in Canada also, where before the war it did not exist.

5. This great industrial organisation, amply equipped as it is with capital, material, machinery, expert knowledge and trained labour, is in anything but a secure position. Fostered as it has been wholly by the exceptional conditions of the last four years, it must wither, and very rapidly, in proportion as these conditions or their equivalent cease to obtain.

6. We are thus led to consider a question raised by General R. M. Groves at the meeting of our Committee at which the first report of Special Committee No. 3 was presented, the question, namely, of the importance in the widest national and imperial interests of the development of the use of aircraft after the war. If it appeared that the public interest was not involved in the continued and extended use of aircraft, the dwindling of the aircraft manufacturing industry, with whatever hardship to individuals it might be accompanied, would not be a national disaster, but we could not neglect the possibility that no less vital an interest than the safety of the State itself might be concerned in the matter. Accordingly we invited Special Committee No. 3 to report further to us on the question raised by General R. M. Groves.

7. The supplementary report† of Special Committee No. 3 appears to us to go to the root of the problem, and we agree with that report in believing that the development of civil aerial transport services, in order to create a market for the manufacturing industry and consequently to enable it to maintain its power of production and of progressive improvement in design, to the extent and for the reasons given by the Special Committee, is essential for the safety of the Empire. We agree that aerial transport services cannot be developed by the ordinary commercial methods so as to secure the required result, and that State action of some kind in developing aerial transport services is therefore unavoidable.

8. As to the form of State action to be taken, it will be observed that two main alternatives are discussed by the Special Committee under the heads of :—

- (a) State assistance to private enterprise.
- (b) State ownership or participation in the ownership of aerial transport undertakings.

The Special Committee have not felt able to advise as between the two alternatives; and, similarly, we feel that the problem, raising as it does issues far larger and graver than at the outset of our enquiry we could have expected to be confronted with, is one for His Majesty's Government itself rather than for us to determine upon. The choice involves the consideration of political questions, labour questions, and questions of national finance upon which a Committee constituted as ours is, is hardly competent to advise, and which seem appropriate for Cabinet decision. We confine ourselves, therefore, to saying that, in our opinion, the form of State action to be taken may be either of those described under heads (a) and (b) above, or even a combination of the two, but that the decision in the matter must rest with His Majesty's Government. The arguments for and against each of these alternatives are fully set out in paragraph 7 of the supplementary report of the Special Committee.

9. In paragraph 5 of their supplementary report the Special Committee gave a picture of the extent of the development of aerial transport services which should be aimed at. We agree with their view and

* See Appendices IV. and V. pp. 60, 63

† See Appendix V. p. 63.

desire to emphasise the importance of a general scheme of main air-routes being planned in advance, so that when aerial services come to be put into actual operation they may be in harmony with the scheme.

10. While considerations of national security afford the all-important reason for advocating State action for the development of aerial transport services, other advantages, also to be hoped for from such development, should not be overlooked. Among the most important of the national benefits to be hoped for are increased facilities for friendly intercourse with foreign nations, and, still more, the improvement in inter-communication between the widely-scattered countries which make up the British Empire. So far as the Governments of the self-governing Dominions and of India are concerned, it will be for those Governments, to whom copies of this Report might, we suggest, be forwarded, to determine their own attitude in regard to the problems presented by the subject of our discussions. Whether they decide themselves to run or to join with the British Government or each other in the running of aerial services, or not, it is in any case to be hoped that by arrangement with the British Government they may be willing to give all necessary facilities for the arrival and departure of British aircraft. Such facilities would include the provision of aerodromes and landing places or the grant to the authorities controlling British aerial services of the right to acquire them for themselves. The Dominion and Indian Governments would, we hope, also be willing, unless they were running State-owned aerial services of their own, to allow the British authorities to tender to their Post Offices for the carriage of their mails, and generally to operate in their territory on the same terms as their own citizens. It has already been shown that the longer the distances which it is desired to cover rapidly the greater are likely to be the commercial advantages enjoyed by aerial transport for such purposes as the carriage of mails as compared, e.g., with rail and steamer transport, whence it appears that the Dominions and India, owing to their great geographical area and the wide distances which, in many cases, separate their important centres of population, offer a fruitful field for the development of civil aeronautics.

11. It requires but little imagination to envisage the possibilities of aerial communication in such a country as Canada, where the journey from Halifax to Victoria is one of nearly 3,000 miles, passing through such centres as Quebec, Montreal, Ottawa, Toronto, Winnipeg, Calgary, and Vancouver, or in Australia, where a journey round the coast from Brisbane to Perth, through Sydney, Melbourne, and Adelaide is slightly longer, or in the Union of South Africa, where a journey from Capetown to Johannesburg is one of 800 miles, and leads on to Buluwayo or Salisbury, and thence across Northern Rhodesia, and what was once German East Africa, to British East Africa, the Nile Valley, and Cairo. It is obvious how important a bearing the improvement in inter-imperial communication is likely to have on that greatest of problems, the problem of the future relation to one another of the self-governing States of the British Empire.

12. We are of opinion that in all matters of inter-imperial aerial traffic, as, for instance, in the formulation of such a scheme of main aerial routes as is referred to in paragraph 9. in so far as these routes extend beyond the limits of the British Isles, joint or co-operative action by His Majesty's Government and the Governments of the Dominions and of India should, wherever possible, be secured.

13. In the case of the Crown and other Colonies and Protectorates, the British Government is in a position more directly to control the development of civil aeronautics and to secure the facilities in the way of aerodromes, landing grounds, and the like, that it requires for the transport in which it may be interested. In many cases the Crown and other Colonies and Protectorates, being of great geographical extent, offer the same favourable opportunities for aeronautics that we have noticed in the case of the self-governing Dominions and India. Some of their governments may be disposed to assist the formation of aerial transport companies or to start aerial services of their own. These would be matter for settlement between them and the British Government, but it seems to the Committee to be likely that such services would be valuable in many remote parts of the British Empire, not only for postal, but for general administrative work, while the setting up of organisations of this kind would form valuable links in schemes of long-distance services connecting the United Kingdom with other parts of the Empire, and would, moreover, encourage the design and building of special types of machines suitable for use, e.g., on large rivers or lakes. In all countries, in which other means of communication are few and difficult, aerial services would be particularly valuable for purposes of exploration and survey, owing to the remarkable developments brought about by the war in the art of aerial photography. The apparatus used has reached so high a degree of perfection that map-making, or the correction of maps already made, by means of aerial photography should present comparatively little difficulty. Aircraft should also provide a valuable means of aiding research in zoological and other physical sciences in many parts of the world. In setting up aerial services in remote parts of the Empire the State should, we think, if necessary, assume the duty of providing such landing facilities and of marking such routes as may be necessary for certain main lines. The acquisition of the necessary land would not, except in and near large towns, be a matter of any great cost or difficulty.

14. So far as the policy of His Majesty's Government is concerned, we desire to lay the strongest emphasis on the necessity, to which Special Committee No. 3 have called attention in the last paragraph of their supplementary report, of an early decision. To postpone decision until after the war might well be to allow the manufacturing industry to languish for lack of orders, and thus to lose the means of carrying out any policy that might eventually be determined upon. If, therefore, His Majesty's Government accept our main proposition that the fullest possible development of civil aerial transport services immediately after the war is a national necessity, and that it cannot be achieved without State action, it will be necessary for them to settle at once what form that action is to take. If it is to take the form of assistance to private enterprise, it will be necessary for His Majesty's Government to enter into communication with the promoters of such enterprise, and to satisfy themselves as to the sufficiency of their proposals. If it is to take the form of direct State ownership of or participation in aerial transport services, it will be necessary to settle precisely what services are to be undertaken, and to prepare in advance all the measures necessary for bringing them into operation immediately on the declaration of peace. In either event, the negotiation of a Convention, at any rate with our Allies, as recommended in our Interim Report, and, probably, the arrangement of agreements with the Dominion and other Governments of the Empire, to regulate inter-imperial and international flying, would seem to be indispensable preliminaries to action, and should, we venture to suggest, be taken in hand as soon as possible.

should be taken to co-ordinate the work of the Meteorological Offices of groups of Colonies and Protectorates geographically close to one another, as, for example, the East and West African groups of Colonies and Protectorates. Combined results are likely to be more valuable than the unco-ordinated results of the work of a number of comparatively small stations.

5. In regard to Accident Investigation, while we agree with the Special Committee in paragraph 16 of their final report that a distinction may legitimately be drawn between privately owned aircraft and aircraft carrying passengers for hire, we think, nevertheless, that the appropriate Government Department should have power to order an official investigation to be held, if it is thought necessary in the public interest, in any case of serious accident, no matter what class of aircraft may be involved in such accident. Enquiries might, at the discretion of the appropriate Government Department, be conducted through the agency of an unofficial body, such as the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society. It appears to us that the knowledge that a State authority was empowered to hold an investigation into any case of serious accident, if it thought fit, would give the public a sense of security, and would thus be to the advantage of the aerial transport industry rather than otherwise. It does not seem necessary to apprehend that a Government authority would hamper the industry by directing unnecessary inquiries into a number of trifling accidents arising from easily ascertainable causes.

CONCLUDING OBSERVATIONS.

1. In conclusion we desire to point out that preliminary action has already been taken by several of our Allies for the purpose of preparing for civil aerial transport, in some cases by the institution of experimental postal services. It has been reported, also, that enemy countries have moved in this direction. We consider it of vital importance that the British Empire should not be allowed to lag behind other nations in this movement, more especially as this might have a very serious effect upon the position of the Empire with regard to the international aspects of aerial transport. We would urge that there is a large amount of preliminary work which could be commenced at once. In Chapters II., III., and V. of our Report we have already indicated the urgency of the following matters:—Preliminary inquiries as to routes, landing grounds, and aerodromes, involving in the two latter cases consultation with local authorities; the necessity for preliminary discussion with the Dominions and our Allies on the broad questions of principle dealt with in the reports of Special Committee No. 3; the immediate establishment of the Bureau in aid of Research as suggested in the report of Special Committee No. 5. We consider, also, that it is a matter of urgent necessity to establish a system of Propaganda throughout the Empire in order to convince the whole nation of the vast importance and possibilities of aerial transport and to familiarise the Governments and the local authorities with the subject. There is evidence of the initiation of such a system in enemy countries.

2. In order to carry out these views we therefore recommend that a special branch (commencing on quite a modest scale) should be formed at once for the purposes specified under the Air Ministry, to ensure that all necessary preliminary action be taken without delay—definite responsibility being imposed upon the Air Council. We would venture, further, to suggest that any executive authority which may be established for the purpose would be greatly assisted if an advisory panel could be formed of gentlemen who have given time and thought, and have expert knowledge of the problems dealt with in our Report, and who could be consulted as occasion demanded by the executive authority on questions arising in the course of its work.

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 W. Lockwood Marsh, Major, R.A.F.
 J. Whiteside McCay, Major-General.
 Montagu of Beaulieu, Brig.-General.
 J. T. C. Moore-Brabazon, Lt.-Col., R.A.F.
 Arthur Morley.
 Morris.
 G. E. P. Murray.
 Mervyn O'Gorman, Lt.-Colonel.
 George H. Perley.
 J. E. Petavel.
 *Frank Pick.
 J. C. Porte, Lieut.-Colonel, R.A.F.
 J. W. Pringle, Colonel, R.E.
 E. Elvey Robb, Major, R.A.F.
 R. M. Ruck, Major-General.
 W. P. Schreiner.
 W. Sempill, Colonel, R.A.F.
 Napier Shaw.
 J. D. Siddeley.
 Thos. Sopwith.
 T. Vincent Smith, Major, R.A.F.
 G. I. Taylor, Major.
 Charles Tufton.
 Arthur E. Turner.
 H. G. Wells.
 H. White Smith.
 H. J. Wilson.

D. O. Malcolm,
 Secretary.

May 11th, 1918.

† "In signing the foregoing Report as Acting Chairman, I desire to make it clear that I do so without prejudice to any decision at which the Air Council, of which, as Parliamentary Under-Secretary of State for the Royal Air Force, I am Vice-President, may arrive upon any of the recommendations contained in the Report, and without attempting to anticipate any such decision.

"I should add that I fully concur in the recommendations contained in the Report regarded solely from the point of view of the development of civil aerial transport."

(Signed) John Baird.

11/5/18.

* 1. I think it would be unfortunate if a Report of such importance as that of this Committee were to go forward without someone taking upon himself the task of expressing an entirely different groundwork of policy towards civil aerial transport to that set out in the Interim Report of this Committee, confirmed as it is by further applications and developments in the Final Report.

We are in the midst of a war of which the concluding terms cannot yet be foretold. It is only natural at this time that warlike considerations should predominate in our minds. It is only natural that the sense of insecurity should drive us towards seeking greater security in great warlike measures. That we, as a nation and empire, should establish our security upon a firm and self-supported basis is accepted as a cardinal principle. But we are in the midst of a war of which the confessed object is to make the whole world secure, to render the appeal to the arbitrament of war for the future of less resort and of less avail, and whether this object will be achieved or not is still unsettled.

Apart altogether from the mere terms which will bring this war to a conclusion, there are reactions growing which will profoundly alter the circumstances of international relationships with the peace. Some factors in these reactions are already apparent and effective. There is the revolution in Russia, the advance in the power of labour, the political arrival of woman. I think it is fair to say that these factors tend towards an internationalism of a new order, one result of which must be the collapse and discredit of the old diplomacy. It is fair to expect that the secrecy of international negotiations will be done away, and with it most of the suspicion which secrecy always arouses; the system of bargain and counter bargain will be largely impossible. The world and they that dwell therein must cease to be regarded as the business assets of national firms.

2. I write in the spirit of hope. Such a view of the future must make the claim to aerial sovereignty wear a different aspect from that suggested by the Interim Report of this Committee with its annexes. The sovereignty of the air is in itself an academic or theoretical question. Each nation must be supposed to have the sovereignty in the air over its territories. The practical question is the only important one. How is the sovereignty to be asserted and exercised? Is each nation to make its own laws and fix its own rules and regulations, and then, by a process of bargaining one with another, to secure concessions and set up a series of more or less favoured-nation treaties or conventions, or are the nations as a whole to agree upon some international code of laws, with rules and regulations to follow, to be applied openly and equally among all nations upon some mutually enforceable sanction? If causes of offence are to be removed, the second alternative is the only acceptable one. I think, therefore, that in taking any steps towards the establishment of laws or of rules and regulations for civil aerial transport at this time care should be taken to avoid any commitments which would hinder the adoption of the second alternative at the earliest favourable moment. The door should be left open for the widest possible conference and the most general acceptance.

* See reservation appended.

3. There are two other selfish reasons for this policy :—

- (a) The strategic position of this country in relation to the air differs fundamentally from the strategic position in relation to the sea. So long as the shores of the North Atlantic are occupied by the leading civilised peoples so long the British position is advantageous as a centre of sea power. But if air power is to usurp to any degree the place of sea power—and this seems probable so long as flight over land holds appreciable advantages over flight over sea, which is the case under conditions as they exist to-day—so the position of a country placed centrally as regards land must be superior to the position of a country placed centrally as regards water. The German aims of Central Europe, Central Africa, and the Berlin to Baghdad approach to Asia are seen to be the more sound and the more dangerous as this idea is carried to fruition. The very scattered and discontinuous character of the countries constituting the British Empire becomes an obstacle to the development of aerial transport and aerial power. The British Isles are badly placed for aerial communication. Other nations bar the access to the great land masses associated to form the British Empire. A clear right of way free from restriction across France and Italy and Spain is essential to effective progress in inter-colonial air communications. Our self-interest, therefore, as a great Power lies towards an international settlement of air sovereignty.
- (b) And for similar considerations our interest as a commercial and industrial people must lie in the same direction. The right to pass across other national territory without let or hindrance, relief from varying terms and conditions attaching to flight which may be onerous and irksome, the absence of Customs restraints or tariff restrictions, and generally the absence of the apparatus for hampering or artificially routing trade are all wanted. On all these grounds it is submitted that the case for an international settlement is strengthened.

I, therefore, dissent to the somewhat selective and particularist suggestions of the Main Committee approving, without qualification, the report of Special Committee No. 1.

4. I can only suggest that warlike considerations equally led to the decision to place the control of civil aerial transport with the Air Ministry, whose prime function must be warlike, the conduct of war or of preparations for war. The case for civil control of civil aerial transport was submitted to the Main Committee in the following memorandum (except for some slight amendments) :—

- (a) Civil aerial transport cannot be discussed apart altogether from military aeronautics. There must be many aspects which they have in common just as there must be many aspects in which they are opposed. The policy and outlook of the one have no necessary connection with the policy and outlook of the other. The control, therefore, cannot be simple and complete in a single hand.
- (b) The root principle of any allocation of shares in the control must be to provide separate representation of opposed aspects and policies, to secure adequate and impartial consideration, while at the same time securing common treatment of those aspects and policies which are at one.
- (c) On the analogy of railways, shipping, canals, tramways, etc., the Board of Trade, in its capacity as a Ministry of Communications, would be the fitting department of the Government to be concerned with the commercial and civil aspects of aeronautics. On the contrary analogy of the decision of the Main Committee, shipping should be brought under the control of the Admiralty, and railways, roads, and canals under the control of the War Office in times of peace. Such a step could not, I think, be contemplated.
The recent reorganisation of the Board of Trade into a Ministry of Commerce and a Ministry of Public Utilities might be carried a stage further, and transport utilities placed together as a definite integral group of the whole, forming a Ministry of Communications, and leaving gas, water, electricity, and other supply services only to be comprised among public utilities.
- (d) The need for a unified and single control of those matters which are similar in character and purpose applies with equal force here. There are many common considerations relating to the regulation and control of traffic quite apart from the particular means by which the traffic is carried. The Board of Trade has in the course of time built up an organisation and practice for dealing with these questions which a slight development would extend to cover aerial transport. Especial reference may be made to such questions as rates and charges, preferences, classification of commodities, efficiency of and necessity for service, accidents and accident prevention, trade agreements, etc., all of which have a commercial bearing rather than a merely technical bearing.
- (e) The Air Ministry would continue to be responsible for all those aspects of aeronautics, other than commercial, being extended and developed to the best advantage and generally for all technical aspects. Its particular responsibilities would, I think, be properly extended from purely warlike responsibilities to cover :—

1. The establishment, maintenance and operation of all aircraft belonging to the State or used for State purposes irrespective of the particular uses to which they are put or the particular Government Departments for which they are worked (*e.g.*, Post Office);
2. The establishment, maintenance and operation of all aerodromes and landing grounds belonging to the State (I would emphasise that the State ownership of aerodromes and landing grounds should be extended liberally beyond bare warlike or strategic requirements);
3. The establishment, maintenance and operation of all auxiliary services essential to aeronautics such as weather observation and reporting (in conjunction with the Meteorological Office), wireless telegraphy, signalling, distinguishing of routes, etc., because such services must be common to all users of aircraft and can only be effective on a national scale;
4. The ultimate control and responsibility for the central research and experimental station. (It is suggested that, apart from private effort, the Government should establish a central research and experimental station on a large scale and fully equipped to meet all the needs of the industry and the State under a representative constitution.)

(f) In addition to the purely commercial questions the Board of Trade would appear to be the proper Ministry to be responsible for

1. The licensing of aircraft and pilots;
2. The investigation of accidents relating to aircraft employed for civil use;
3. The establishment of rules and regulations for aerial traffic, including safety requirements for passenger services;
4. The licensing and inspection of aerodromes and landing grounds not belonging to the State.

The Air Ministry would adopt the rules and regulations of the Board of Trade in connection with State-owned aircraft and aerodromes. The rules and regulations for aerial navigation and conduct generally would be a joint undertaking. The technical inspecting officers of the Board of Trade would be presumably seconded from the Air Ministry. A close relationship of the two would necessarily exist.

(g) Finally, the administration of the law and the prosecution of offences against the rules and regulations for aerial navigation or aerial traffic would be carried out by or under the supervision of the Board of Trade. It is essential, I think, that there should be a clear distinction drawn between civil and military administration, particularly in relation to the enforcement of law and order. It would be an eminent departure from constitutional practice to set up a Government Department chiefly of an executive character and primarily to carry out the work of operating aircraft for the State, and then permit it to undertake the administration of the law which it may itself fail to observe or to undertake duties of an administrative character on behalf of privately-owned aircraft in which State and private interest might very well be in conflict.

With this explanation, therefore, I dissent from the recommendation of the Main Committee that the Air Ministry should have its scope and powers extended to cover civil aerial transport.

5. I submitted to the members of Special Committee No. 3 a memorandum setting out a connected series of views on the question of the demand for and supply of aircraft after the war which failed to secure adoption. Without traversing that memorandum which is on record, I think that the report of that Committee and the report of the Main Committee on the subject fail to distinguish sufficiently between the actual output of aircraft by factories and factory capacity for aircraft production.

My understanding of the situation is that aircraft of types suitable for civil use will not comply sufficiently closely with the requirements of aircraft of types for warlike purposes to make them effectively interchangeable, and that aircraft of civil types will only serve for purposes auxiliary to military employment proper. That being so, a capacity to rapidly increase the output of machines of military type is the desideratum, rather than the continuous upkeep of large fleets of only partially serviceable aircraft.

It is agreed that there must be an establishment of aircraft kept up wholly for military purposes and fixed at such strength as the Government from time to time deems essential to the national safety. Beyond that the most material object to be assured is a capacity to produce swiftly a sufficiency of aircraft to meet the extravagant demands of war.

Experience in the present war has shown that many factories and industrial plants ordinarily engaged upon work of a useful and wealth-producing character can be adapted to the production of aircraft or parts of aircraft when occasion compels. It is, therefore, strongly urged that a proper scheme should be worked out for the co-ordination of such factories and industrial plants as are suitable to an enlarged production beforehand, so that the change-over on the outbreak of war may for the future be instantly effective. For this purpose it may be that modifications should be introduced in the lay-out and tool equipment which while not seriously prejudicial to the tasks of peace, would enhance efficiency for the tasks of war. Reserves of tools, patterns, jigs, drawings, etc., should be held in readiness against the day of change, and should be constantly overhauled and kept up to date.

To the extent to which auxiliary factories and industrial plants can in this way be brought into account to bridge the enormous gap between the normal peace and war requirements of aircraft so the problem of the aircraft industry after the war becomes more manageable.

6. In addition to the omission indicated in the preceding paragraph, I regret that the Report of the Main Committee omits any reference to the economic limit which must be placed upon the expansion of aeronautics, seeing that there is little prospect of the immediate commercial return from the operation of aircraft being sufficient to support an adequate programme. The burden of armaments has been heavy in the past, but the trend of this war has been to build up a material equipment of artillery, tanks and other devices for warfare on land which must afterwards remain a costly addition to the establishment. Unless, therefore, some steps can be taken to limit armaments as the outcome of this war, the burden looks like being greater than can be borne with an army on a Continental scale, a preponderating naval and aerial fleet on top of the debt charges consequent on the war itself. Here, again, until the conclusion of this war can be reasonably foreseen, it is hard to pronounce for any definite policy, but a hopefulness of outlook is not to be put aside as unjustified. There are limiting conditions to the aircraft industry which deserve notice in a report of this kind.

7. Nothing that I have said will, I trust, be taken to detract from my concurrence with the vital necessity of taking all measures which may be necessary for the safety and security of our Empire in whatever situation may arise on the close of this war.

So many points are dealt with directly or by implication in the Report of the Main Committee with which I am in accord that I have signed that Report, but my signature must be qualified by the observations set out in this memorandum.

(Signed) Frank Pick.

13/5/1918.

APPENDIX I.

Report of Special Committee No. 1.

Terms of Reference :—

To advise as to policy and necessary legislation, with special reference to—

- (1) The attitude to be adopted by the State with regard to national sovereignty in the air and international questions connected with aerial transport.
- (2) The question of State ownership (if any) or of necessary State control and regulations as to Customs, Quarantine, and Aliens.
- (3) Necessary amendments of the common and statute law as to the air space covering private property and as to compulsory purchase of land for aerodromes and landing grounds.
- (4) The principles of liability for damage caused by or to aircraft.

PART I.

National Sovereignty in the Air and International Questions.

1. In considering this branch of the enquiry referred to them by the Main Committee the Special Committee have found it necessary to view the subject from two aspects. The first of these relates to the general attitude which it is thought that His Majesty's Government should adopt at any future International Conference with regard to aeronautics and the second to the more detailed terms of any Convention that H.M.G. may see fit to agree to as one of many contracting Powers. The Committee recognise the fact that it would not be within the province of the Main Committee in any sense to prescribe to H.M.G. a complete policy governing their action at any future International Conference. This policy is clearly dependent partly upon factors which do not fall within the terms of reference to the Main Committee, as, for instance, the relative strength of the European Powers at the end of the War and the development of aircraft for attack and defence on land and sea. In presenting their recommendations the Committee desire it to be understood that these should be regarded only from the point of view of the effect of international policy upon the use of aircraft for civil and commercial purposes.

2. * * * * *

3. The Committee do not think that, from the point of view of civil and commercial aeronautics it would be of much advantage to include in this report anything in the nature of a study or history of the much-disputed question of sovereignty in the air space. They have had the opportunity of considering various papers in which the right of the State to sovereignty in the air space over its territories, as opposed to the doctrine of the "freedom of the air" is discussed.

* * * * *

4. It seems that throughout the period of the International Conference in Paris in 1910 and up to the outbreak of the war H.M.G. had always maintained the position that every State should claim full and absolute sovereignty in the air above its territories and territorial waters, and that this claim was disputed by certain of the other negotiating Powers, notably Germany. Since the outbreak of war the principle of State sovereignty over the air has been generally claimed, and, except by Germany, recognised; Holland, Denmark, and Switzerland have consistently regarded the passage of belligerent aircraft over their territory as an unneutral act, and taken active steps to vindicate their rights.

5. * * * * *

6. It will be observed that the recommendations in the preceding paragraph do not touch upon the vexed question of territorial waters. The Committee have come to the conclusion that the claim of the State, as expressed in that paragraph, should apply also in respect of the air space above territorial waters, but in view of the present uncertainty in the determination of the limits of such waters, the Committee also recommend that the claim in this respect should be made applicable to any waters now or hereafter to be claimed as territorial waters.

7. With regard to the detailed terms of any future International Convention relating to aeronautics, the Committee derived great assistance from a Report of a Sub-Committee of the Committee of Imperial Defence, dated 17th July, 1913. In this Report were reviewed the terms of the Draft Convention prepared in Paris at the International Conference held from May 18th to July 29th, 1910. This Conference was not able to complete a draft convention for ratification by the contracting Powers, owing mainly to a conflict of opinion between the British and German delegates as to the right of each State to the sovereignty of the air over its territories. The contention of the British delegates has already been referred to in paragraph 4 of the present report. The Draft Convention, as it stood when the International Conference finally adjourned represents the limits within which the conferring Powers were able to agree at the time of adjournment.

8. In the Report of the Sub-Committee of the Committee of Imperial Defence the Draft Convention is set out, and in a parallel column are placed the amendments and modifications suggested by that Sub-Committee. The Committee have thought that the most convenient method of dealing with international problems of civil and commercial aeronautics was to consider the articles of the Draft Convention seriatim together with the amendments and modifications proposed by the Sub-Committee of the Committee of Imperial Defence. A translation of the text of the Convention prepared in the Foreign Office by Lord Drogheda, together with the observations of the Sub-Committee of the Committee of Imperial Defence and of this Committee thereon is set out as Appendix A to the present report. With regard to the three annexes to the Convention which frame rules respectively as to nationality and registration marks, characteristics of aircraft, and Rules relating to aerial navigation, the Committee, in view of the technical details involved and the recent development of aircraft from the scientific point of view, have thought it advisable to refer these to Special Committee No. 2 for investigation and report. Appendix A, p. 25.

9. At the end of the Draft Convention of 1910 will be found four recommendations which do not form a part of the text of the Draft Convention itself. Of these recommendations, the subject matter of the first two appear to the Committee to relate to matters which fall within the scope of Special Committee No. 2. With regard to No. 3, the Committee have made a recommendation. With regard to No. 4, the Committee understand that the Conference of 1910 contemplated an International Board for Aerial Navigation which should act as a permanent link between the various Governments, and should collect information with a view to the revision of the rules of the road and for questions of international importance, but that the British Delegation did not consider that the time was ripe for a permanent institution of this kind. In present circumstances it is evident that the possibility of establishing such an International Board is considerably more remote than it was in 1910, and the Committee do not feel that they can usefully make any definite recommendation on the subject.

10. Two points have arisen for consideration which do not touch upon the text of the Convention itself:—

- (i.) It appears to the Committee that questions of damage caused by foreign aircraft visiting this country will have to be borne in mind in connection with any future Convention. For the purpose of ensuring reparation for such damage it might be possible to require all foreign aircraft to insure against risks of damage to third parties as a condition of their registration or licence, as the case may be. The Committee think that this point should be considered by H.M.G., particularly in view of the possibility of some mutual system of national insurance being ultimately arranged.
- (ii.) As a matter of policy it will be for H.M.G. to decide which are the Powers with whom they would wish to enter into an international agreement of the nature contemplated in the draft convention.

* * * * *

PART II.

Government Control and Legislation.

1. The control of aerial navigation after the war in the United Kingdom and the Empire is a matter which will necessitate some legislation. Before the war the control of aerial navigation in the United Kingdom was dealt with by two Acts of Parliament, the Aerial Navigation Act, 1911 (1 and 2 Geo. 5, C.4.) and the Aerial Navigation Act, 1913 (2 and 3 Geo. 5, C.22.). Under the first of these two Acts power was conferred upon the Home Secretary to prohibit the navigation of aircraft over prescribed areas, and an Order by the Home Secretary under that Act, dated 22nd September, 1913 (S.R. and O., 1913, No. 1090) prohibited the navigation of aeroplanes over so much of the County of London as lay within a circle, the centre of which was Charing Cross and radius of which was four miles in length. The Act of 1913 extended the power of the Home Secretary to regulate aircraft and provided for compulsory landing of aircraft coming from any place outside the United Kingdom. Orders and Regulations made by the Home Secretary dated 1st March, 1913 (S.R. and O., 1913, Nos. 228 and 243) made provision for (a) prohibited areas; (b) portions of the coast line prohibited to aircraft from abroad; (c) landing areas for aircraft from abroad; and (d) conditions imposed on aircraft from abroad. On August 2nd, 1914 (S.R. and O., 1914, No. 1117), an Order was made by the Home Secretary prohibiting navigation of all, except Naval and Military, aircraft over the whole area of the United Kingdom. These Acts, Orders, and Regulations represent the only legislative enactments made before the war. Some similar legislation had been passed in other portions of the British Empire.

2. In anticipation of the early development of aeronautics, the Home Office, in 1911, prepared an Aerial Navigation Bill,* which represents what in that year would have been the basis of a complete code of law controlling aerial navigation. This Bill, a print of which is appended to this report as Appendix B, has been of the greatest assistance to the Special Committee in this branch of their enquiry, and though later Appendix B, p. 36. aeronautical developments render modification of some of its provisions necessary, the Special Committee approve of the general lines on which the Bill is drawn.

3. It has appeared to the Committee convenient to deal in the body of this report with the general principles on which Government control and legislation should be based and to relegate to a third Appendix (Appendix C) their recommendations as to matters of detail and their suggestions as to such drafting modifications of the Bill as they think may be of assistance to the Parliamentary draftsman. Appendix C, p. 40.

4. In the Preamble to the Bill will be found an assertion of sovereignty and rightful jurisdiction of the Crown over the air superincumbent on all parts of H.M. Dominions and the territorial waters adjacent thereto. With regard to this assertion, the Special Committee would refer to Part I. of their report, paragraphs 2—6 inclusive, in which the international aspects of the assertion are dealt with.

* * * * *

* This Bill was in a preliminary stage of preparation and had not been adopted by the Home Office or the Government

5. It will be observed that the Bill contemplates the following Government Departments as taking part in control and regulation:—the Home Office, the Board of Trade, Customs, and Post Office. Of these the two last named are only concerned with particular provisions relating to Customs and mails. The Bill proposes that the Home Office should act in imposing and enforcing general regulations, while to the Board of Trade are assigned duties as to registration, certificates of different kinds, and regulations regarding collisions, salvage, and matters *ejusdem generis*. In so far as the powers of the Board of Trade are concerned the Bill is drawn largely upon the analogy of the Merchant Shipping Acts. The creation of a new Air Ministry will afford a convenient opportunity for conferring on that Ministry the powers of the Home Office and Board of Trade to regulate aerial navigation. The advantages of assigning to a single Department of State the regulation of all matters relating to civil aerial transport are manifest, and the relevant clauses of the Bill will require amendment accordingly.

6. The Committee propose next to deal with the questions of principle arising on the different clauses of the Bill.

Clause 1.

In connection with sub-section (1) (b) of this Clause and any regulations which may be made thereunder, attention is called to the Committee's recommendations in Part I. of this report relating to Article 19 of the Draft International Convention, and particularly to the additional rule which the Committee suggest should be inserted in that Article. It appears to the Committee that some caution should be observed in the prescription of areas for the landing of foreign aircraft, so that, while every reasonable encouragement should be given to the visits of foreign aircraft, reciprocal facilities should be secured for our own aircraft landing abroad. It has to be borne in mind that as the geographical area of the British Isles is comparatively small, it is to the advantage of this country, from the purely commercial point of view to secure free access for her aircraft to foreign territory. From this point of view, therefore, a liberal policy in the matter of international aerial navigation for civil purposes is indicated. Certain verbal amendments to this Clause are suggested in Appendix C.

Clause 2.

The Committee appreciate the fact that the broad questions of nationality and naturalisation are being dealt with independently of aerial navigation. As a matter of principle arising on (d) they think that in the case of companies the true criterion should be that the effective control of the company for all purposes should be vested in British subjects. They refer to their recommendation on Article 3 of the Draft Convention as equally applicable to the sub-section in question.

With regard to the ownership of aircraft by subjects of British Protectorates, the Committee adopt the suggestion of the legal advisers of the Colonial Office that a clause should be added to the Bill empowering His Majesty, by Order in Council, under the Foreign Jurisdiction Act to apply the provisions of the Bill, with any necessary adaptations, to Protectorates and Protected States. The India Office should be consulted as to whether the proposed new clause would be applicable to India as it stands or whether it would require modification to apply it to the Native States.

Clause 3.

The Committee think that, following the precedent of the Merchant Shipping Act, 1894, the Bill should expressly provide for local registration in the various British Possessions.

Clause 4.

The Committee feel that the question of certificates of airworthiness is one which requires close attention. Regulations as to certificates of navigability and reciprocal recognition by the contracting Powers of such certificates were contemplated in the Draft Convention of 1910. It appears to the Committee that for the purpose of ensuring safety for the ordinary population it is better to provide for the competency of pilots by stringent regulations rather than to run the risk of hampering the development of civil aeronautics by imposing on all aircraft onerous conditions as to tests and examination, which might possibly be imposed within the terms of the Clause. At the same time the Committee think it reasonable to require that passenger machines plying for hire must be of types the airworthiness of which has been officially certified. The Committee therefore recommend that the provisions of Clause 4 should only be made applicable to types of passenger machines plying for hire, and that this should be made clear in the Clause itself, and not left to exemption under the regulations. Even in the case of types of aircraft requiring certificates of airworthiness the Committee feel that the regulations should be so drawn as not to hinder the development of design in the early days of civil aerial transport. The Committee think that these conclusions should be borne in mind in the settlement of any future Convention.

Clause 5.

The Committee approve this Clause.

Clause 6.

The Committee, while recognising the necessity for collision regulations, are not in a position to make recommendations as to the details of such regulations, which fall within the province of Special Committee No. 2. In so far as the clause proposes alternative sub-sections, the Committee approve the second alternative sub-section (3). As to the alternative sub-sections numbered (4) the Committee are of opinion that it is advisable to retain the principles governing both the alternatives. As to sub-section (5), subject to a drafting amendment noted in Appendix C, the Committee approve this provision, omitting therefrom the power of seizure and detention as being unnecessary. They consider that infringements of the regulations are sufficiently dealt with under the other parts of the Clause.

Clause 7.

The Committee approve this clause subject to some drafting amendments suggested in Appendix C.

Clause 8.

The Committee approve this Clause, but they express the view that private aircraft flying in their own country and not for hire should be expressly exempted from the obligation of carrying logs.

Clause 9.

Subject to the details of these regulations being considered by Special Committee No. 2, the Committee approve this Clause.

Clause 10.

The Committee approve this Clause subject to the exceptions already suggested by them in their recommendation to Article 33 of the Draft Convention. (See Appendix A.)

Clause 11.

The Committee recommend the substitution of an alternative clause proposed by the Secretary to the Post Office, which is set out in Appendix C.

Clause 12.

This Clause is very important to private landowners. It proposes to deprive the landowner of his frequently asserted right to the air space over his land *usque ad cælum*. To retain this doctrine in its entirety would be fatal to civil aeronautics. On the other hand, to allow unrestricted flying over private property at all altitudes would interfere with the reasonable rights of landowners. The interference would take the form either of trespass or of nuisance.

The Committee think that the following recommendations would, on the one hand, give reasonable protection or compensation to landowners and, on the other, impose on aviators no obligation which could not be covered by insurance at reasonable rates, and so avoid hampering the development of civil aeronautics.

The Committee therefore recommend that the Bill should provide as follows :—

- (a) No action for trespass should lie except for material damage to person or property, whether caused by flight ascent or landing or the fall of objects from aircraft.
- (b) That this right of action for trespass should include one for injury caused by the assembly of persons on the landing or ascent of aircraft elsewhere than at authorised aerodromes or landing places.
- (c) That the obligation on the aviator in an action for trespass should be absolute, negligence not being a necessary element in his liability and "unavoidable accident" no defence.
- (d) That an action for nuisance should lie for damages only, and then only if breach of flying regulations is proved as well as actual nuisance.
- (e) That special flying regulations should be made in connection with the ascent and landing from or at authorised aerodromes and landing places, and for the area around the aerodrome or landing place over which aircraft must necessarily be at low altitudes. Nuisance and injury to the value of property caused by the existence of aerodromes and landing places are met by paragraph 10 of this report.
- (f) That the power of seizure and detention proposed in Clause 12 should be limited to what is necessary to establish the identity of the aviator and his aircraft.

Reasonable apprehensions may be entertained of nuisance being caused by the frequent flight of aircraft at low altitudes along regular routes, but the Committee are not at present in a position to make any recommendation as to limitations of altitude being prescribed by regulation.

Clause 13.

The Committee think that it is inadvisable to name in the Clause a fixed percentage for salvage reward, but that the amount to be paid should be left to the discretion of the appropriate tribunal.

Clause 14.

The Committee approve this Clause.

Clause 15.

The Committee understand that this Clause contemplates regulations which will minimise damage to aircraft while under detention. As to the nature of such regulations the Committee have obtained advice from Special Committee No. 2. It appears that the main causes of damage to aircraft under such conditions will be (i.) weather, (ii.) interference by spectators. Without making suggestions in detail the Committee think that the regulations should provide that the person detaining the aircraft should agree to any reasonable proposal put forward by the pilot for the avoidance of damage, e.g., mooring the machine head to wind, with the assistance of earth-screws or stakes, if such are available, and arranging for a guard or other suitable means of preventing damage by spectators. It seems that the mooring of the aeroplane is more important than its protection from the rain, in cases where the aircraft is only to be detained for some hours.

Clause 16.

Subject to a note in Appendix C the Committee approve this Clause.

Clauses 17 and 18.

Subject to a drafting amendment in Clause 18, the Committee approve these Clauses.

Clause 19.

The Committee think that the language of Section 2 of the Aerial Navigation Act, 1913 (which closely corresponds with this clause) should be substituted. Recent experience has shown the danger of foreign aircraft flying over prohibited areas of strategic importance. The Committee think that the regulations contemplated and, indeed, the Clause itself should be made more drastic, and that anyone flying over an area prohibited for naval or military reasons should be liable to be fired at by a Commissioned Officer in charge of an anti-aircraft gun, in his discretion, even without a preliminary signal, in a case of urgency.

Clause 20.

The Committee think that this Clause contains useful provisions which might well be extended to all British Possessions, subject to the right of the legislature of any such Possessions to alter them.

Clauses 21 and 22.

The Committee approve these Clauses.

Clause 23.

The Committee think that Clause 23 would be clearer if re-cast, and that it should provide that the Act and regulations should apply, *mutatis mutandis*, throughout all British Possessions, unless and until the legislature of any British Possession otherwise provides, subject to the exception that local legislatures should not be empowered to modify provisions of an international character, that is to say, those relating to registration, collisions, aircraft papers, and signals of distress.

Clause 24.

It appears to the Committee that certain provisions in the Bill, at least those contained in Clause 12, should apply to aircraft belonging to His Majesty. They, therefore, recommend that this clause should be so drafted as to make the Bill applicable to aircraft belonging to His Majesty, except in so far as any part thereof, other than Clause 12, may be excluded by Order in Council.

7. It will be observed that the Bill contains no provisions dealing with aerodromes or landing places. The Committee have considered the question whether all aerodromes (including Flying Schools) and landing places should be State owned. They have come to the conclusion that this is not desirable, but that, while private persons and companies should be allowed to establish and own aerodromes and landing places, these should be subject to Government licence, inspection, and regulation in some form. It seems to the Committee that reasonable regulations will go a long way towards preventing injury and annoyance to the public, and will at the same time protect aircraft owners from frivolous claims and proceedings. As experience accumulates the regulations will, no doubt, require modification and different regulations will be appropriate according as the aerodromes and landing places are in populous or sparsely-populated districts. In licensing aerodromes the State will, no doubt, have regard to strategic considerations, and provision should be made that when war is imminent any privately owned aerodromes that may have been allowed to be established, with their equipment, should at once be available for military use.

The Committee have already touched upon the necessity of some flying regulations applicable particularly to aerodromes. With regard to this and any other regulations for preventing injury and annoyance to the public, they do not offer detailed suggestions, but they think that Section 126 of the Factory and Workshop Act, 1901 (Special Orders) furnishes a satisfactory precedent for the scope of the powers to make regulations to be conferred on the appropriate Government Department.

8. The consideration of aerodromes and landing places involves the question of the compulsory acquisition of land for their establishment. The Committee are of opinion that the Government should be given similar rights of compulsorily acquiring land for aerodromes and landing places as it has for acquiring land for military works. Private persons wishing to obtain powers for the compulsory acquisition of land for the establishment of aerodromes must proceed by way of private Act of Parliament or provisional order. Such powers would, presumably, have to include powers to cut down trees, remove wire, or perform other similar acts on adjoining land not acquired.

9. It is scarcely within the province of the Committee to recommend alterations in procedure relating to the compulsory acquisition of land. At the same time they think that it would be of great assistance to the development of aeronautics generally if the determination of the amount of compensation payable to the landowner could be made the subject of a more simple and less expensive procedure than that at present employed in private bill legislation. The Light Railways Act of 1896 affords a useful precedent for the avoidance of some of the difficulties. With regard to the amount of compensation payable to the landowners the principles of the Land Clauses Acts have been construed to the landowner's advantage through the establishment by recent judicial decisions of the doctrine known as "special adaptability," whereby the landowner can, in fact, obtain a sum representing a value greater than the ordinary market value of his land where he can show that the land is specially adapted for the purpose for which it is being compulsorily taken. This judicial doctrine has in some instances increased the amount payable to landowners, and it is one which the landowner might pray in aid successfully in the case of the compulsory acquisition of land for an aerodrome. The Committee think that the application of this doctrine should be specifically excluded.

10. The Committee have also considered the subsidiary question of claims for compensation by persons, the value of whose property has been impaired by reason of the establishment of an aerodrome in the vicinity. They think that claims for such compensation should be entertained at any time within five years from the date of the establishment of the aerodrome, and that such compensation should be payable from State funds in the case of an aerodrome established by the Government and by the proprietor in the case of a privately owned aerodrome.

11. The Committee think that the matters referred to in paragraphs 7 to 10 inclusive, above, should be the subject of legislation, and that as they are all matters affecting the development and regulation of aeronautics from the general point of view, they can well be dealt with by the addition of further clauses to the Aerial Navigation Bill under consideration.

In conclusion, the Special Committee wish to record their warm appreciation of the assistance rendered by the Secretaries, upon whom has fallen much work, which has been so ably carried out as greatly to facilitate their proceedings.

Sydenham (Chairman).
Butler Aspinall.
J. H. Balfour Browne.
M. D. Chalmers.
Drogheda.
W. Barnard Faraday.
R. M. Groves, Wing Captain.
L. N. Guillemard.
*G. Holt Thomas.
*W. Joynson Hicks.
*J. Whiteside McCay, Maj. General.
G. E. P. Murray.
J. W. Pringle, Colonel.
E. Elvey Robb, Captain.
W. Sempill, Wing Commander.
*W. P. Schreiner.
E. R. Wayland, Lt. Colonel.

Those members whose names are marked with an asterisk append the following reservations to the Report :—

We concur in the Report with the reservation that in our opinion State ownership of aerodromes and landing places is necessary in the interests of national defence and highly desirable, also, for commercial purposes.

(Signed) J. Whiteside McCay.

W. P. Schreiner.

I desire to add a few words by way of reservation to Clause 6 of Part II. of this Report, so far as it affects Clause 12 of the Home Office Bill.

Our recommendations seem to leave it open to an aviator to fly over private property at any height he likes unless actual material damage is proved, and even if a nuisance is created the aviator is still free if he keeps within certain regulations, the terms of which we have not considered.

In my view, though the whole doctrine of the right of the landowner to property in the air to an indefinite height must be curtailed, still, I am clearly of the opinion that the public will demand, and rightly, a limit above which (except under stress of weather) aviators must fly above private property, and that any persistent flying under this height should be preventable by injunction.

The actual height should, I think, be the subject of consultation with the other sub-committees, but probably somewhere between 2,000—3,000 feet would be fair.

(Signed) W. Joynson Hicks.

I concur in the Report with the following reservations, which are only made with the object of avoiding restrictions which may hamper development of a new mode of transport, of which very little is known at the present time, whereas, as experience accumulates, it will be easy to make such regulations as may be necessary :—

Part I., paragraph 1.

Whilst it is necessary to confer upon the Home Secretary or other authority the right to prohibit the navigation of aircraft over prescribed areas, I should favour the expression of an opinion from this Committee that the prohibition of flying over London should be repealed, also the regulations as to aircraft coming into England. Many of the regulations made were made naturally for war purposes. Compulsory landing of aircraft in England, for instance, must affect British aircraft more than any other, as it is probable that if compulsory landing is insisted upon in England, compulsory landing will be insisted upon in other countries. It will be easy to make such regulations when circumstances show that it is necessary. The Committee, moreover, suggest that the powers at present wielded by the Home Office and Board of Trade will be conferred upon the Air Ministry, in which I quite concur, but it makes it more necessary to leave the new authority a free hand to make such regulations as circumstances may prove necessary in the future.

Part II., paragraph 6, Clause 5.

I see no reason at the present time for requiring any Government certificate for private flyers, nor for restricting the use of the flying machine in this respect any more than a motor car or boat, especially as the public is protected by the fact that the flyer himself is always running a greater risk than anyone else. The conditions of the Aero Club certificate have in the past been quite sufficient.

Paragraph 6, Clause 12.

Ditto. I am not in agreement with the Committee that the Bill should provide any regulations as to the altitude at which pilots should fly. I see no reason to suppose that in the immediate future more machines will be in use at aerodromes than were in use previous to the war, and if circumstances show that a great many more machines are in use, to the danger or annoyance of the public, such regulations as may be necessary may then be made. To hamper at the present time a new development with regulations, which might be quite unnecessary, would probably restrict development.

Paragraph 6, Clause 14.

I am not in agreement with giving the Police such powers of search of aircraft and the persons therein, although it might be well to give the Secretary of State power to make regulations on this point in the future should they be necessary.

Paragraph 7.

I am not in agreement with any control whatever over aerodromes and landing places at the present time other than the powers which existed before the war, and which have proved quite satisfactory up to the present time. Any control must tend to hamper the establishment of private grounds and landing places, which is undesirable in the early stages of development.

The above reservations I have made solely with the object of permitting as free as possible development of the use of aircraft. I do not, however, foresee any such development in the immediate future as will necessitate regulations other than those as existed before the war, and, in the absence of more complete knowledge of the subject, I would suggest that, wherever possible, conditions should be left as they are until our experience of the subject has so accumulated that we have a definite knowledge of what regulations are expedient and desirable.

(Signed) G. Holt Thomas.

APPENDIX A.

INTERNATIONAL CONVENTION in regard to Aerial Navigation drafted by the Conference held at Paris in 1910.

With Observations of the Sub-Committee of the Committee of Imperial Defence, and of Special Committees Nos. 1 and 2 of the Civil Aerial Transport Committee.

Presented as Appendix A to the Report of Special Committee No. 1 of the Civil Aerial Transport Committee.

Observations of the Sub-Committee of the Committee of Imperial Defence.

CHAPTER I.—NATIONALITY AND REGISTRATION OF AIRCRAFT.

Observations and Recommendations of Special Committee No. 1 of the Civil Aerial Transport Committee.

Acceptable.

ARTICLE 1.
THE term "aircraft" comprises: Free balloons, airships, and flying machines.

Acceptable.

Acceptable.

ARTICLE 2.
An aircraft is only governed by the present Convention if it possesses the nationality of a contracting State.
None of the contracting States shall permit a free balloon or airship to fly over its territory unless it complies with the above condition, though special and temporary authorisation may be granted.

To substitute the words "an aircraft" for the words "a free balloon or airship."

This Article to stand, provided that domicile is translated as "residence," and that the rights and duties which a State confers upon its aircraft are clearly defined and are similar to those drawn up at the 1910 Conference.

ARTICLE 3.
In determining the nationality of aircraft, the legislation of each contracting State shall base its decision either on the nationality of their owner or on his domicile in its territory; the State has, moreover, the right of requiring that the owner, if a national, shall also be domiciled in its territory, and it can place on its national register aircraft owned by foreigners domiciled in its territory as well as those owned by its own nationals.

C.I.D. Sub-Committee's proviso approved.

If the aircraft belongs to a corporate society or joint-stock company it can only acquire the nationality of the State where the company's head office is situated.

In cases where the aircraft belongs to several owners the proportion of co-proprietors who are nationals of the State or are domiciled in its territory must be at least two-thirds.

The Special Committee understand that the two criteria of the nationality of aircraft, viz., the nationality of the owner, and the owner's residence in the territory of a contracting State, are not mutually exclusive alternatives. Any provision as to nationality should be considered in the light of existing and future legislation relating to naturalisation of foreigners. Any future legislation as to the nationality of aircraft should provide that British nationality should be taken to mean ownership by British subjects or by corporate bodies registered in the United Kingdom or in some part of His Majesty's Dominions, the effective control of which for all purposes is vested in British subjects.

Acceptable.

ARTICLE 4.
When the aircraft possesses the nationality of one of the contracting States in conformity with article 3, none of the other States can confer their nationality upon it.

Acceptable.

Acceptable.

ARTICLE 5.
An aircraft will lose its nationality if the conditions under which it was granted cease to exist.

Acceptable.

Acceptable.

ARTICLE 6.
The State which confers its nationality on an aircraft shall enter the latter on a register.
In cases where the aircraft's usual station is in the territory of another contracting State, the latter will immediately be notified of its registration.

Acceptable.

Acceptable.

ARTICLE 7.
The entry in the register shall contain a description of the aircraft and shall indicate the number or other identification mark given to it by the maker, the national mark provided for in Annex A, the registration number, the usual station, the name, nationality, and domicile of the owner, and the date of registration.

Acceptable.

Acceptable.

ARTICLE 8.
As soon as an aircraft has been registered a certificate of nationality shall be issued, consisting of an extract from the register giving the particulars specified in the preceding Article.

Acceptable.

Observations of the Sub-Committee of the Committee of Imperial Defence.

CHAPTER II.—CERTIFICATES OF NAVIGABILITY AND LICENCES.

Observations and Recommendations of Special Committee No. 1 of the Civil Aerial Transport Committee.

- Acceptable. **ARTICLE 9.**
The contracting States will exchange annually in January the entries which have been made in their registers during the preceding year.
On the request of another contracting State each State will be obliged to communicate as quickly as possible the names of the owner and pilot of any aircraft possessing its nationality which has entered the air-space over the other State.
- Acceptable. **ARTICLE 10.**
When flying over the territory of one of the contracting States, aircraft must bear the mark of their nationality and their registration number, in the manner specified in Annex A.
They shall also carry, affixed to the car or fuselage, a plate showing the name and domicile of the owner, and reproducing the nationality mark and registration number which they bear.
- Acceptable. **ARTICLE 11.**
The aircraft must be provided with a certificate of navigability issued or authenticated by the State whose nationality it possesses.
- Acceptable. **ARTICLE 12.**
The certificate of navigability will only be issued after what are considered to be sufficient trials made before a public authority of the contracting State, or an aeronautical association duly empowered by the State. Nevertheless, these preliminary trials need not be required in the case of free balloons, or of flying machines of a type whose navigability has already been duly established.
Periodical or non-periodical visits must be made by the public authorities or by associations duly empowered, in order to verify the navigability of aircraft. Such visits shall be noted on the certificate.
- Acceptable. **ARTICLE 13.**
The certificate of navigability shall contain the following particulars: Name or style of firm and domicile of the maker; place and year of manufacture; number or other identification mark given to the aircraft by the makers; photograph in the case of dirigible balloons and flying machines; characteristics of the aircraft in accordance with the provisions of Annex B.
If one of the characteristics specified in the certificate of navigability is modified such certificate shall cease to be valid.
- Acceptable. **ARTICLE 14.**
The pilot, chief mechanic, and their substitutes must be provided with licences issued or authenticated by the State whose nationality has been conferred upon the aircraft of which they are in charge.
In urgent cases the pilot can choose, to replace him or to carry out the duties of chief mechanic, persons provided with licences issued or made valid by another contracting State.
- Acceptable. **ARTICLE 15.**
Different licences will be issued for the control of a free balloon, an airship, and a flying machine, and the licence issued for one category of aircraft will not empower the holder to take charge of a different category.
These licences will only be issued after the capacity of the pilots or mechanics has been proved by theoretical and practical tests carried out before a public authority of a contracting State, or an aeronautical association duly empowered by the State.
- Acceptable. **ARTICLE 16.**
Licences will only be granted to persons at least 18 years old and of good character. They shall contain the name, Christian names, and description of the holder, as well as his photograph and signature.
- Acceptable. **ARTICLE 17.**
A contracting State can only give effect to a certificate or licence which has been issued by another contracting State.
- Acceptable.
- An additional classification should be provided distinguishing official, commercial, and private aircraft by means of special colouring or marks.
- The Special Committee recommend that due provision should be made to secure the competency of pilots and to secure that aircraft plying for hire shall be of types officially certified as being navigable, but that certificates of navigability should not be required for individual aircraft and that this Article should be amended accordingly.
- Acceptable.
- Acceptable.
- Acceptable.
- For the words "and a flying machine" to substitute the words "an aeroplane and a seaplane."
- Acceptable.
- Acceptable.

Observations of the Sub-Committee of the Committee of Imperial Defence.

Acceptable.

ARTICLE 18.

Certificates of navigability and licences issued or authenticated by the State whose nationality an aircraft possesses shall be recognised as valid by the other States, unless it is clear that the conditions under which they have been issued in accordance with the regulations set forth above are no longer fulfilled.

Each State has the right not to recognise, so far as flights within the limits of, and above, its own territory are concerned, the certificate of navigability or licence granted to one of its nationals by another contracting State.

Such non-recognition shall immediately be notified to the State which has issued the certificate or licence.

CHAPTER III.—ADMISSION OF AERIAL NAVIGATION WITHIN THE LIMITS OF, OR ABOVE, THE TERRITORY OF A FOREIGN STATE.

Articles 19 and 20 were left undecided by the Paris Conference. In 1913, the Sub-Committee of the Committee of Imperial Defence suggested the insertion of the following Articles in the Convention:—

1. Each contracting State shall permit for so long as the present Convention is in force the aircraft of the other States to fly within the limits of and above its territory, subject to the restrictions laid down in the following rules:—

2. Each State shall have the right to impose restrictions on the navigation of foreign aircraft, and, more particularly, to forbid such navigation so far as it deems necessary in order to guarantee its own security or that of the lives and property of its inhabitants.

These restrictions shall be applied without any inequality to the aircraft of every other contracting State.

It is, however, agreed that on personal grounds, independent of its nationality, a State can exempt an aircraft of any other contracting State from any one of the restrictions imposed in virtue of the first paragraph.

3. Moreover, each State can forbid or regulate the crossing of its frontiers, provided that the principle laid down in rule 1 is not violated, and that in every case, except when aerial navigation is forbidden, the extent and locality of the places where the passage of the frontier is permitted are such as to give access to the neighbouring contracting States.

4. In cases of accident verified by an authority of the country where an aircraft has been compelled to land, the right of access, which under the provisions of rule 2, paragraph 1, might be forbidden, cannot be refused.

The provisions of rule 2, paragraph 2, do not apply to the measures which, in extraordinary circumstances, a State may take to safeguard its security.

5. The contracting States undertake to adopt or to propose to their legislatures such measures as may be required in order to make the private law of their country conform to the above provisions.

* * * * *

Observations and Recommendations of Special Committee No. 1 of the Civil Aerial Transport Committee.

Acceptable.

The proposed rule suggested by the C.I.D. Sub-Committee approved.

The rule proposed by the C.I.D. Sub-Committee limits a contracting State's right of restricting navigation by the aircraft of other contracting States, and prohibits it from differentiating as between different foreign contracting States. This proposal is open to the objection that one contracting State might use its powers of restriction more severely than others, but nevertheless could not on this account be differentiated against by the others. To meet this objection the Special Committee would propose to insert the following after the second sub-paragraph:—

"It is, however, agreed that any contracting State may refuse to accord to any other contracting State any facilities which the latter does not itself accord under its regulations."

"It is also agreed that on personal grounds," &c., &c.

The C.I.D. Sub-Committee's recommendation agreed to, the Special Committee being strongly in favour of the omission of any such rule.

The proposed rules suggested by the C.I.D. Sub-Committee approved.

The Sub-Committee would prefer to omit rule 3 altogether on the ground that it is superfluous. It was only drafted in case its omission should prove impracticable in the face of the opposition of other States.

Observations of the Sub-
Committee of the Committee
of Imperial Defence.

Observations and
Recommendations of Special
Committee No. 1 of the Civil
Aerial Transport Committee.

Acceptable. **ARTICLE 21.**
Each contracting State shall have the right to reserve the public conveyance of persons and goods between two points on its territory for nation aircraft only or for the aircraft of certain contracting States, or to subject such navigation to special restrictions.
The establishment of international routes of aerial communication will depend upon the assent of the States concerned.

Acceptable.

Acceptable. **ARTICLE 22.**
If a contracting State imposes restrictions such as those contemplated in article 18, paragraph 2, its aircraft may be subjected to analogous measures by any other contracting State.

Acceptable.

Acceptable. **ARTICLE 23.**
The restrictions and reservations contemplated in Articles 19, 20, 21, and 22 shall immediately be published and notified to the Governments concerned.
The forbidden zones shall be defined with sufficient precision to enable them to be shown on aeronautical maps of a scale of at least $\frac{1}{500000}$. The contracting States shall be obliged to communicate these maps to one another.

First paragraph acceptable. To substitute for the second paragraph: "The forbidden zones shall be defined with precision and shown on aeronautical maps which the contracting State shall be obliged to communicate to one another."

Acceptable. **ARTICLE 24.**
As soon as the pilot of any aircraft perceives that he has entered the air space above a forbidden zone he must give the signal of distress specified in Article 16 of Annex (C) and land as soon as possible; he must also land if requested to do so by warning given from the ground. Each State shall give notice of the warning signals which it has adopted.

To substitute for this Article the following: "As soon as the pilot of any aircraft perceives that he has entered the air space above a forbidden zone he must act in accordance with such regulations as may be prescribed by the State. The contracting States shall communicate such regulations to one another."

CHAPTER IV.—REGULATIONS TO BE OBSERVED ON
DEPARTURE, ON LANDING, AND DURING
FLIGHT.

Acceptable. **ARTICLE 25.**
When flying, aircraft must be provided with their certificates of nationality and of navigability and with the licences of such of the personnel as require them. Log books must also be carried.

Acceptable.

Acceptable. **ARTICLE 26.**
The log book must contain the following particulars: Category to which the aircraft belongs, its nationality mark, place and number of its registration, name, nationality, profession, and domicile of its owner.
For each ascent the following entries must be made in the log book:—

To omit in the fourth paragraph the words: "and the altitude, in the case of free balloons and airships by means of a barograph which they must have on board."

The name, nationality, and domicile of the pilot or crew, and the name, nationality, and domicile of the passengers;

Whenever circumstances permit a description of the route followed and of the altitude kept; the route will be indicated on a map, and the altitude, in the case of free balloons and airships, by means of a barograph which they must have on board.

Description of all interesting occurrences, and especially of the places called at, of the aircraft met during the flight, and of any accidents to the aircraft, crew or passengers.

These particulars will be entered in the log book, so far as possible, during the flight, or, if that is impossible, not more than twelve hours after landing.

Acceptable. **ARTICLE 27.**
Each State remains free to regulate the conditions in which the log book of flying machines is kept so long as they fly exclusively over its territory.

Acceptable.

Acceptable. **ARTICLE 28.**
The log book must be kept for at least two years after the last entry, and must be produced on every request of the public authorities.

Acceptable.

Acceptable. **ARTICLE 29.**
The authorities of the country will always have the right to visit the aircraft on its departure and landing, and to exercise in the atmosphere above their territory police jurisdiction and customs supervision.

Acceptable, but the Special Committee hold the view that in the case of the United Kingdom there is no necessity to press for a right of Customs supervision in the air.

Each State can enact that if an aircraft of another contracting State lands on its territory the nearest police or customs authorities must immediately be notified.

The personnel on board the aircraft must conform strictly to the police regulations and provisions of the customs laws of the country.

Acceptable. Each State undertakes to enact that all aircraft within the limits of, or above, its territory, and all its own aircraft within the limits of, or above, the territory of another contracting State shall comply with the "Rules relating to Aerial Traffic" annexed to the present Convention (Annex (C)) and to punish those which fail to do so.

Acceptable.

Acceptable. **ARTICLE 31.** The contracting States must instruct their authorities to afford aircraft the necessary assistance when they land or are in distress. They will also instruct their populations, as well as their shipping and aircraft, in the measures to be taken to assist an aircraft in distress.

Acceptable.

Acceptable. **ARTICLE 32.** Any person finding a wrecked aircraft must notify the neighbouring municipal authority or the competent authority at the next port at which he touches; the wreck, if it can be identified, will be restored to its owner, who, if he does not abandon it, shall repay the expenses of the person who has salvaged it, and shall remunerate him at the rate of 5 per cent. of the value of the wreck. If the wreck is abandoned, the competent authority will proceed according to local legislation.

Acceptable, it being understood that the Article contemplates the finding of wrecked aircraft both on land and at sea, and that in the first case the notification must be made to the neighbouring municipal authority, in the second to the competent authority at the next port touched at.

CHAPTER V.—CUSTOMS AND TRANSPORTATION.

Acceptable. **ARTICLE 33.** Aircraft landing in a foreign country and intended to be re-exported shall enjoy, together with their equipment, exemption from customs dues, provided they comply with the formalities required in this respect in each country, such as those in regard to permits to import for drawback, temporary admission, payment of dues into Court, or the triptych. Supplies and material for the navigation of the aircraft will enjoy the privileges and exemptions usually accorded in the contracting State.

Acceptable, provided that the privileges and exemptions accorded in respect of supplies and material for the navigation of aircraft are of the same nature as those generally accorded in respect of supplies and material for the running of motor-cars taken to a foreign country for touring purposes.

When a landing takes place in a foreign country the baggage and personal effects of the aeronauts and passengers on board an aircraft shall be given the same treatment as similar objects which travellers or passengers import by the land or sea frontiers.

Acceptable. **ARTICLE 34.** The carriage of goods by air can only take place in virtue of special conventions between the States concerned or of the provisions of their own legislation.

Acceptable, provided that the word "goods" should be taken to mean goods in a commercial sense.

Acceptable. **ARTICLE 35.** The carriage by aircraft of explosives, arms, and munitions of war, and of traveller and other carrier pigeons, is forbidden in international traffic.

Acceptable.

Acceptable. **ARTICLE 36.** Each State can forbid or regulate the carriage or use of photographic apparatus above its territory. It can cause the negatives found on board a foreign aircraft landing on its territory to be developed, and can, if necessary, seize the apparatus and negatives.

Acceptable.

Proposed to omit the words "applied to national aircraft in the same way as to foreign aircraft," and to replace them by the words "applied to the aircraft of all other contracting States."

ARTICLE 37. Restrictions can be imposed on the carriage of articles other than those specified in articles 34, 35, and 36, provided such restrictions are, generally speaking, applied to national aircraft in the same way as to foreign aircraft; it is, however, agreed that, for personal reasons independent of nationality, a State can exempt an aircraft from one or other of these restrictions.

Acceptable, subject to the amendment proposed by the C.I.D. Sub-Committee.

Proposed to insert after the words "radio-telegraphic apparatus" the words "or to forbid them to do so"

ARTICLE 38. Each State has the right to authorise aircraft within the limits of and above its territory to carry on board a radio-telegraphic apparatus. Such apparatus cannot, without special permission, be used except when the safety of the aircraft is concerned.

To substitute for this Article the following: "Each State has the right to forbid or to regulate the carriage, or use, within the limits of and above its territory, of radio-telegraphic apparatus."

Acceptable. **ARTICLE 39.** The regulations issued in virtue of articles 34, 36, and 37, and the general authorisations granted in virtue of article 38, shall immediately be published and notified to the other contracting States.

Consequent upon the preceding recommendation, to omit the words "and the general authorisations granted in virtue of Article 38," and to substitute the words "and 38,"

Acceptable.

ARTICLE 40.
Public aircraft are the aircraft employed in the service of a contracting State, and placed under the orders of a duly commissioned official of that State.

The provisions of the present convention will be applied to public aircraft, with the exception of those of articles 2 to 5, 11 to 18, and 38.

Public aircraft may carry a radio-telegraphic apparatus on board, but cannot use it, without special permission, except when the safety of the aircraft is concerned.

In the second paragraph, to omit the words "and 38." In the third paragraph, after the words "use it" to insert the words "when in or above foreign territory."

Acceptable.

ARTICLE 41.

Military aircraft are the public aircraft in military service when they are under the orders of a commander in uniform and have on board a certificate proving their military character.

Besides the provisions from which public aircraft are exempted by article 40, paragraph 2, the provisions of articles 6 to 10, 35, and 37 do not apply to military aircraft.

Military aircraft come under the special provisions of articles 43 and 46.

Acceptable.

Acceptable.

ARTICLE 42.

The only distinctive national mark borne by military aircraft will be the Sovereign emblem of their State. Each contracting State shall notify the other States of the Sovereign emblem which it will use.

Acceptable, subject to the proviso that His Majesty's Government should have the right to select any emblem or distinctive mark which appears suitable to them, not necessarily a national flag design.

Acceptable.

ARTICLE 43.

In cases where any communication has to be made by the commander of a military aircraft, he will notify the competent authorities of the country; if the latter are not military authorities, they will inform the military authorities without delay.

Acceptable.

New Article Proposed.
The departure or landing of the military aircraft of a contracting State in the territory of another State, as well as the passage of military aircraft over such territory, will only be allowed with the authorisation of the latter State.

ARTICLE 44.

The departure or landing of the military aircraft of a contracting State in the territory of another State will only be allowed with the latter's authorisation.

Moreover, each contracting State is free to forbid, or to regulate, as its interests demand, the passage of the military aircraft of the other contracting States over its territory.

The new Article proposed by the C.I.D. Sub-Committee approved.

Acceptable.

ARTICLE 45.

Nevertheless, a sojourn required by necessity cannot be refused to the military aircraft of a contracting State.

A military aircraft which, in such case of necessity, is above a foreign territory, shall give the signal of distress laid down in article 16 of Annex (C), and shall effect a landing as quickly as possible.

Immediately after landing, the commander of the aircraft shall notify the competent authority of the country, as defined in article 43. The military authorities will make an examination and decide upon the necessity of the landing.

Acceptable.

***New Article Proposed.**
When the stay of the military aircraft within the limits of, and above, the territory of a foreign State is to be regarded as legitimate, in conformity with Article 44, such aircraft will enjoy the same privileges as are accorded by international usage and courtesy to foreign ships of war.

The above privileges will also be accorded to the members of the crew wearing uniform, so long as they do not cease to form a distinct unit or are carrying out their duties.

ARTICLE 46.

When the sojourn of the military aircraft within the limits of, and above, the territory of a foreign State, is to be regarded as legitimate in conformity with articles 44 and 45, such aircraft shall enjoy the privilege of extra-territoriality.

Similarly the members of the crew wearing uniform shall enjoy extra-territoriality, so long as they do not cease to form a distinct unit or are carrying out their duties.

The authorities of the country are not, however, precluded from applying to the military aircraft of another contracting State, and to their crews, the measures required either to assure the safety of the State, or the observance of sanitary regulations, or to protect lives and property from imminent danger.

The new Article proposed by the C.I.D. Sub-Committee and their note as to verification in the case of public aircraft approved.

Acceptable.

ARTICLE 47.

Police aircraft are public aircraft employed in the service of the police, especially that of the departments of public safety, public health, or customs.

The provisions of articles 41, 42, 44, and 45 will by analogy be applied to police aircraft.

The sovereign emblem borne by police aircraft will be different to that of military aircraft. Moreover, the functions which, under article 45, paragraph 3, belong to the military authorities, will, in the case of police aircraft, be carried out by the civil authorities.

Acceptable, subject to the Special Committee's proviso with regard to Article 42.

* Note by the Sub-Committee.—It is desirable to press at the same time for the insertion of a separate clause requiring public as well as private aircraft claiming the privileges of distress to submit to "constatation" (verification).

Acceptable.

ARTICLE 48.
The present Convention shall apply to aerial navigation within the limits of and above the territory or territorial waters of the contracting States.

Acceptable.

The provisions of the Convention, within the terms of article 2, shall be imposed upon the aircraft belonging to the nationals of a contracting State, whatever their domicile, and upon the aircraft belonging to the nationals even of a non-contracting State domiciled in the territory of a contracting State.

Acceptable.

ARTICLE 49.
The present Convention does not restrict the freedom of action of belligerents, or affect the rights and duties of neutrals.

Acceptable.

Acceptable.

ARTICLE 50.
A central authority shall be set up in each State to make and receive direct the communications contemplated in the Convention.

Acceptable.

Acceptable.

ARTICLE 51.
The present Convention shall be ratified as soon as possible.

Acceptable.

The ratifications shall be deposited in the archives of the Ministry for Foreign Affairs of the French Republic.

The first deposit of ratifications will be recorded in a protocol signed by the representatives of the adhering States and the Minister for Foreign Affairs of the French Republic.

The later deposits shall be made by written notification addressed to the French Government and accompanied by the ratification.

Certified copies of the protocol of the first deposit of ratification, of the notifications mentioned in the preceding paragraph, and of the ratifications which accompany them, shall immediately be communicated by the French Government through the diplomatic channel to the States which have signed the present Convention, or adhered to it. In the cases contemplated in the preceding paragraph, the said Government shall at the same time make known the date on which it received the notification.

Proposed:

After words "into force in" insert the words "one or more of."

At end of article insert:

"The denunciation of the present convention by one of the contracting States for one or more of its colonies, possessions, or protectorates will always be effected by a special notification addressed to the French Government, which will be deposited in the archives of that Government. It will take effect twelve months after the date of such deposit."

ARTICLE 52.
The present Convention does not apply as of right except to the mother countries of the contracting States.

If a contracting State desires that it should be put into force in its colonies, possessions, or protectorates, it shall declare its intention either expressly in the ratification or in the Act of Adherence (article 53, paragraph 2), or by a special notification addressed in writing to the French Government, which shall be deposited in the archives of that Government. If the State making the declaration chooses the latter procedure, the French Government will immediately transmit to the other contracting States a certified copy of the notification, indicating the date of receipt.

The amendments proposed by the C.I.D. Sub-Committee approved.

Acceptable.

ARTICLE 53.
Non-signatory States may adhere to the present convention, whether they were represented at the Paris Conference on Aerial Navigation or not.

Acceptable.

The State which desires to adhere notifies its intention in writing to the French Government, enclosing the Act of Adhesion which will be deposited in the archives of the said Government. This Act will show the letter or combination of letters which the State will use as its national mark, and which must differ from those included in Annex (A).

The French Government shall immediately transmit to all the signatory or adhering States a certified copy of the notification and Act of Adhesion, indicating the date of receipt.

Acceptable.

ARTICLE 54.
The present Convention shall take effect, for the States which participate in the first deposit of ratifications, sixty days after the date of the protocol of the deposit, and for the States which ratify or adhere to it afterwards, and the colonies, possessions, or protectorates not mentioned in the ratifications, sixty days after the notifications specified in article 51, paragraph 4, article 52, paragraph 2, and article 53, paragraph 2, have been received by the French Government.

Acceptable.

Observations of the Sub-Committee of the Committee of Imperial Defence.

Proposed:

For words "three years" in the second paragraph read "two years."

Insert at end of article:

"After two years from the date of the first deposit of ratifications each State will have the right to summon a conference to revise the convention, and, in default of an agreement, the present Convention will terminate if its prolongation is not voted by a majority of the contracting States."

Acceptable.

Observations and Recommendations of Special Committee No. 1 of the Civil Aerial Transport Committee.

Acceptable, subject to the amendments proposed by the C.I.D. Sub-Committee.

ARTICLE 55.

If one of the contracting States wishes to denounce the present Convention, the denunciation shall be notified in writing to the French Government, who will immediately communicate a certified copy of the notification to all the other States, indicating the date of receipt.

The denunciation, which cannot be made till three years after the date of the first deposit of ratifications, shall apply only to the State which has notified it, and one year after the notification has reached the French Government.

Done at Paris,

and in one single copy.

ANNEX (A).

NATIONALITY AND REGISTRATION MARKS.

The nationality mark specified in Article 10 will be represented by the following capital letters in Latin characters:—

Germany, D; Austria, A; Belgium, B; Bulgaria, B G; Denmark, D M; Spain, E; France, F; Great Britain, G B; Hungary, H; Italy, I; Monaco, M C; Netherlands, N L; Portugal, P; Roumania, R M; Russia, R; Serbia, S B; Sweden, S; Switzerland, S S; Turkey, T.

The letters and numbers indicating the nationality mark and registration number must be legible at the greatest possible distance, and must in all cases have a minimum height of 65 centim. The letters and numbers will be two-thirds as wide and one-sixth as thick as their height. They will be coloured black on a white background, and painted on the aircraft itself in a place chosen so that the distinctive signs are legible in flight.

ANNEX (B).

CHARACTERISTICS OF THE AIRCRAFT.
(Article 13 of the Convention.)

Acceptable.

For free balloons:—

1. Dimensions of the envelope (diameter, circumference, capacity).
2. Diameter of the valve.
3. Fabric of the envelope.
4. Position of the valve and rip-panel with their respective controls.
5. Details of the suspension of the car.

For airships:

1. Envelope: Type; nature, principal dimensions; ballonets.
2. Car: quantity, dimensions, position.
3. Motor: type, quantity, power, bore of cylinders, stroke of pistons.
4. Propellers: type, quantity, position.
5. Vertical rudders: type, quantity, position.
6. Horizontal rudders: arrangement, type, quantity, position.
7. Stabilising planes: arrangement, quantity, position.

For flying machines:

1. Type.
2. Planes: quantity, dimensions, total surface, position.
3. Motors: as for dirigibles.
4. Propellers: as for dirigibles.
5. Rudders: as for dirigibles.
6. Tail-planes: as for dirigibles.
7. Landing chassis: nature, position.

Acceptable.

ANNEX (C).

RULES RELATING TO AERIAL NAVIGATION.
(Article 30 of the Convention.)

1.—Regulations respecting Lights.

ARTICLE 1.

The regulations concerning lights must be observed from sunset to sunrise in all weathers, and during that time no other light must be shown which could be taken for one of the prescribed lights.

Acceptable.

Acceptable.

Acceptable.

- ARTICLE 2.—*Lights to be carried by Airships.*
An airship under way, that is to say, moving under its own power, must carry:—
- (a.) At the bow, a brilliant white light arranged in such a manner as to throw an uninterrupted beam over a horizontal arc of 220 degrees, that is to say, from right ahead to 110 degrees on each side.
 - (b.) On the right, a green light arranged in such a manner as to throw an uninterrupted beam over the whole of a horizontal arc of 110 degrees, that is to say, from right ahead to 20 degrees abaft the beam on the left.
 - (c.) On the left, a red light arranged in such a manner as to throw an uninterrupted beam over the whole of the horizontal arc of 110 degrees, that is to say, from right ahead to 20 degrees abaft the beam on the left.
 - (d.) The three lights—white, green, and red—must be visible in each vertical plane corresponding to their respective zones in each direction, comprised between the vertical downwards and the line as nearly as possible approaching to the vertical, and making an angle of at least 30 degrees above the horizontal.
 - (e.) The green and red side lights must also be provided with shields or screens, arranged in such a manner that their light cannot be seen on the opposite side.
 - (f.) The white light must be visible at a distance of at least 4 kilom. and the green and red side lights at a distance of at least 2 kilom. on a dark night with a clear atmosphere.
 - (g.) An airship shall, moreover, be provided with the means of showing occasionally a white light astern, if overtaken by another aircraft.

Acceptable.

- ARTICLE 3.—*Lights to be carried by Flying Machines.*
The rules relative to lights are, in principle, applicable to flying machines, but, as a temporary concession, they need only carry a single lamp or beacon, arranged in such a manner as to show a green light to the right and a red light to the left.
The angles of visibility in the horizontal must be those laid down in the case of airships. So far as the angles of visibility in the vertical and the minimum radius of visibility of the lights are concerned, it is simply recommended that the regulations prescribed for dirigible balloons be followed as closely as possible.

Acceptable.

- ARTICLE 4.—*Lights to be carried by Free Balloons.*
Free balloons must always carry ready for use a white light, which must be displayed on the approach of another aircraft.

II.—*Audible Signals*

Acceptable.

- ARTICLE 5.
(a.) During fog, mist, snow, or heavy rains aircraft must, by day as well as by night, make use of powerful, discontinuous, audible signals.
(b.) In the same circumstances, free balloons must also make use of such signals whenever they are in the neighbourhood of motor-driven aircraft.
(c.) The above regulations only apply to flying machines so far as is practicable.

The regulations contained in this Article are substantially those which are in force at the present time for the navigation of naval airships, and except that an additional regulation should be made providing for a top light, throwing an uninterrupted beam in a vertical direction upward, the Special Committee approve this Article.

The present regulations in the case of naval and military flying machines provide for port and starboard lights (red and green respectively, but showing in each case a white light straight ahead) and a white tail light.

Difficulty is experienced in preventing the lights being masked when viewed from certain angles, and investigation is proceeding for the purpose of overcoming this difficulty.

It will be observed that the rules laid down in this Article are not so precise as the existing regulations, and the Special Committee recommend that the international rules shall be so drawn up, in consultation with the flying authorities of the Allied Governments, as to include more definite provisions as to the lighting of flying machines.

The Special Committee recommend that the white light referred to in this Article should be displayed by free balloons at all times during the period mentioned in Article 1.

As regards paragraphs (a) and (b) the Special Committee are of opinion that paragraph (a) should be made applicable to airships and free balloons, and that paragraph (b) should consequently be deleted.

With regard to paragraph (c) the Special Committee understand that the difficulties of providing a satisfactory audible signal as between flying machines are insuperable, and that therefore this paragraph cannot stand in its present form. It is understood, however, that the possibility of providing aeroplanes with magnetic or wireless signalling apparatus is now being investigated, and should any simple system be successfully devised the Special Committee think that an international regulation enforcing its use would be desirable.

III.—*Rules of the Road.*

ARTICLE 6.

Acceptable.

A motor-driven aircraft must always keep at a distance of at least 100 metres from another aircraft in every direction, whether horizontal, vertical, or oblique.

ARTICLE 7.

Acceptable.

Motor-driven aircraft must always make way for free balloons.

ARTICLE 8.

Acceptable.

When two motor-driven aircraft are flying on courses which cross in such a way as to give reason to fear a collision the aircraft which sees the other on the right of its own course must give way to the other aircraft.

When, in accordance with the above rule, one of the aircraft has to change course, the other must keep its own course and maintain its speed.

ARTICLE 9.

Acceptable.

Every motor-driven aircraft which, in accordance with the above rules, has to give way to another aircraft, must, if circumstances permit, take care not to cross in front of the other aircraft.

ARTICLE 10.

Acceptable.

When two motor-driven aircraft meet head on or nearly so, following opposite or almost opposite courses, at altitudes which only differ slightly, so that a collision is to be feared each must turn to the right so as to pass the other on its left.

ARTICLE 11.

Acceptable.

Notwithstanding any of the rules laid down in the preceding articles, every motor-driven aircraft overtaking another must steer clear of the latter's course.

An aircraft overtaking another is an aircraft which nears another on a course which meets the latter's wake at an angle of more than 20 degrees—that is to say, which is in such a position in regard to the aircraft which it overtakes that it could not, at night, perceive either of the latter's side-lights. No later change in the position of the two aircraft can make the aircraft which overtakes the other considered to be *crossing* the latter's route, in the sense of Article 8, nor can such change relieve it from the duty of steering clear of the latter's course until it has absolutely passed it.

ARTICLE 12.

Acceptable.

Whenever the necessary manœuvres are not specified in the preceding rules, the aircraft which have to manœuvre can do so vertically as well as horizontally.

ARTICLE 13.

Acceptable.

In case of imminent collision, the two aircraft must manœuvre as best they can. In particular, the highest must try to ascend and the other to descend.

When they are on the same level and crossing one another, whichever sees the other on the right of its own course must ascend, and the other must descend.

ARTICLE 14.

Acceptable.

When an airship has stopped voluntarily, it must display a conspicuous black ball: it is then subject to the same rules as an aircraft under way.

If it is no longer under control owing to a breakdown of any kind, it must display two conspicuous black balls placed vertically one above the other: it will then be treated as a free balloon.

At night in both cases, it shall only display a white light, and shall be treated as a free balloon.

IV.—*Landing and Distress Signals.*

ARTICLE 15.

Acceptable.

When an airship is about to land it must—

By day, display a triangular red flag on the underside of the car.

By night, wave or flash a white light, at the same time keeping the regulation side lights burning.

Articles 6 to 13 inclusive.

These Articles, although they contain rather more detailed provisions as to the possibilities of collision, closely resemble the regulations for preventing collisions in the air drawn up in 1912 by the Royal Aero Club, which are in force in the United Kingdom at the present time.

The Special Committee are of opinion that the rules of the Royal Aero Club should form the basis of the collision rules in any future Convention, with the addition of the following two suggested rules dealing with the possibility of collision between flying machines and airships:—

1. A flying machine must always keep at a distance of at least 200 metres in every direction from an airship.

2. Flying machines must always make way for airships and free balloons, and airships must always make way for free balloons.

In all the circumstances mentioned in this Article the present practice for an airship is to employ wireless signalling or signalling by flash-light. The Special Committee are of opinion that this Article should be re-drafted so as to accord with the present practice.

The present system of landing signals in the case of airships is by wireless or flash-light by day or night; in the case of flying machines no particular regulation is in force universally, although Verey light signals are used at night, and can also be employed by day.

The Special Committee are of opinion that this Article should be re-drafted so as to apply the present system of landing signals to airships, and that in the case of flying machines the regulations should be the subject of discussion with Allied Governments, always provided that these regulations shall be of the simplest possible character.

Acceptable.

ARTICLE 16.

(a.) In case of distress, when above land or sea, an airship must, so far as possible—

By day, display a triangular red flag on the underside of the car, in addition to the two superposed black balls mentioned in Article 14.

By night, wave or flash a white light, and at the same time extinguish the side lights.

By day as well as by night, it can, in addition, make use of an audible signal.

(b.) A free balloon in distress must—

By day, display a triangular red flag on the underside of the car; and

By night, wave a white light.

By day as well as by night, it can, in addition, make use of an audible signal.

Wing Captain Groves, R.N., a member of Special Committee No. 2, appended the following reservation to these recommendations:—

Article 2 (f.) "This Article prescribes for airships distances of at least 4 kilom. and 2 kilom. at which the white light and the coloured side lights respectively are to be visible on a dark night with a clear atmosphere. In my opinion, in view of the increased speed of aircraft, the rule should be amended so as to provide minimum distances of visibility of 6 and 3 kilom respectively in the case of small airships, and of 8 and 4 kilom respectively in the case of large airships. Such an amendment is desirable when the very short time which a modern aeroplane takes to traverse, *e.g.*, a distance of 2 kilom. is taken into account."

Lieutenant-Colonel O'Gorman, a member of Special Committee No. 2, appended the following reservation to these recommendations:—

Audible Signals.—"In so far as these signals are intended to warn aeroplanes of the presence of airships or balloons, such signals are of little value, and if the avoidance of collision with aeroplanes is one of the chief reasons for carrying such signals on airships then it is not worth while to impose the carrying of the appliances for making audible signals on such craft: a wireless or other signal of more universal utility would be far preferable in time of fog."

Special Committee No. 2 appended the following general note to their recommendations:—

"It will be observed that the Draft Convention contains no regulations as to flying into and out of aerodromes. Although the general rules of the air would apply to such flying, it seems to the Special Committee that some aerodrome regulations of a quite general character should be made the subject of international agreement. Such regulations as have been drawn up in the United Kingdom are not completely satisfactory, and the Committee are not in a position to recommend a detailed code. At certain stations the following system is in vogue for controlling inward and outward traffic. Large movable arrows are employed, which can be illuminated at night, and which indicate always the direction of the ground wind; or, in the absence of wind, the best lie of the land. This enables pilots who arrive to land head to wind, while those who start away on a flight also do so head to wind. Some additional and equally simple rule is necessary to prevent the possibility of collision between a machine which is spiralling down to reach the aerodrome and one which is gliding in straight ahead, and also between incoming and outgoing traffic and any machine which might be making practice or pleasure flights above the aerodrome."

Note.—The following four recommendations were inserted at the end of the Draft Convention for the purpose of putting on record the views of particular delegations, although at the time the provisions proposed had not been accepted as practicable by the Conference as a whole:—

Recommendations

In addition the Conference makes the following recommendations:—

Acceptable.

1. That the Governments shall endeavour to indicate by clearly visible marks certain points which can be used as landmarks by aeronauts, and which should be placed on the ground, or on buildings such as railway stations, &c
2. That the Governments shall mark visibly and uniformly high tension electric wires, and the supports of aerial cables and shall indicate their position on aeronautical maps of the same decimal scale in each country.
3. That the regulation of radio-telegraphic communication between aircraft, the earth, and ships, as well as all questions of technique and financial adjustment, shall be submitted to the forthcoming London Conference on radio-telegraphy.
4. That the Governments shall study the question how far it would be useful to set up an International Board for Aerial Navigation, and consider what powers should be conferred on such a Board.

With regard to paragraph (a) the Special Committee are of opinion that this paragraph should be re-drafted so as to provide for signals similar to those mentioned in their recommendation in relation to Article 14, but they think that the provision as to audible signals by day and night should be preserved.

With regard to paragraph (b) the Special Committee approve these regulations.

The Special Committee are further of opinion that a short regulation should be added dealing with distress signals by flying machines, which might take the form of smoke bombs or Vevy lights.

It is understood that this matter was not considered at the Conference referred to; it is recommended that it may be considered at the next International Conference that may be held on the subject.

APPENDIX B.

*AERIAL NAVIGATION BILL.

ARRANGEMENT OF CLAUSES.

Clause.

1. Power to regulate aerial navigation.
2. Qualifications by owning aircraft.
3. Registration of British aircraft.
4. Certification of airworthiness.
5. Certification of officers.
6. Collision regulations.
7. Identification regulations.
8. Aircraft papers.
9. Signals of distress regulations.
10. Customs regulations.
11. Post Office regulations.
12. Trespass and damages for injury caused by aircraft.
13. Salvage of wrecked aircraft.
14. Search.

Clause.

15. Seizure and detention of aircraft.
16. Forgery, &c., of certificates, &c.
17. Punishment for offences.
18. Provisions as to public foreign aircraft.
19. Power to fire on aircraft flying over prohibited areas.
20. Jurisdiction.
21. Supplementary provisions as to British aircraft.
22. Application of Foreign Enlistment Act.
23. Extent of Act.
24. Exemption of Government aircraft.
25. Application to Scotland.
26. Application to Ireland.
27. Application of Act to Isle of Man and Channel Islands.
28. Short title and commencement.

DRAFT OF A BILL

FOR THE REGULATION OF AERIAL NAVIGATION.

[1 Geo. 5.]
A.D. 1911.

WHEREAS the sovereignty and rightful jurisdiction of His Majesty extends, and has always extended, over the air superincumbent on all parts of His Majesty's dominions and the territorial waters adjacent thereto:

And whereas it is expedient to regulate the navigation of aircraft, whether British or foreign, within the limits of such jurisdiction, and in the case of British aircraft to regulate the navigation thereof both within the limits of such jurisdiction and elsewhere:

Be it therefore enacted by the King's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

Power to regulate aerial navigation.

1.—(1) The Secretary of State may by order regulate or prohibit aerial navigation by British or foreign aircraft or any class or description thereof over the British Islands and the territorial waters adjacent thereto, or any portions thereof, and in particular, but without derogating from the generality of the above provision, may by any such order—

- (a) prescribe zones (hereinafter referred to as prohibited zones) over which it shall not (except as otherwise provided by the order) be lawful for aircraft to pass;
- (b) prescribe the areas within which aircraft coming from any place outside the British Islands shall land, and the other conditions to be complied with by such aircraft;
- (c) prohibit, restrict, or regulate the carriage in aircraft of explosives, munitions of war, carrier pigeons, photographic and radio-telegraphic apparatus and any other article the carriage of which may appear to the Secretary of State to be dangerous to the State or to the person or property of individuals;
- (d) prohibit, restrict, or regulate the carriage in aircraft of merchandise or passengers;
- (e) make such provision as may appear best calculated to prevent damage and nuisance being caused by aircraft.

(2) If any person does anything in contravention of any of the provisions of any such order he shall in respect of each offence be guilty of a misdemeanour:

Provided that if it is proved that the contravention was committed with the intention of communicating to any foreign State any information, document, sketch, plan, model, or knowledge acquired, made or taken or with the intention of facilitating the communication at a future time of information to a foreign State any information, document, sketch, plan, model, or knowledge acquired, made or taken or with the intention of facilitating the communication

at a future time of information to a foreign State, he shall be guilty of a felony, and on conviction on indictment be liable to penal servitude for life or for any term not less than three years, and this proviso shall have effect and be construed as if it were part of the Official Secrets Act, 1889.

A.D. 1911.

(3) Every order under this section shall have effect as if enacted in this Act, but as soon as may be after it is made shall be laid before each House of Parliament, and if an address is presented to His Majesty by either House of Parliament within the next subsequent twenty-one days on which that House has sat next after any such order came into force, praying that the order may be annulled, His Majesty may annul the order and it shall thenceforth be void, without prejudice to the validity of anything previously done thereunder.

[See 8 Edw. 7. c. 40. s. 10 (3.)]

2.—An aircraft shall not be deemed to be a British aircraft unless owned wholly by persons of the following descriptions (in this Act referred to as persons qualified to be owners of British aircraft), namely:—

Qualifications by owning aircraft. [See 57 & 58 Vict. c. 60. s. 1.]

- (a) Natural-born British subjects;
- (b) Persons naturalised by or in pursuance of an Act of Parliament of the United Kingdom, or by or in pursuance of an Act or Ordinance of the proper legislative authority in a British possession;
- (c) Persons made denizens by letters of denization;
- (d) Bodies corporate established under and subject to the laws in force in some part of His Majesty's dominions and having their principal place of business in those dominions, [all of whose directors and shareholders come under one of the afore-mentioned heads]:

Provided that any person who either—

- (1) being a natural-born British subject has taken the oath of allegiance to a foreign Sovereign or State or has otherwise become a citizen or subject of a foreign State; or
- (2) has been naturalised or made a denizen as aforesaid;

shall not be qualified to be an owner of a British aircraft, unless after taking the said oath or becoming a citizen or subject of a foreign State, or on or after being naturalised or made a denizen as aforesaid, he has taken the oath of allegiance to His Majesty the King and is during the time he is owner of the aircraft either resident in His Majesty's dominions or a partner in a firm actually carrying on business in His Majesty's dominions.

3.—(1) Every British aircraft shall be registered in such manner as the Board of Trade may by regulations prescribe:

Registration of British aircraft.

Provided that an aircraft which is registered under the law of any foreign nation as an air-

A.D. 1911. craft belonging to that nation shall not also be registered as a British aircraft.

(2) Regulations under this section may provide for—

- (a) the appointment and duties of registrars;
- (b) the keeping of registers and the particulars to be entered therein;
- (c) the procedure for obtaining the registration of aircraft by the owners thereof, including the evidence to be produced as to the qualifications of applicants;
- (d) the issue, form, custody, and delivery up of certificates of registration;
- (e) the transfer and transmission of British aircraft;
- (f) the fees to be paid;
- (g) the application with the necessary modifications, for any of the purposes aforesaid of any of the provisions contained in sections twenty to twenty-two, twenty-five, twenty-seven to thirty, thirty-nine to forty-six (except so far as those sections relate to mortgages), forty-eight to fifty-three, fifty-six, fifty-seven, sixty, sixty-one, and sixty-four of the Merchant Shipping Act, 1894.

[See 57 & 58 Vict. c.60, ss.2 (2) & 72.]

(3) If an aircraft required under this Act to be registered is not so registered it shall not be recognised as a British aircraft, and shall not be entitled to any of the benefits, privileges, or advantages, or protection enjoyed by British aircraft, nor to assume the British national character, but so far as regards the payment of dues, the liability to fines and forfeitures, and the punishment of offences committed on such aircraft, or by any person belonging to it, such aircraft shall be dealt with in the same manner in all respects as if she were a recognised British aircraft.

(4) If any person required under the regulations to deliver up a certificate of registration fails to do so, he shall be guilty of an offence under this Act.

(5) If the owner or pilot of an aircraft uses or attempts to use a certificate of registry not legally granted in respect of the aircraft, he shall in respect of each offence be guilty of a misdemeanour.

Certification of airworthiness.

4.—(1) An aircraft (if not exempted from the provisions of this section by the regulations made thereunder) shall not be navigated unless its airworthiness has been certified in accordance with regulations made by the Board of Trade and the certificate of airworthiness in respect thereof is for the time being in force.

(2) The regulations of the Board of Trade under this section may, amongst other things—

- (a) prescribe the conditions to be fulfilled (including the equipment to be carried) and the tests to be applied in determining airworthiness;
- (b) provide for the conduct on behalf of the Board of Trade by other bodies of tests and examinations of aircraft;
- (c) provide for the issue, form, custody, and delivery up of certificates of airworthiness;
- (d) provide for the recognition of certificates of airworthiness granted under the laws of any British possession or foreign nation which appear to the Board of Trade effective for ascertaining and determining airworthiness;
- (e) prescribe the fees to be paid in respect of the grant of such certificates and in respect of applications therefor;
- (f) provide for the exemption from the provisions of this section of aircraft of any particular class or under any particular circumstances prescribed by the regulations.

(3) The regulations of the Board of Trade under this section may in the prescribed manner require the owner of any aircraft in respect of which a certificate of airworthiness has been issued or is recognised under those regulations to submit his aircraft at any time for such tests and examinations as may be prescribed for determining whether the conditions of airworthiness continue to be fulfilled, and may authorise endorsement on any such certificate of the result of such tests or examinations, and the cancellation of any such certificate, or the withdrawal of the recognition thereof, on its being found

A.D. 1911. that such conditions have ceased to be fulfilled, or on failure to comply with any such requirement as aforesaid.

(4) If any person navigates or allows to be navigated any aircraft (other than an aircraft of an exempted class) in respect of which a certificate of airworthiness granted or recognised under this section is not for the time being in force, or navigates or allows to be navigated an aircraft in respect of which such a certificate is for the time being in force, knowing that the prescribed conditions of airworthiness have ceased to be fulfilled, he shall be guilty of a misdemeanour:

Provided that this sub-section shall not, nor shall any proceedings taken thereunder, affect any liability of any such person to be proceeded against by indictment for any other indictable offence.

5.—(1) Every aircraft when being navigated shall be provided with a navigator duly certified in accordance with this section, and also, in such cases as may be prescribed by regulations made by the Board of Trade, with such other officers so certified as may be prescribed.

Certification of officers. [See 57 & 58 Vict. c. 60. s. 92.]

(2) The Board of Trade may make regulations—

- (a) as to the issue and form of certificates of competency under this section;
- (b) prescribing the cases in which officers other than the navigator are to be certificated, and the number and character of such officers;
- (c) prescribing the qualifications to be possessed for obtaining a certificate as navigator or as officer serving in any other capacity;
- (d) for holding examinations of candidates for certificates and for such examinations being conducted on behalf of the Board of Trade by other bodies;
- (e) as to the issue of new certificates in place of certificates which have been lost or destroyed;
- (f) as to the cancellation, suspension, endorsement and delivery up of certificates of competency;
- (g) as to the recognition of certificates of competency issued to navigators and other officers under the laws of any British possession or foreign nation which appear to the Board effective for ascertaining and determining their competency;
- (h) as to the fees to be paid on the grant of a certificate and by candidates entering for examination.

(3) The regulations shall provide for different certificates of competency being issued in respect of different classes of aircraft, and a navigator or other officer shall not be deemed to be duly certificated in respect of an aircraft of any class unless he is the holder for the time being of a valid certificate of competency under this section in respect of that class of craft, and of a grade appropriate to his station in the aircraft or of a higher grade.

(4) If any person—

- (a) navigates or allows to be navigated any aircraft not provided with a duly certificated navigator, and, in the case of any aircraft which is under the regulations required to be provided with other certificated officers, without such other officers; or,
- (b) having been engaged as a navigator or other officer required to be certificated, navigates, or takes part in the navigation of, an aircraft without being duly certificated; or
- (c) employs a person as a navigator or as an officer in contravention of this section without ascertaining that the person so serving is duly certificated;

that person shall be guilty of an offence under this Act.

6.—(1) The Board of Trade may make regulations (hereinafter referred to as collision regulations) for the prevention of collisions in the air, and may thereby regulate the lights to be carried and exhibited, the fog signals to be carried and used, and the steering and flying rules to be observed by aircraft.

Collision regulations. [See 57 & 58 Vict. c 60. ss. 418 & 419.]

(2) All owners and navigators of aircraft shall obey the collision regulations, and shall not

A.D. 1911. carry or exhibit any other lights or use any other fog signals than such as are required by those regulations.

(3) If an infringement of the collision regulations is caused by the wilful default of the owner or navigator of the aircraft, the owner or navigator of the aircraft shall in respect of each offence be guilty of a misdemeanour.

(4) If any damage to property arises from the non-observance by any aircraft of any of the collision regulations, the damage shall be deemed to have been occasioned by the wilful default of the person in charge of the aircraft at the time, unless it is shown to the satisfaction of the court that the circumstances of the case made a departure from the regulations necessary.

Alternative for Subsections (3), (4).

(3) If an infringement of the collision regulations is caused by the wilful default of the owner or navigator of an aircraft or of any person in charge of the craft at the time, that owner, navigator or person shall be guilty of a misdemeanour.

(4) If the infringement of the collision regulations is caused by any wilful default, the wilful default shall be deemed to be the wilful default of the navigator. Provided that if the navigator proves to the satisfaction of the court that he issued proper orders for the observance and used due diligence to enforce the observance of the collision regulations, and that the whole responsibility for the infringement in question rested with some other person, the navigator shall be exempt from any punishment under this provision.

(5) The collision regulations may provide for the inspection of aircraft for the purpose of seeing that the craft is properly provided with lights and the means of making fog signals in conformity with the collision regulations [and the seizure and detention of any craft not so provided].

Identification regulations.
[See 3 Edw. 7, c. 36, s. 7.]

7.—(1) The Board of Trade may make regulations providing generally for facilitating the identification of aircraft, and in particular for determining and regulating generally the size, shape, and character of the identifying marks to be fixed under the regulations, and the mode in which they are to be affixed and rendered easily distinguishable [whether by night or day], and any such regulations may provide for the recognition of identifying marks complying with the law of any British possession or foreign nation which appears to the Board of Trade equally effective for facilitating the identification of aircraft.

(2) The regulations under this section may provide for the seizure and detention of any aircraft which is not marked in accordance with those regulations.

(3) If any person navigates or allows to be navigated any aircraft in respect of which any of the requirements of the regulations made under this section are not complied with, he shall be guilty of an offence under this Act [qu. he shall be guilty of a misdemeanour].

Aircraft papers—

8.—(1) The Board of Trade may make regulations—

- (a) requiring logs and such other papers as may be prescribed to be carried in aircraft;
- (b) prescribing the form of such logs and other papers;
- (c) prescribing the entries to be made in logs and the time at which and the manner in which such entries are to be made;
- (d) as to the production, inspection, delivery up, and preservation of logs and other papers.

(2) If any person contravenes any of the provisions of the regulations under this section he shall be guilty of an offence under this Act.

Signals of distress regulations.
[See 57 & 58 Vict. c. 60, s. 434.]

9.—(1) The Board of Trade may make regulations as to what signals shall be signals of distress in respect of the various classes of aircraft, and the signals fixed by those regulations shall be deemed to be signals of distress.

(2) If a pilot of an aircraft uses or displays or causes or permits any person under his authority to use or display any of those signals of distress except in the case of an aircraft in distress such of those signals as are appropriate to the class

to which the aircraft belongs, he shall be liable to pay compensation for any labour undertaken, risk incurred, or loss sustained in consequence of any person having been deceived by the signal [qu. he shall be guilty of an offence against this Act].

A.D. 1911.

10.—The Commissioners of Customs and Excise may, subject to the consent of Treasury, make such regulations as they may consider necessary for the prevention of smuggling and safeguarding the interests of the State with respect to the importation or exportation of goods in aircraft into or from the British Islands, and may for that purpose apply, with the necessary modifications, all or any of the enactments relating to Customs, and may by those regulations, with the consent of the Secretary of State and upon such terms as to payments to police authorities as he may sanction, require officers of police to perform in respect of aircraft all or any of the duties imposed on officers of Customs, and may for that purpose confer on police officers all or any of the powers possessed by officers of Customs.

Customs regulations.

11.—The Postmaster-General may make regulations with respect to the conveyance of postal packets in aircraft, and may for that purpose apply, with the necessary modifications, all or any of the enactments relating to mail ships and the conveyance of postal packets in ships.

Post Office regulations.

12.—(1) The flight of an aircraft over any land in the British Islands shall not in itself be deemed to be trespass, but nothing in this provision shall affect the rights and remedies of any person in respect of any injury to property or person caused by an aircraft, or by any person carried therein, and any injury caused by the assembly of persons upon the landing of an aircraft shall be deemed to be the natural and probable consequence of such landing.

Trespass and damages for injury caused by aircraft.

(2) Where injury to property or person has been caused by an aircraft, the aircraft may be seized and detained until the owner thereof has given security to the satisfaction of a justice or an officer of police not below the rank of inspector to pay such damages as may be awarded in respect of the injury and any costs incidental to the proceedings.

13.—(1) If any person finds, whether on land or at sea, an aircraft which has been wrecked or lost, he shall as soon as may be communicate with the police or other proper authority, and the police or authority shall communicate the information to the owner of the aircraft if he can be ascertained.

Salvage of wrecked aircraft.

(2) Where any such aircraft is salvaged, then—

- (a) if the owner of the aircraft does not abandon his right to the aircraft he shall pay to any persons whose services have contributed to the salvage of the aircraft, including any person or authority who has given or communicated such information as aforesaid, any expenses incurred by them for the purpose and five per cent. of the value of aircraft as salvaged, after deducting from that amount the amount of the expense of salvage payable by the owner, to be distributed amongst those persons in such manner as, in default of agreement, the court having cognisance of the case may think just; and
- (b) if the owner abandons his right to the aircraft, it shall be sold or otherwise dealt with for the benefit of the salvors.

(3) The Board of Trade may make regulations for the purpose of carrying this section into effect, and in particular may prescribe what authority shall be deemed the proper authority, the manner in which communications are to be made, the manner in which an owner may abandon his right to an aircraft, and the manner in which aircraft may be sold or otherwise dealt with for the benefit of the salvors.

14.—(1) If any officer of police has reason for suspecting that an offence against this Act or any regulations made thereunder has been or is being committed on board any aircraft, he may enter and search the craft, and may search any person found therein or who may have been landed therefrom:

Search.
[See 39 & 40 Vict. c. 36] ss. 183-185.

Provided that before any person is searched, he may require to be taken with all reasonable despatch before a justice, who shall, if he sees no reasonable cause for search, discharge that

A.D. 1911. person, but if otherwise direct that he be searched, and if a female she shall not be searched by any other than a female.

(2) If any person assaults or obstructs any officer of police in searching an aircraft, or in searching any person in the aircraft, or who may have landed therefrom, he shall be guilty of an offence against this Act, and if any officer of police without reasonable ground causes any person to be searched, that officer shall be guilty of an offence against this Act.

Seizure and detention of aircraft. 15.—The Secretary of State may make regulations as to the manner in which aircraft, liable to seizure and detention under this Act, may be seized and detained.

Forgery, &c., of certificates, &c. 16.—If any person—

[See 57 & 58 Vict. c. 60. s. 104; 3 Edw. 7, c. 36. s. 5.]

(a) forges or fraudulently alters, or assists in forging or fraudulently altering, or procures to be forged or fraudulently altered, any certificate of registration, airworthiness, or competency under this Act or any log or other papers required under this Act to be carried in an aircraft; or

(b) makes or assists in making or procures to be made any false representation for the purpose of procuring the issue of a certificate of airworthiness, or of procuring either for himself or for any other person a certificate of competency; or

(c) fraudulently uses a certificate of registration, airworthiness, or competency which has been forged, altered, cancelled, or suspended, or to which he is not entitled; or

(d) fraudulently lends his certificate of competency, or allows it to be used by any other person; or

(e) forges or fraudulently alters or uses or assists in forging or fraudulently altering or using, or procures to be forged or fraudulently altered or used, or allows to be used by any other person, any mark for identifying an aircraft, he shall be guilty of a misdemeanour.

Punishment for offences. [See 57 & 58 Vict. c. 60. s. 680.]

17.—(1) An offence against this Act declared to be a misdemeanour shall be punishable with a fine or with imprisonment not exceeding two years, with or without hard labour, but may, instead of being prosecuted on indictment as a misdemeanour, be prosecuted summarily in manner provided by the Summary Jurisdiction Acts, and if so prosecuted shall be punishable only with imprisonment for a term not exceeding three months, with or without hard labour, or with a fine not exceeding one hundred pounds, or with both such imprisonment and fine.

(2) An offence against this Act not declared to be a misdemeanour shall be prosecuted summarily in manner provided by the Summary Jurisdiction Acts, and shall be punishable with a fine not exceeding one hundred pounds or with imprisonment for a term not exceeding three months, with or without hard labour, or with both such imprisonment and fine.

[See 57 & 58 Vict. c. 60. s. 58.]

(3) Where a person is beneficially interested otherwise than by way of mortgage in any aircraft registered in the name of some other person as owner, the person so interested shall as well as the registered owner be subject to all the pecuniary penalties by this Act imposed on owners of aircraft, so nevertheless that proceedings may be taken for the enforcement of any such penalties against both or either of the aforesaid parties with or without joining the other of them.

Provisions as to public foreign aircraft.

18.—It shall not be lawful for any aircraft in the service of any foreign State to pass over or land on any part of the British Islands or the territorial waters adjacent thereto except on the invitation of His Majesty [or of some department of His Majesty's Government], and any person carried in an aircraft contravening the provisions of this section shall be guilty of a misdemeanour, and, unless the Secretary of State otherwise orders, the aircraft may be seized, detained, and searched, and the persons carried therein or landed therefrom may be searched in accordance with the provisions of this Act.

Power to fire on aircraft flying over prohibited areas. [See 39 & 40 Vict. c. 36 s. 181.]

19.—If any aircraft flies or attempts to fly over any prohibited zone or being an aircraft in the service of a foreign State flies or attempts to fly over any part of the British Islands or the

A.D. 1911. territorial waters adjacent thereto in contravention of this Act, it shall be lawful for any commissioned officer in His Majesty's navy, army, or marines [not below the rank of], to cause a gun to be fired as a signal, and if, after such gun has been fired, the aircraft fails to respond to the signal by complying with such regulations as may be made by the Secretary of State under this Act for dealing with the case, to fire at such aircraft, and any such commissioned officer and every other person acting in his aid or by his direction shall be and is hereby indemnified or discharged from any indictment, penalty or other proceeding for so doing.

20.—(1) For the purpose of giving jurisdiction under this Act every offence shall be deemed to have been committed in the place in or over which the same was actually committed or in any place in which the offender may be. [See 57 & 58 Vict. c. 60. ss. 684 and 686.]

(2) Where any person, being a British subject, is charged with having committed any offence on board any British aircraft in the air, over the high seas, or over any foreign country, or on board any foreign aircraft to which he does not belong, or not being a British subject is charged with having committed any offence on board any British aircraft in the air over the high seas, and that person is found within the jurisdiction of any court in His Majesty's dominions which would have had cognisance of the offence if it had been committed on board a British aircraft within the limits of its ordinary jurisdiction, that court shall have jurisdiction to try the offence as if it had been so committed.

(3) Where any offence is committed in any aircraft in the air over the British Islands or in the territorial waters adjacent thereto, the offence shall be deemed to have been committed either in the place in which the same was actually committed or in any place in which the offender may be.

21.—(1) If any person assumes the British Supplementary character on an aircraft owned in whole or in part by any person not qualified to own a British aircraft for the purpose of making the aircraft appear to be a British aircraft, the aircraft shall be liable to be seized and detained under this Act unless the assumption has been made for the purpose of escaping capture by an enemy or by any person in the exercise of some belligerent right. [See 57 & 58 Vict. c. 60. s. 69.]

(2) If the owner or pilot of a British aircraft does anything or permits anything to be done, or carries or permits to be carried any papers or documents, with intent to conceal the British character of the aircraft or of any person entitled under this Act to inquire into the same, or with intent to assume a foreign character, or with intent to deceive any person so entitled as aforesaid, the aircraft shall be liable to be seized and detained under this Act, and the pilot, if he commits or is privy to the commission of the offence, shall in respect of each offence be guilty of a misdemeanour. [See 57 & 58 Vict. c. 60. s. 70.]

(3) If an unqualified person acquires as owner, otherwise than in accordance with this Act or the regulations made thereunder, any interest, either legal or beneficial, in an aircraft assuming the British character, that interest shall be subject to forfeiture. [See 57 & 58 Vict. c. 60. s. 71.]

22.—The Foreign Enlistment Act, 1870, shall have effect as if the expression "ship" included of any description of aircraft, and as if the expression "equipping" in relation to an aircraft included, in addition to the things specially mentioned in that Act, any other thing which is used in or about an aircraft for the purpose of fitting or adapting her for aerial navigation. Application of Foreign Enlistment Act.

23.—(1) The provisions of this Act and of the regulations made thereunder shall, except so far as they are expressly limited to the British Islands and the territorial waters adjacent thereto, apply to—

(a) all British aircraft wheresoever they may be; and

(b) all foreign aircraft whilst in or over any part of His Majesty's dominions and the territorial waters adjacent thereto; and in any case arising in a British court concerning matters arising within British jurisdiction foreign aircraft shall, so far as respects such provisions, be treated as if they were British aircraft; Extent of Act.

Provided that no such provisions, except those relating to the registration of aircraft and

A.D. 1911. those contained in collision regulations, aircraft papers regulations, and signals of distress regulations, shall apply to aircraft whilst in or over any part of His Majesty's dominions outside the British Islands or in or over the territorial waters adjacent to any such part.

(2) Subject as aforesaid, nothing in this Act shall be construed as limiting the power of the Legislature of any British possession outside the British Islands to make provision in relation to the possession and the territorial waters adjacent thereto with respect to any of the matters dealt with by this Act.

Exemption of Govern- 24.—This Act shall not, except so far as it may ment air- be applied by Order in Council, apply to air- craft. craft belonging to His Majesty.

Application 25.—In the application of this Act to Scotland to Scotland. the following modifications shall be made:—

26.—In the application of this Act to Ireland the following modifications shall be made:—

A.D. 1911.
Application to Ireland.

27.—(1) In the application of this Act to the Isle of Man the following modifications shall be made:—

A.D. 1911.
Application of Act to Isle of Man and Channel Islands.

(2) In the application of this Act to the Channel Islands the following modifications shall be made:—

28.—This Act may be cited as the Aerial Navigation Act, 1910, and shall come into operation on the day of nineteen hundred and eleven.

A.D. 1911.
Short title and commencement.

APPENDIX C.

RECOMMENDATIONS OF SPECIAL COMMITTEE NO. 1. OF THE CIVIL AERIAL TRANSPORT COMMITTEE AS TO MATTERS OF DETAIL IN THE AERIAL NAVIGATION BILL, 1911, AND SUGGESTIONS AS TO DRAFTING MODIFICATIONS, FOR THE CONSIDERATION OF THE PARLIAMENTARY DRAUGHTSMAN.

As to the terminology of the Bill generally the Committee recommend a revision of terms, e.g., "pilot" for "navigator" and "fly" for "navigating" in accordance with changes in aeronautical terminology which have taken place since 1911. The reference to the Government Departments specified throughout the Bill may need revision.

PREAMBLE.

In line 1 to insert the words "full and absolute" before the word "sovereignty." (See Law Officers' opinion cited in paragraph 2 of Part I. of this report.)

In line 5 to insert the words "control and" before the word "regulate."

CLAUSE 1, 1 (d).

In line 5, after the word "merchandise," to insert the word "goods," and after the word "passengers" to add the words "or other persons."

In subsection (2), line 20, to substitute "1911" for "1889," as the Official Secrets Act, 1889, has been repealed by the Official Secrets Act, 1911.

CLAUSE 2 (d).

In lines 4 and 5 to substitute for the words in square brackets the words "the effective control of which for all purposes is vested in British subjects." (See paragraph 6 of Part II. of this report.)

CLAUSE 3.

In line 21, after the words "Board of Trade," to insert the words "in the United Kingdom or the competent authority in any British Possession," so as to make it clear that Colonial as well as British registration is contemplated.

CLAUSE 4.

To amend this clause in accordance with the recommendation of the Special Committee referred to in paragraph 6 of Part II. of their Report in such manner as to secure that passenger machines plying for hire shall be of types the airworthiness of which has been duly certified, but that save as above no certification of airworthiness of aircraft shall be required.

CLAUSE 6.

Line 4, after the word "fog" to insert the words "or other." To incorporate the second alternative subsection (3) as preferable to the first, and to combine in this clause the provisions of the two alternative subsections 4. In subsection 5, line 37, after the word "fog," to insert the words "or other." Line 38, to omit the words in square brackets.

CLAUSE 7.

In subsection 1, line 6, to omit the words in square brackets. In subsection 3 to substitute for the words "he shall be guilty of an offence under this Act," the words "he shall be guilty of a misdemeanour." A serious offence may be committed.

CLAUSE 8.

To insert a proviso to the effect that a private aircraft flying in its own country shall be exempted from the necessity of keeping or carrying a log.

CLAUSE 10.

To insert, if thought necessary, some words giving effect to the privileges and exemptions referred to in Article 33 of the Draft Convention, 1910.

CLAUSE 11.

To substitute for this clause, on the suggestion of the Post Office, a clause in the following terms:—

(1) All provisions contained in any Act with respect to the conveyance of mails by railways shall apply so far as they are applicable to the conveyance of mail bags and officers of the Post Office by aircraft, and the Postmaster-General may by Post Office Regulations make any necessary modifications in the said provisions with a view to their application to aircraft.

(2) In this section the expressions "Mail Bag" "Officer of the Post Office" and "Post Office Regulations" have the same meaning as in the Post Office Act, 1908.

CLAUSE 12.

See the detailed recommendations in paragraph 6 of Part II. of this report.

CLAUSE 13 (2) (a).

In line 8, after the word "aircraft," to insert the words "if salvaged."

As to the fixing of the amount of the salvage award, see note to Clause 13 in paragraph 6 of Part II. of this report.

CLAUSE 16.

Attention is drawn to the later provisions of the Forgery Act, 1913.

CLAUSE 18.

In line 18, to substitute for the word "invitation" some word which more closely follows the French word "autorisation" in Article 44 of the Draft Convention, and to omit the words in square brackets.

CLAUSE 19.

To substitute for this clause section 2 of the Aerial Navigation Act, 1913, subject to the general recommendations of the Committee contained in their note to Clause 19 in paragraph 6 of Part II. of this report.

CLAUSE 23.

To re-cast this clause in accordance with the note thereon in paragraph 6 of Part II. of this report.

CLAUSE 24.

This clause to run as follows:—"This Act shall apply to aircraft belonging to His Majesty except in so far as any part thereof other than Clause 12 may be excluded by Order in Council."

APPENDIX II.

Interim Report of Special Committee No. 2.

INTRODUCTORY.

The Special Committee were requested to advise as to the practical possibilities of aeronautics from a scientific and technical point of view, with special reference to certain detailed subjects which of necessity call for consideration in connection with this branch of the Main Committee's enquiry. Before these detailed subjects are dealt with, the Special Committee think it advisable to emphasise some general considerations. Since aeronautics represent in their civil and commercial aspect an untried field of enterprise, it is impossible to arrive at very definite conclusions in many of the subjects considered by the Special Committee, particularly owing to the fact that the technical and scientific data at present obtainable are applicable to aircraft used only for naval and military purposes, and to conditions of flight varying widely from those which will prevail after the war. In this connection, it should be remembered that the whole trend of design has been towards efficiency in the fighting machine, and, consequently, there has been little opportunity for research and enquiry into possibilities of the commercial uses of aeroplanes and airships.

The same considerations apply to those branches of the Special Committee's enquiry which deal with the practical running of aerial services on commercial lines.

With regard to the detailed subjects assigned for consideration by the Special Committee, these have been in most cases referred either to small sub-committees or individual members of the Special Committee, and the present report is intended to present the conclusions which can be drawn from the materials supplied in this manner. The Main Committee will observe that it has not been possible as yet to cover the whole field of enquiry, but it has been thought that the conclusions at present reached can conveniently be summarised in an interim report. It is, therefore, proposed to deal with the different items of the terms of reference to the Special Committee in order.

- I. The possibilities of the employment of aircraft at present and in the near future in transporting passengers, mails, and parcels with the estimated limits of their range, weight, carrying capacity, and running costs, based on the assumption of reasonable State regulation of air traffic, and the probability or otherwise of the use of privately owned aircraft by individuals for pleasure or other purposes.

TYPES OF AIRCRAFT.

In considering the possibilities of the employment of aircraft for purposes of the transport of passengers, mails and parcels, the Special Committee directed an enquiry* to be made as to (i.) four existing types of aeroplane, and (ii.) rigid airships. These were made the subject of reports by Col. O'Gorman and Mr. Bairstow, as to the aeroplanes, and by Wing Captain Maitland, as to the airships, which are appended to the present Report as Appendices A and B. With regard to aeroplanes, the following four types were selected, viz. :—

- (i.) The Handley-Page, with 250 h.p. Rolls-Royce engines, and the "America" flying boat.
- (ii.) The de Havilland 4, with 250 h.p. Rolls-Royce engine or 230 h.p. B.H.P. engine.
- (iii.) The R.E. 8, with the R.A.F. 150 h.p. air-cooled engine.
- (iv.) The Sopwith "Pup," with an 80 h.p. Le Rhone engine.

These types were selected to cover the whole range of well-known machines with a view to estimating the possibilities of transport from existing data.

Colonel O'Gorman and Mr. Bairstow presented the following general conclusions to the Special Committee on the hypothesis of aerial transport in still air.

- A. It is profitable, so far as fuel consumption is concerned, to fly high.
- B. It is profitable, so far as fuel consumption is concerned and so far as the cost of aeroplane construction is concerned, to use a heavy loading of the wings.
- C. Since high-wing loading means fast alighting, the provision of first-class grounds will, it is considered, lead to economy of transport. Your Sub-Committee contemplates landing speeds upwards of 60 m.p.h. This does not refer to seaplanes or flying boats.
- D. High speed of flight is in direct conflict with great weight carrying capacity.
- E. It follows from D that, in selecting the flying speed of the aeroplane to be used, a compromise must be struck between the value of (a) fuel and labour economy and (b) speed or time saving.
- F. As illustrating E, a lightly loaded aeroplane, such as is commonly used now, cannot possibly at 120 m.p.h. (low level speed) fly 1,000 miles, that is to say, there will be no lift available to carry even the flyer; whereas, at 80 m.p.h., no less than 30 per cent. of the gross weight of the aeroplane becomes available for crew and commercial load.
- G. The comparatively small importance of rapid climbing in commercial air work will make the possibilities of combining high speed and weight-carrying much better than those of the modern service aeroplane.
- H. The cost of production of aeroplanes (taken over the range of variations of type presented by the four service aeroplanes selected and based on quotations for large quantities) is roughly proportional to the total crew and useful load carried: and this in turn is equally proportional to the total gross loaded weight of the aeroplane, viz., at war prices about £900 per every 1,000 lbs. of gross weight.

With regard to conclusion F, it was pointed out by way of explanation in a supplementary note (at the end of Appendix A) that a comparison is drawn therein not between two performances of one machine, but between performances of two different machines, one designed to fly at 120 m.p.h. and the other at 80 m.p.h. Particular attention is drawn to the tables annexed to this Report.

* With regard to the types of aeroplanes selected, it should be noted that this enquiry was directed in July, 1917.

† Not printed, see note on p. 2.

These conclusions were discussed by the Special Committee, and a further report was asked for from Col. O'Gorman and Mr. Bairstow as to the effect in a 1,000-mile journey of an adverse wind on the choice of the flight speed of an aeroplane. This further report is appended as Appendix C. The table attached to this further report sets out the available weight of crew and commercial load per 1,000 lbs. of total loaded weight, as affected by adverse and favourable winds over the journey named. Appendix C.*

In making any definite recommendations as to commercial transport by aeroplane the Special Committee have felt that, for the reasons stated in the beginning of this report, it is impossible at the present stage to fix upon any particular type, and, therefore, they present the following general conclusions from the technical point of view.

CONCLUSIONS AS TO AEROPLANES.

- (i.) That for commercial success speed is probably the most material factor.
- (ii.) That for commercial success the speed needed depends very greatly on the conditions of competing methods. Between large centres connected by direct high speed railways, ground speeds of 100 miles per hour are desirable; but for linking places between which the railway service is slow or interrupted by sea crossings, lower speeds will be found commercially practicable.
- (iii.) That, at present, stages of about 500 miles would be the normal limit, but that it will be desirable from the commercial point of view that stages should be as long as possible.
- (iv.) That it is desirable as speedily as possible to develop the existing facilities for night flying, especially for the carriage of mails.
- (v.) That heavy loading is necessary for commercial success, but, since this will involve a high landing speed, development of land and air brakes is necessary.
- (vi.) That in view of certain disadvantages of high landing speed, efforts should be made to keep loading as low as possible consistently with securing a commercial rate of speed and to provide for aerodromes and landing places possessing the best possible surfaces, and that it may well be hoped that future inventions and improvements in design will enable a lower landing speed to be attained without sacrifice of flying speed. Appendix B.*

AIRSHIPS.

With regard to airships, the report of Wing Capt. Maitland is appended to this Report as Appendix B. The Special Committee desire to draw special attention to the fact that in airships above a certain size the proportion of available lift, i.e., crew, fuel, ballast, passengers and merchandise, to total weight increases rapidly, rising to as much as 50 per cent. in the case of a rigid airship with a gross lift of 60 tons, of 2,000,000 cubic feet capacity, and, therefore, from the commercial point of view there are obvious advantages in having airships of large size. Further, the conclusion can be drawn from that report that increase in size can be readily accompanied by increase in speed, as the weight of additional engines would occupy a very small proportion of the extra lift. The proportion of disposable lift in the case of non-rigid airships is less, at least in the case of non-rigid airships of the largest size at present known. The Special Committee have come to the conclusion that for commercial purposes the rigid type offers certain advantages over the non-rigid. In a further report (Appendix D) Captain Maitland works out some valuable statistics as to the effect of adverse wind and ascent in a 1,000 mile journey. Appendix D.*

PRIME COST.

It is practically impossible to give any satisfactory estimate of running costs of either type of aircraft from existing data. With regard to the prime cost of machines, Appendices A and B contain curves showing the relation of gross weight to cost and useful load to cost, based on approximate war prices.

General figures relating to cost must be considered as indicative only; the weight of an aeroplane is not a definitely fixed quantity, and the amount of commercial load depends on the length of journey. An upper limit to the amount of commercial load is given in Appendices A and B under the name of "disposable load," this term including both crew and fuel. A lower limit is obviously zero when the journey is so long that the whole of the "disposable load" is absorbed by the crew and fuel.

Figures qualified as above are :—

	Prime cost per lb. of gross weight.	Prime cost per lb. of disposable load.	Prime cost per lb. of commercial load.
Aeroplane (High Speed)	18/-	40/-	Upwards of 40/-
Aeroplane (Low Speed)	18/-	30/-	Upwards of 30/-
Airship (Rigid)	9/-	18/-	Upwards of 18/-

MAIL SERVICES.

The question of the carriage of passengers or of goods has not yet been considered by the Committee except from the technical point of view of the range and weight-carrying capacity of aircraft generally, but the Committee hope at an early date to report further on this important branch of their subject, and on the closely connected question of the probability of the use of privately-owned aircraft by individuals. In regard to what follows with respect to air mail services it should be understood that the Committee consider that in so far as the useful load-carrying capacity of the aircraft is not fully occupied by the transportation of mails it should be employed in the conveyance of passengers and even of small parcels of valuable goods.

It has been pointed out above that it is desirable from the commercial point of view that stages should be as long as possible. This principle is illustrated with peculiar clearness in the case of mail services. A London-Paris air service, for example, should be effected in $2\frac{1}{2}$ hours, or less, as against, say, seven hours by the land or sea route. An air mail service would here enjoy a very evident advantage as compared with any other. With longer Continental flights, such as that from London to Paris, and then on to Turin, greater

* Not printed, see note on p. 2.

savings of time should be possible as compared with existing means of communication. In the case of the Italian mail, the time saved might amount to as much as a day. The longer the flight the more important is the time saved, and, consequently, the better are the prospects of an aerial mail service. There is, for example, nothing impossible, given the proper facilities, in sending mails by air from London to Calcutta in four days, as against sixteen days (minimum), or from London to Johannesburg in six days as against nineteen. When the importance to business of full and rapid communication, and the great cost of trans-ocean cabling is borne in mind, it appears perfectly reasonable to anticipate that people will be willing to pay a price per ounce for letters carried by aircraft sufficient to make these long distance air mail services commercially profitable. A cable message of 100 words from London to Johannesburg to-day, at 2s. 6d. a word, costs £8 10s., and 24 hours at least usually elapse between the despatch of a message from London and its delivery to the addressee. A letter of 5,000 words need not weigh more than an ounce or two. If such a letter could be sent in six days, even at 2s. 6d. an ounce, the saving in cost would be enormous, and the extra time taken by this means of communication as compared with the cable would in many cases be more than compensated for by the avoidance of the risk of misunderstanding inseparable from the use of the necessarily abbreviated language of cable messages.

The case is naturally different as regards air mail communications within Great Britain. In the case of services from London to large provincial towns, it may be said to require a flight of at least three hours, at an average, say, of 100 miles an hour, for the speed of an air-mail service to reveal itself and for this speed to offer a sufficiently marked saving of time over land transit, remembering that one must reckon the time taken in establishing the land connections of an air service. When an oversea journey is made, such as the passage across the Irish Sea in a flight to Dublin, the saving of time offered by an air service is much more evident, and the same holds good in the case of cross-country routes, e.g., from Cardiff or Bristol to Southampton, where express rail services are lacking. Attention is drawn to Appendix E, outlining a scheme for an experimental air-mail between London and Glasgow. Mr. Murray, criticising this memorandum at the meeting of the Special Committee on October 12th, considered that a load of 100 lbs. of mails per machine, and not 1,000 lbs., was all that could be hoped for, at any rate, in the early stages of such a service. No definite figures have been arrived at, so far, as to the financial aspects of an air-mail service. In Appendix E, just referred to, Mr. Holt-Thomas's estimate of 4s. 6d. a mile for overhead charges and running costs for an air-mail service between London and Paris (as outlined in his lecture before the Aeronautical Society on May 30th, 1917) was adopted in the absence of other data. So far as a service in the United Kingdom is concerned, assuming the correctness of Mr. Murray's view that only a very limited volume of express mails would be available (having regard to the excellence of existing methods of communication), then it would become necessary to charge some high fee, such as 1s. or more per letter, if there is to be any hope of an air-mail service proving remunerative. The Committee, however, are sanguine enough to hope that Mr. Murray's estimate may be somewhat too conservative, and the matter is being considered in greater detail.

In view of the great advantages anticipated in suitable instances, the Special Committee definitely recommend the institution of experimental mail services without waiting for the end of the war, if this is consistent with Naval and Military interests, but Mr. Murray desires to record his opinion that the out-of-pocket cost, if any, of such experimental services, should be borne, not by the vote for the G.P.O., but by that of the Department most immediately concerned, presumably the Air Ministry.

II. The possibility of little-known or unexpected inventions modifying the lines of present development.

The Special Committee concur in the following conclusions drawn up by Lord Montagu, Mr. Lanchester, and Mr. Wells on this branch of their inquiry.

"It is considered that, whilst there may be considerable development in the appliances for flying at present known and available, namely, the aeroplane and the airship or dirigible balloon, and in the engines they use, these developments afford no prospect of more than a quantitative modification of existing conditions.

"So far as the aeroplane is concerned, there is every probability of considerable improvement. Such things as an increased use of folding wings, a device already used by the R.N.A.S., minimising the storage capacity required and improving braking mechanism—under which head we may include reversible engines and propellers, and other forms of brakes—diminishing the amount of space needed for landing, may be anticipated. Beyond this, it is thought, that an all-round improvement in efficiency and weight-saving may be expected. These improvements will probably only slightly modify the general outline of the problem. The helicopter has been considered, as well as possible combinations of airship and aeroplane. The latter alone seems to involve the remotest possibility of affecting present practice to any serious extent.

"On the question of fuel, every effort should be made by State aid or State encouragement to widen the basis of fuel production as much as possible, and to prevent the enormous interests in connection with automobilism, both on land and in the air, being dependent upon fuel of any one given kind, especially if that be derived from overseas or foreign sources of supply. Attention is called to the fact that fuel supply for aircraft cannot be considered apart from the fuel supply of motor vehicles of other kinds, i.e., private cars, buses, lorries, etc. Whereas on the fuel question, as in the case of the machines themselves, there is no sign at present of any revolutionary development, the fact must be recognised that it may at any time become possible by chemical discovery to produce volatile hydro-carbon fuels in great quantities at comparatively small cost. While it cannot be definitely asserted that undiscovered methods of synthetic production exist, it is known that in the matter of chemical discovery the possibility is always there, and it is not possible to say, when speaking of fuel, that the future can be forecast with any degree of certainty."

In addition to these conclusions the Special Committee are of opinion that the following lines of invention are of great importance to commercial aeronautics, viz., the gyroscope and its incidental uses, the turbine system applied to combustion engines, and directional wireless.

III. The Rules that will be required for aerial traffic regulation, routes, and zones, signalling and lighting of routes and landing places, night flying, wireless communication, dissemination of meteorological information, safety appliances and prohibited areas, illustrated by one or more actual routes assumed to be in use by an organised aircraft service.

RULES OF THE AIR.

With regard to rules for aerial traffic regulation, viewed from the point of view of domestic control, the Special Committee approve of the existing code of rules drawn up by the Royal Aero Club. These rules are appended as Appendix F. to this report. These rules are aimed mainly at preventing collisions in the air, and some additions will be necessary to deal with problems arising from the ascent from and descent to aerodromes. The Special Committee will report further on such additions when they have had the opportunity of considering certain military and naval regulations to be applied in the case of existing aerodromes. With regard to traffic regulations from the international point of view, the Special Committee are proposing to report to Special Committee No. 1, particularly as to certain proposed regulations contained in the 3rd Annex to the Draft Convention of Paris of 1910, which will require revision in the light of the recent developments of aeronautics generally. Appendix F, p. 50.

The Special Committee do not at present make any recommendation as to different altitudinal zones for different types of aircraft, although they recognise that in the future some regulation on this subject may become necessary.

AIR ROUTES GENERALLY.

In considering the planning and definition of particular air routes, certain general considerations arise. In the case of a commercial aerial service the route will generally begin or end at some large town or centre of population; but its course may vary in accordance with the needs of intermediate towns in a populated country and in accordance with the factors of prevailing winds and landing facilities in the case either of long journeys over undeveloped countries or of long journeys over the sea.

In the two latter instances the necessity for a planned and defined route is sufficiently obvious, for in the case of a flight over, e.g., Africa, the provision of landing facilities on a liberal scale is impracticable, and in the case of a flight from America to Europe prevailing winds will play a large part in fixing outward and homeward tracks. In the United Kingdom, or at any rate in England, present and future military requirements will involve the creation of a large number of landing grounds, but where mails have to be delivered, the provision of definitely marked routes is necessary for the sake of economy, speed, reliability, and safety of navigation.

LANDING GROUNDS ON AIR ROUTES.

As to the provision of alighting grounds, the Special Committee have not felt justified in committing themselves to a definite recommendation that landing places are required at fixed distances along aerial routes. What it is thought will happen, in the ordinary course of development, will be for main aerodromes to be established in the neighbourhood of the large centres of population, and then for these main aerodromes to be connected by the institution of subsidiary aerodromes near smaller centres of population; while purely emergency landing grounds along the various routes will be placed, not so much with the idea of their being at regular intervals, but rather with a view to providing safe alighting points in localities where the nature of the country might render dangerous an involuntary descent.

To illustrate the problems which may arise as to aerial routes, the Committee desire to draw attention to certain conclusions which may be drawn from reports obtained from their members as to certain specified routes arbitrarily chosen. These reports were submitted to the Committee by the following members:—

- | | |
|---------------------------------------------|-----------------------|
| (a) London—Edinburgh—Glasgow—Dublin—London. | (Major-General Ruck.) |
| (b) London to the Riviera. | (Mr. Holt Thomas.) |
| (c) London to South Africa | (Lord Montagu.) |
| (d) The Atlantic Route. | (Commander Porte.) |
| (e) London—Norway—Sweden—Russia. | (Major-General Ruck.) |

In drawing up these reports it has not been possible to work out in detail the precise provision that will be required on each for signalling and lighting and for other matters mentioned in heading III. (quoted above) of the terms of reference to the Special Committee. Decisions as to what is required in these respects on particular routes can only be arrived at by actual experiment, and the Special Committee have therefore confined themselves to such general propositions as can be affirmed with some measure of confidence in the light of existing knowledge.

LONDON—EDINBURGH—GLASGOW—DUBLIN—LONDON.

As to (a) it appears that, so far as the existence of landing grounds is concerned, the most attractive route northward at the present time would follow the line of the Great Northern and North-Eastern Railways, viâ Berwick. In so far as the route to Edinburgh is viewed in the light of direct transit, regardless of intermediate stops, this line offers the greatest advantages on the score of time-saving; but when the possibilities are considered of linking up important centres of population, a route to the westward covering, e.g., Bedford, Northampton, Leicester, Nottingham, Sheffield, and Leeds may be preferable. As against this route it should be mentioned that in some conditions of weather pilots prefer to proceed along the coast as far as possible. The creation in the future of further landing facilities may considerably modify conclusions as to the best route to Edinburgh from the commercial point of view, and the possibility of planning a route generally to the westward of the East Coast line must not be lost sight of.

The route from Edinburgh to Dublin might pass Glasgow and Belfast, viâ Kilmarnock, Ayr, Stranraer, Belfast, Portadown, Dundalk, and Drogheda. On this section the route is more or less undeveloped as far as landing grounds are concerned.

From Dublin to London the route might follow the track of the mail steamers to Holyhead, and thence the line of the present London and North-Western Railway, viâ Chester and Crewe, assuming it to be a part of what would ultimately become a West Coast route to Scotland, viâ Manchester and Liverpool. At present there are objections to a West Coast route to Scotland, owing to the mountainous nature of the country north of Carlisle and the absence of landing grounds. In fact, the most direct line from North Wales

to London would turn off near St. Asaph and go straight to Birmingham. Landing facilities from the military point of view already exist on this route from Tern Hill, near Market Drayton, through Birmingham, Coventry, Rugby, and Aylesbury.

LONDON TO THE RIVIERA.

As to (b), the route from London to the Riviera, this does not call for much comment, except that it will probably follow the line of Paris, Dijon, Lyons, and Marseilles, showing a saving of time from London to Marseilles of something like seventeen hours. An alternative route would be to fly from Avignon direct to Cannes, leaving Marseilles and Toulon on the right, thus effecting a considerable saving in distance.

LONDON TO SOUTH AFRICA.

As to (c) the routes from London to South Africa, Lord Montagu furnished particulars of an Eastern route, viâ Marseilles, Naples, Crete, Egypt, and the Valley of the Nile, and Northern Rhodesia, and a Western route, viâ Bordeaux, Gibraltar, and the Sahara, Lagos, Angola, and Rhodesia. The total distance of the Eastern route is some 7,800 miles, and the Western route some 7,210 miles. On a theoretical basis of a speed of 80 miles per hour and continuous flying for twenty-four hours per day, the time taken by the Eastern route would be 4 days 1½ hours, and by the Western route 3 days 18 hours. Lord Montagu pointed out in his report that meteorological conditions, generally speaking, favoured the use of the Eastern route from the United Kingdom to South Africa and the use of the Western route on the return journey from South Africa to the United Kingdom. Whichever route may in the future be found to be the better, or whether it may be found desirable to operate both, the Committee can at this stage only recommend that a practical experiment should be instituted on either or both routes at as early a date as possible. The Eastern route would appear to be commercially the more important, and would pass mainly over British territory. It would be easy to exaggerate the importance of this latter consideration in connection with future commercial aerial traffic generally, but for the purposes of conducting an experiment there are obvious advantages in having to deal with territory under the jurisdiction of His Majesty rather than with foreign territory.

THE ATLANTIC ROUTE.

As to (d), the Atlantic route, Commander Porte pointed out in his report that for some time to come a direct route from Ireland to Newfoundland and vice versa will be found impracticable. He suggested that the only possible solution of the Trans-Atlantic route at the present time and for many years to come, would be to use the so-called "Azores" route, employing San Miguel, the principal island of the Azores, as a landing station. To avoid the great distance of a direct flight from the United Kingdom to San Miguel, he recommended a route from London viâ Paris, Madrid, and Lisbon, the distance from Lisbon to San Miguel being 775 miles. From San Miguel to Newfoundland is 1,346 miles, although this distance could be reduced to 1,045 miles by calling at Flores, another of the Azores group. The use of Newfoundland as a terminus presents great difficulty owing to continual fog on the banks and around Newfoundland itself.* The effect of this fog is to make a journey westward to Newfoundland liable to the danger and uncertainty involved in having to come down to land through the fog. The same difficulty does not occur in the eastward journey from Newfoundland, in that the pilot can lay his course by the compass and would within a comparatively short period find himself outside the fog area.

Commander Porte's conclusion is that, at any rate in the immediate future, it would be preferable to fix upon New York as the Western terminus of the Atlantic route. The distance from San Miguel to Long Island is roughly 2,250 nautical miles, and Commander Porte suggests that for the purpose of dividing this long distance into reasonable stages, it would be necessary to design and arrange for "Sea Stations," in the shape of long ships of, say, 600 ft., with a clear upper deck of 400 ft., fitted with wireless and the necessary signalling apparatus. Such an arrangement would make possible the use of aeroplanes rather than seaplanes.

While Commander Porte is a high authority, the Special Committee do not feel that they possess sufficient independent information to enable them to express a confident opinion with regard to his conclusions. So far as these are based upon the prevalence of fog on the Newfoundland coast, Major Taylor is disposed to think that they are open to question. Major Taylor's impression, based upon his study of the subject, is that the sea fogs prevailing off the Newfoundland coast are low in altitude and do not extend far inland. Any further evidence that could be obtained on this point would be valuable.*

Here, again, the Committee can only recommend that a practical experiment should be instituted as early as may be possible, all available information as to the weather conditions likely to be encountered that may be in the possession of the Meteorological Office or of the Governments of the U.S.A., Canada, and Newfoundland having first been studied with a view to undertaking the experiment with the best chances of success.

This route would appear to be a particularly suitable one for an experiment with airships as well as with aeroplanes, the distance in a direct line from the East Coast of Newfoundland to the West Coast of Ireland being no more than could be accomplished in favourable weather by airships already in existence.

LONDON TO RUSSIA.

As to (e), the route from the United Kingdom to Russia, viâ Norway and Sweden, it was suggested to the Committee that a service might be conducted from London to Yarmouth by aeroplane, a distance, approximately, of 100 miles; by seaplane from Yarmouth to Christianssand, a distance of approximately 450 miles; by seaplane from Christianssand to Stockholm, crossing the Swedish lakes, a distance of approximately 360 miles; and, as a final stage, from Stockholm to Petrograd by seaplane, a distance of approximately 450 miles, crossing the Baltic and continuing up the Gulf of Finland. The total distance would be about 1,360 miles. The progressive reliability of aeroplanes will probably, within a short period, render the use of seaplanes unnecessary. This route, also, might afford a favourable opportunity for the use of airships.

*See the heading "Aerial Routes" in the final report of this Special Committee and Appendix B to that report.

MARKING OF AERIAL ROUTES.

As to the marking of aerial routes, several recommendations have been made.

Wing Captain Groves has suggested that all main routes should be marked at intervals of five miles by a strip, 200 feet in length and 16 feet in breadth (formed of chalk or small stones treated with some white mixture), each mark pointing exactly along the line of route. He recommends, also, that alongside each mark should be an alphabetical letter, 50 feet in length, to indicate the routes to which they belong; while, in addition to these letters, each mark should have its distinguishing number, in figures 16 feet high. In clear weather these figures would not be required by the pilot, but in thick weather, rain, or other adverse conditions, they would help him to discover his exact whereabouts.

Lieut.-Col. O'Gorman, after considering the memorandum by Captain Groves, suggested that main railway routes should be identified by various combinations of dots and dashes formed by lines of chalky stones, but the representative of the Board of Trade expressed the view that there would be serious difficulties in the practical working of this proposal.

Generally speaking, and in the light of the information before the Special Committee, it would appear that in anything like favourable weather, a pilot has no difficulty in finding his way from point to point, correcting his compass course by visual observations of prominent landmarks, and by following railways when they are on his line of flight. This applies particularly to the aviator who flies frequently over any given route, as, for example, in the case of the "ferry" pilots who take new machines by air from London to G.H.Q. in France, or to Montrose in Scotland. These pilots find it so easy to steer an accurate course by compass and visual observations of landmarks and railways that they have, apparently, never even considered the need for artificial markings.

When clouds are low, however, and an aviator may have to fly as low, perhaps, as a few hundred feet in order to correct his compass course by an observation of the ground, it is considered that artificial markings would be extremely useful; and one suggestion which has been made, and which meets with the approval of the Special Committee, is that the roofs of railway stations or sheds should have their names painted upon them in letters large enough to be distinguished by the pilot of an aircraft. It would be of great advantage that these letters should be brightly illuminated at night.

The Special Committee recognise that while it may meet the case for a military aviator to find his way from one landmark to another, or to follow some convenient railway, even should this take him a little from his course, a commercial pilot, carrying mails, say, from London to Paris, will find any deviation from the direct line reflecting itself adversely not only in his time-table, but also in the matter of fuel consumption. It may be thought necessary, therefore, by those who operate such commercial services, to lay down some very clear system of landmarks, so as to ensure an absolute adherence by their pilots to a given line of flight. The placing of such marks on private ground will, of course, be a matter of arrangement between land-owners and aircraft companies; though it would appear advisable that there should be supervision by the authorities to prevent any possible confusion arising through the use by various companies of different schemes of marking.

NIGHT FLYING.

As to night flying, at any rate on a commercial scale, it is recognised that some special method of illuminating aerodromes and intermediate points, so as to enable pilots to land and also to afford them a means of checking their compass course, and to help them in combating the difficulties of ground mists and fogs, will need to be adopted; but this question has not yet been considered in detail.

METEOROLOGICAL INFORMATION

The dissemination of meteorological information has obviously a very important bearing on the development of civil aerial transport, particularly from the point of view of the safety and punctuality of services which will require to run to time-tables. Much meteorological knowledge has, of course, been accumulated for many years by the Meteorological Office, but, as such knowledge has hitherto been required almost wholly for the purpose of persons moving over the surface of land and sea, the study of the meteorology of the upper air, which is all-important for the purpose of aeronautics, is in a less advanced condition. The first steps must be in the direction of collecting the required body of knowledge and arranging for the tabulation of the data, as they vary from hour to hour. This involves at the outset much scientific study and research, a branch of our subject which falls primarily within the scope of Special Committee No. 5, by whom, however, we have been supplied with two valuable papers by Major Lyons and Sir Napier Shaw, which are attached as Appendices to the interim report of that Special Committee.

Assuming measures to have been taken for the collection of the necessary scientific knowledge, it remains to consider measures for making it readily and easily accessible to the pilots and others concerned for the purposes of practical flying. Many useful suggestions in regard to this matter are contained in Sir Napier Shaw's paper, and the subject has also been dealt with by a Sub-Committee of Special Committee No. 2, consisting of Lord Montagu and Major Taylor. Their report, with the conclusions of which we agree, is appended (Appendix G). We particularly desire to emphasise the importance of the establishment at each main or "terminal" aerodrome of what Sir Napier Shaw has described as a "Map room," in charge of a person capable of explaining rapidly and intelligently to practical pilots the meteorological conditions likely at the moment to be met with in the vicinity. Such establishments, if they are to be efficient, presuppose the frequent direct communication to them by pilots of information as to the conditions actually experienced by them in their flights. The importance of making such communications should be impressed upon pilots,

and commercial machines should be fitted for this as well as for other purposes with wireless telegraphic apparatus. It will appear from a report by Colonel O'Gorman and Major Vincent Smith (Appendix H) that this requirement should eventually present no serious difficulty, since it is to be expected that a large commercial machine would not be navigated by one pilot working single-handed, but that the pilot would ordinarily be accompanied by at least one assistant who would be able to send the requisite wireless messages without difficulty.

The Committee have ascertained from the Admiralty that there exists a complete system of Naval Meteorological Stations in the United Kingdom in direct communication with the Admiralty Office in London. These stations are run at a small cost, a staff consisting of an officer and three men being sufficient for day and night duty. At most of these stations weather maps can be prepared. Although these stations have not been established solely for aeronautical purposes the Committee think that their assistance may well be invoked in connection with a scheme for disseminating meteorological information, and at least they can serve as models for stations to be established in connection with terminal aerodromes.

PROHIBITED AREAS

With regard to the question of prohibited areas, the Special Committee are not yet in a position to submit a report.

SAFETY APPLIANCES

The Committee have taken into consideration the use of safety appliances in commercial aircraft. These will no doubt be largely developed by experiment after the conclusion of the war, and the Committee would draw special attention to the different lines of enquiry with regard to safety appliances suggested in a report by Captain Maitland and Colonel O'Gorman (Appendix I), with which the Committee concur.

IV. The estimated number, size, and location of landing grounds suitable for an organised aircraft service, with the technical requirements of management staff and maintenance and the estimated running cost of such grounds.

LANDING GROUNDS GENERALLY

As stated earlier in this report, the Special Committee do not advise the provision of landing grounds at fixed distances on aerial routes, although they hold the view that in the case of main routes the safety and regularity of commercial services will largely depend on the existence of a sufficient number of alighting points lying along the line of route.

Generally speaking, the positions selected for aerodromes or landing grounds should comply with the following conditions :—

- (1) bear some reference to the direction of the main aerial routes ;
- (2) be sufficiently far from the centres of cities to be fairly clear of houses in the direction of flight ;
- (3) be unlikely to be shut in by buildings in the immediate future ;
- (4) be as far as possible clear of railways, telegraphs, trees, and other obstructions ;
- (5) be situated on ground as far as possible free from mist and fogs ;
- (6) be provided with adequate water supply, telephone connections and good facilities for rail, tram, bus and motor traffic with the different districts of the cities to be visited ;
- (7) be capable of expansion.

AERODROMES AND INTERMEDIATE LANDING PLACES

With regard to aerodromes, the Committee has obtained a report from Colonel O'Gorman, Mr. Holt-Thomas and Mr. Lanchester, and with regard to intermediate landing places a report from Captain E. Elvey Robb. These reports are attached as Appendices J and K. The Committee agree with these reports generally, and consider them valuable as indicating the possible requirements of the future, when there has been time for civil aerial transport to develop itself on a considerable scale. As things stand at present, however, it must be borne in mind that the exigencies of the war have already led to the establishment in all parts of the country of aerodromes and landing places with an equipment fully sufficient to deal with any civil air traffic to be expected in the earlier days of peace. The reports should not therefore be read as indicating that it will be necessary in the near future to set up new and elaborate organisations with consequent heavy expenditure for the purposes of civil air traffic alone.

Generally speaking, the Committee hold the view that, subject to necessary military regulations, it is desirable to arrange for the user by civil aircraft of as many as possible of the intermediate landing grounds, which are at present or will in the future be under military control.

V. The estimated cost of maintaining an aerial service, including aerodromes, sheds, landing grounds, labour, wages, running expenses, depreciation and repairs, exclusive of capital charge for the purchase of machines on the assumption of a route of definite length and the employment of a definite number of aircraft thereon.

VI. To advise in the light of the answers to the foregoing questions as to the main aerial routes which might be marked out and prepared for now for utilisation by an aircraft service.

* Not printed, see note on p. 2.

On these two branches of their enquiry the Special Committee are not yet in a position to submit a report, although certain matters which fall within paragraph VI. have already been touched upon in that part of this report which deals with certain specified air routes.

R. M. Ruck, Major-General (Chairman).
Atholl.
Leonard Bairstow.
G. B. Cockburn.
R. M. Groves, Wing Captain, R.N.
*G. Holt-Thomas.
E. M. Maitland, Wing Captain, R.N.
G. E. P. Murray.
Mervyn O'Gorman, Lt.-Colonel.
Frank Pick.
J. C. Porte, Wing Commander.
J. W. Pringle, Colonel.
E. Elvey Robb, Captain.
W. P. Schreiner.
W. Sempill, Wing Commander, R.N.
T. Vincent Smith, Major, R.F.C.
T. Sopwith.
G. I. Taylor, Major.
E. R. Wayland, Lt.-Colonel.
H. G. Wells.
H. White Smith.

D. O. Malcolm,
Secretary. December 19th, 1917.

* Mr. Holt-Thomas signs the report with the reservation that the adoption of a scheme of landing grounds on all main routes is, in his opinion, essential to the success of civil aerial transport as regards regularity of service, rapid conveyance by reserve machines in case of break-down, and the effect on design and efficiency of machines. The landing ground scheme, in his opinion, should be adopted, and he sees in it the probable solution of many difficulties as regards flying in fog and by night, etc. He also puts forward the argument that the expense of any such scheme has already proved to be almost negligible compared with the cost of any service, and that therefore, taking into account the undisputed advantage offered, he is unwilling that this report should go out without expression of opinion on his part that the landing ground scheme on all main routes should certainly be recommended and adopted. On this point he is bound to totally disagree with the report, as he considers that in the absence of a landing ground scheme irregularities in aerial services may occur which may have a very dangerous effect on the future of aerial navigation in the opinion of the Public.

SPECIAL COMMITTEE No. 2.—INTERIM REPORT.

APPENDICES.

†APPENDIX A.

Report by Col. O'Gorman and Mr. Bairstow on 4 types of Aeroplane.

†APPENDIX B.

Report by Brig.-General Maitland as to Rigid Airships.

†APPENDIX C.

Memorandum by Lieut.-Col. O'Gorman and Mr. L. Bairstow as to the effect of an adverse wind on the choice of the flight speed of an aeroplane.

†APPENDIX D.

Report by Brig.-General Maitland on a 1,000-mile Journey by Rigid Airship.

† Not printed, see note on p. 2.

APPENDIX E.

Memorandum by the Assistant Secretary (Technical) on the establishment of an experimental air-mail service, one machine being run each way daily, weather permitting, between London and Glasgow, via Newcastle and Edinburgh.

It is assumed that, in an experimental service, started immediately after the war, only a limited quantity of express mails would be carried, at a fee determined by the Post Office, and that the bulk of the mails will still go, as at present, by land.

A London-Glasgow route has been chosen for illustration for several reasons. In the first place, it requires at least a three hours' flight, at an average, say, of 100 miles an hour, such as that from London to Newcastle, for the speed of an air service to reveal itself and for this speed to offer a sufficiently marked saving of time over railway transit, remembering that one must reckon the time taken in establishing the land connections of an air service.

In regard to cities which are, say, a four hours' journey by rail from London, such as Manchester, it is possible to "express" a letter in London at a reasonable hour in the morning, and for this letter—which goes by a fast train—to reach its destination well before the close of the business day. An express air service on such a route, therefore, even if it could cut down the time by an hour or so, as compared with the transit by train, would only be offering a business man a slightly additional convenience. He might, indeed, say that so long as his "express" letter reached its destination in time to be dealt with before the office to which it was addressed closed for the day that he was satisfied, and was indifferent whether the letter was delivered, say, at 2.30 p.m. or 3.30 p.m. But in the case of a city like Newcastle, or cities farther North, it is not possible to "express" letters in the morning in London, at any hour which might be considered reasonable for business purposes, and for these letters to reach such cities by train in time to be dealt with before the close of the business day. Therefore, by instituting a London-Newcastle-Edinburgh-Glasgow service, and by so arranging this service that a business man could post a letter in the morning in London or Glasgow, and for this letter to reach its destination before the close of the business day, one would offer the business world a very clear facility, which cannot be offered by any existing means of transit.

The use is assumed of an aeroplane which, carrying 1,000 lbs. of mails, will maintain an average speed of 100 miles an hour.

It is very necessary to consider the time occupied in establishing the land communications of an air service. Letters must be carried from the city to the aerodrome, and then, at the other end, from the aerodrome to the city. In the period immediately following the war, Hendon will, it may be assumed, be the London terminal aerodrome for mail services. It is assumed, also, that mails will be carried between the G.P.O. and the aerodrome in motor vans. In a year or eighteen months after the war the Post Office will, it is hoped, have in operation a miniature electric underground railway, carrying mails from East to West of London, and vice versa, at a maximum speed of 35 miles an hour. An extension of this railway from Mount Pleasant to the Hendon Aerodrome would enable mails to be carried from the G.P.O. to Hendon in about a quarter of an hour.

In the provisional time table which is submitted for a London-Glasgow service, three-quarters-of-an-hour has been allowed for each land connection and distribution of letters, as made by motor vans or motor cycles.

*PROVISIONAL TIME TABLE: London-Glasgow, Glasgow-London,
One machine each way daily.
LONDON-GLASGOW.*

Posting is allowed at the G.P.O. up to 10.30 a.m., when the mail-bags are closed, and carried to Hendon in a motor-van. The time table is then as follows:—

11.15 to 2.15.—Carriage of the mails by air from Hendon to Newcastle. The distance in a straight line is about 250 miles: but an allowance is made for slight deviations on the part of the pilot, while a three hours' flight has been assumed for the convenience of obtaining a round figure. In actual working, however, taking the average speed throughout at 100 miles an hour, the journey should be accomplished in a little less than three hours. But, as against this, may be set such small losses of time, in the actual operation of a service, as cannot be calculated in advance. The aeroplane does not alight at Newcastle, but drops the Newcastle mail in a net, and continues its flight. The Newcastle mail is then carried into the city, and may be assumed to have been distributed by 3 o'clock. It might be found necessary in actual working to descend at Newcastle to pick up letters which Newcastle firms desired to send by air to Glasgow.

2.15 to 3.15.—The aeroplane continues its flight to Edinburgh. It does not stop at Edinburgh, the mail-bag for that city being dropped into a net, and the letters delivered by four o'clock.

3.15 to 3.45.—The aeroplane completes its last stage to Glasgow.

3.45 to 4.30.—Glasgow mail carried into the city and distributed.

GLASGOW-LONDON.

Posting is allowed in Glasgow up to 10.30 a.m. Then the mail-bags are closed and taken to the aerodrome. The time-table is then as follows:—

11.15 to 11.45.—The aeroplane flies from Glasgow to Edinburgh, alighting to pick up mails for Newcastle or London. It might also, if there were any, carry mails from Glasgow to Edinburgh.

11.50 to 12.50.—The aeroplane continues its journey to Newcastle, where it alights to unload and also to pick up.

*12.55 to 3.55.—The aeroplane continues its flight from Newcastle to Hendon.

3.55 to 4.40.—The London mail is carried from Hendon into the city and distributed.

It may be useful to give an illustration of the facilities offered by such an air-mail service as that described:—

The Newcastle recipient of a letter, say, from London, after acquainting himself with its contents, might be able, in some cases to answer immediately by telegram or telephone, or he might prefer to write a more detailed answer which would go back to London in the ordinary way by evening mail, being received in London the next morning. If the recipient of the letter adopted the last-mentioned course, the air-mail being used only one way, there would still be a clear saving in time of a day, as compared with the existing routine of correspondence—this routine being for a letter to be posted in the evening in London, received in Newcastle the next morning, the answer being written and posted that day, reaching London on the third morning.

By courtesy of the Post Office, it is possible to state that at the present time, reckoning the mails dispatched both ways, a total of approximately 260,000 letters and postcards are carried during a period of 24 hours between London, Newcastle, Edinburgh, and Glasgow. Could it be assumed that each individual posting represented a letter weighing an ounce, then it would be possible to state that, if approximately an eighth of this existing volume of mail traffic could be transferred to the air, there would be sufficient to fill one machine each way a day—reckoning each machine to carry a 1,000 lbs. load. But it is the custom of the Post Office to place letters and postcards under one heading, and separate figures are not obtainable.

As to the financial aspect of the London-Glasgow air service, adopting Mr. Holt Thomas's figure of 4s. 8d. per mile for overhead charges and running costs, the daily expenses of a contractor, operating one machine each way, would be roughly £198. As against this, at a full load both ways (a total of 32,000 ounces), the contractor's charge for carriage, to cover his bare expenses, would be almost exactly 1½d. per ounce. Assuming an express service, with a charge to the public of 4d. or 6d. per ounce, for a fair proportion of letters drawn from the total of 260,000 letters and postcards which has been mentioned in the paragraph above, it would appear that, on a contract of carriage the Post Office could well pay the contractor a sum which would not only cover his bare expenses, but show a considerable profit in working.

HARRY HARPER.

10th September, 1917.

* Newcastle firms wishing to send a letter by air to London would be able to post up to as late as 12.10 p.m. This would allow firms in cities near by, such as Gateshead, Sunderland and South Shields, to catch the air mail for London by sending in their letters to Newcastle by train: or an aeroplane might visit these neighbouring districts during the morning, collecting letters for London, which it would bring to the Newcastle aerodrome in time to catch the London machine. Such a system, feeding the main route might be adopted also in other localities.

† This estimate of 4s. 8d. per mile is worked out by Mr. Holt Thomas in his paper read before the Aeronautical Society of Great Britain on May 30, 1917, relating to an aerial service between London and Paris. The figure of 4s. 8d. is based on the assumption of a service by one machine each way daily, and it is thought that a fair analogy can be drawn between the London-Paris service and that outlined in the present memorandum. Without in any way criticising Mr. Holt Thomas's figures, it would appear that they rest on what may be called a conservative basis, and that, therefore, the expenses in the present instance are not estimated at too low a figure.

APPENDIX F.

Rules of the Air, as passed by the Committee of the Royal Aero Club.

REGULATIONS FOR PREVENTING COLLISIONS IN THE AIR.

(Passed by the Committee March 19, 1912.)

In these regulations the term "foul" shall include the giving of dangerous backdraught to another aircraft.

Cross-country Flying.

(a) Two aircraft meeting each other end on, and thereby running the risk of a collision, must always steer to the right. They must, in addition to this, pass at a distance of at least 100* metres, taken between their nearest adjacent points.

(b) Any aircraft overtaking another aircraft is responsible for keeping clear, and must not approach within 100 metres on the right or 300 metres on the left of the overtaken aircraft, and must not pass directly underneath or over such overtaken aircraft.

The distance shall be taken between the nearest adjacent points of the respective aircraft. In no case must the overtaking aircraft turn in across the bows of the other aircraft after passing it so as to foul it in any way.

(c) When any aircraft are approaching one another in cross directions, then the aircraft that sees another aircraft on its right-hand forward quadrant† must give way, and the other aircraft must keep on its course at the same level till both are well clear.

Flying Grounds.

The following Special Regulations apply only to flying grounds:—

(d) Two aircraft meeting each other end on, and thereby

running the risk of a collision, must always steer to the right. They must, in addition to this, pass at a distance of at least 30 metres taken between their nearest adjacent points.

(e) Any aircraft overtaking another aircraft is responsible for keeping clear, and in no case must turn in across the bows of the other aircraft after passing it, so as to foul it or risk a collision, and must, in addition, subject to Rule 12, conform to the following regulations:—

(1) If flying on the same level, *i.e.*, within 5 metres above or below, must pass outside the overtaken aircraft at not less than 10 metres.

(2) If on a different level, must not pass nearer than 10 metres.

The distance shall be taken between the nearest adjacent points of the respective aircraft.

An aircraft when being overtaken shall not alter its course or level, save when in the act of overtaking and passing another aircraft.

FLYING TO THE DANGER OF THE PUBLIC.

(Passed by the Committee Nov. 11, 1913.)

1. Flying to the danger of the public is prohibited; particularly, unnecessary flights over towns or thickly-populated areas, or over places where crowds are temporarily assembled, or over public enclosures at aerodromes at such a height as to involve danger to the public.

2. Flying is also prohibited over river regattas, race meetings, meetings for public games and sports, except flights specifically arranged for in writing with the promoters of such regattas, meetings, etc.

* In the case of dirigibles the distance of 100 metres prescribed above shall be increased to 500 metres.

† From 0 degrees (*i.e.*, straight ahead) to 90 degrees on the right hand constitutes the forward quadrant.

APPENDIX G.

Report on Weather Service for Aerial Transport.

The chief meteorological requirements for the guidance of Aerial Transport may be divided into three groups:—

- (1) Statistical information.
- (2) Forecasts.
- (3) Knowledge of the momentary meteorological conditions along aerial routes.

(1) Statistical information.

Most of the meteorological information at present in existence is in the hands of the Meteorological Office or can be obtained by them.

Statistics already collected are available for such purposes as choosing routes and the sites for aerodromes and buildings. The statistical information at present obtainable differentiates between areas of 50 or 100 miles square; for instance, between the meteorological conditions which are met with on opposite sides of a mountain chain. But there is as yet little information relating to the local variations in meteorological conditions.

Statistics already collected are available for determining such questions as whether it is better to leave Switzerland on the port or starboard hand in flying to Italy, or whether it would pay to go round southwards by the Azores in flying to America. On the other hand, the statistical information at present available is not capable of discriminating between the average meteorological conditions of two alternative sites for aerodromes situated within a few miles, or even 20 or 30 miles, of one another, except in so far as it shows which of the meteorological conditions are likely to be the same in two neighbouring sites. Statistics show, for instance, that the cloudiness and rainfall in two neighbouring sites may be the same unless special circumstances interfere. On the other hand, fogginess and windiness depend almost exclusively on such local conditions that the present statistics are of little use except for the actual station at which observations were made. Perhaps, later, aerodromes will accumulate their own data.

A small staff at the Meteorological Office would collect the available useful information, but such a staff would have to be directed by someone in touch with aeronautics, in order that the information might be collected and tabulated in the form most useful for flying. He would have to decide such questions as whether frequencies or mean values should be dealt with. In dealing with wind statistics, for instance, it is more useful to know the number of hours during which certain winds blow with certain strengths, and from the various directions, than it is to know the mean wind velocity or direction.

If weather stations are going to be established at terminal and intermediate aerodromes in connection with civil aerial transport, it will be necessary to overhaul thoroughly the character of observations taken, in order that special attention may be paid to the data which are most important.

It is advisable that a system should be organised by which observations are taken and recorded regularly by aeroplanes travelling on defined routes. The work of collecting and comparing these statistics, and the superintendence of instruments might be undertaken by the Meteorological Office.

It has been pointed out by various members of the Committee that civil aerial transport will inevitably have to be worked on international lines. It is impossible to forecast what measure of international co-operation will be possible after the war, but it may be pointed out that for many years previous to the war the International Meteorological Committee has done successful work in organising international exchange of meteorological information and international co-operation in meteorological research. It seems certain that it would be advisable to consult with the aerial transport authorities in the allied countries before deciding on any definite plans for a weather service for aerial transport.

(2) Forecasting.

An extension of the present system in operation at the Meteorological Office should provide everything that can be expected in the present state of our meteorological knowledge. The high average correctness of weather forecasts will doubtless be improved.

Present system.—The present system involves taking observations at certain places two or three times a day, and communicating by telegraph with a Central Office, where the weather maps are made and the forecasts issued. Forecasts for 12 or 24 hours ahead at two or three fixed hours should be telegraphed from the Central Office to the termini and intermediate aerodromes.

Directions in which present system could be extended.

1. *Extension of range covered.*—Weather telegrams are already obtained from a few distant places, as Iceland, Cairo, and the Azores, and from ships by wireless. The number of distant stations could be increased and the range extended so as to include Russia, the Balkans, North Africa and America. Before the war the observations sent by wireless from ships usually arrived too late to be used in the forecasts, but the growing importance of messages from the Atlantic in connection with aerial transport will make it

worth while to organise these reports in such a way that the messages arrive in time. For this purpose fuller co-operation with the Royal Navy and the Mercantile Marine should be sought.

By increasing in this way the number of data on which forecasts are based, it will be possible to increase the size of the region for which the forecast is issued and to make it more accurate in all ways.

2. *Extension in the number of weather conditions predicted.*—At present the forecasts are adapted to the needs of people on the ground or the sea—sailors, farmers, travellers, etc. They might be much more useful to flying men if they were made to include the heights at which clouds are to be expected, and the velocity and direction of the upper winds. The first of these has not yet been attempted, but as the data furnished by aeroplanes become more numerous such forecasts may become accurate and useful. The second, the forecasting of wind at various heights, has already been practised successfully in France by the Meteorological Section there, and there is no reason why it should not be carried out even more successfully over a wider range by the Meteorological Office.

Such forecasts would be facilitated by increasing the number of upper air observations and of those on mountains.

(3) *Knowledge of the momentary weather.*

For this purpose the present system is quite inadequate. A continuous weather service would be necessary. All landing grounds would evidently be suitable weather observation stations, and continuous readings and reports could be arranged for, if necessary.

In distributing information two systems could be used. Either the observations could be communicated at frequent intervals, say, every hour, to a Central Office, and could then be telegraphed or telephoned when required to aerodromes, or the observations could be taken only when required and telephoned direct to the termini.

The advantage of the Central Office is that it would have a more comprehensive view of the weather conditions over the whole of Europe, and, moreover, an expert could be kept at the Central Office who would have the present conditions at his fingers' ends, and would know which were liable to a sudden change.

The chief difficulty which is likely to be experienced in this branch of the weather service is that of communicating

the observations sufficiently quickly to the termini. It seems probable that the direct method would be quicker than the Central Office method. Another point in favour of direct communication is that the observations taken at an intermediate landing-ground are only immediately interesting to the termini of the route on which it lies. These two points appear to us to outweigh the advantages of the Central Office method.

If there is a direct telephone wire along the route or constant wireless communication, the whole problem is greatly simplified. On the other hand, if the ordinary telephone lines have to be used, some sort of priority for weather messages will have to be arranged if they are to be of any real use.

The type of observations which could usefully be taken at the intermediate landing grounds needs some consideration. The height of the clouds is one of the most important things for a pilot to know. It would not be difficult to fit a range-finder which would give the height of the clouds at a glance.

The velocity and direction of the wind at various heights is also important, but it needs a skilled observer to make a pilot-balloon ascent, and even then the information is not available for about three-quarters of an hour after the balloon is sent off. It seems hardly possible to use pilot-balloons in connection with this branch of the weather service, unless balloons are sent up at regular intervals of two or three hours, and the last result is communicated in response to any enquiry from a terminus.

On the other hand, on a clear day the upper wind at any particular height would be found in a few seconds by means of a smoke-shell fired vertically and timed so as to explode at the right height.

One of the chief functions of the observer at the landing-grounds would be to report the appearance and disappearance of fog on their own aerodrome. This needs no very special training, but trained and experienced observers will be needed at every important aerodrome where upper-air work is carried out, and also at places from which local or general forecasts are issued. A corps of such observers should form an integral part of the military or civil air services, as, in fact, they already form a part of the Royal Naval Air Service.

MONTAGU.

G. I. TAYLOR (Major)

21/8/17.

† APPENDIX H

Preliminary Memorandum on Inter-communication between Aircraft and the Ground, and also Inter-communication between Aircraft and Aircraft.

APPENDIX I.

Safety Appliances for Commercial Aircraft.

1. The risk of forced landing of aeroplanes is the first of all risks run, and for this two remedial possibilities exist. The most important expenditure on safety and on the general economy of aerial transport is the provision of alighting grounds along the flying routes, and no suggestion herein is put forward in substitution for, or in diminution of, the importance of these route-alighting grounds; the second is the extension of the use of multi-engined aeroplanes. Airships would usually be provided with more than one engine in any case.

2. In considering the detail of appliances to be used in connection with safety on aircraft, regard must be had both to the prevention of accidents and the best method of dealing with the dangers arising after accidents have occurred, whether on the ground before commencing a flight, in the air, or on landing. It must be realised that experience shows that an accident to the machine by no means involves, in the majority of cases, an accident to the flyer and passenger. It is probably that the civil use of aircraft will conduce to much greater safety than the useful standard already reached, quite apart from any appliances—especially since extreme war performance and manoeuvring are not called for.

3. *Fire.*—The direction in which study is advisable in all types of aircraft is to try to arrange for the main petrol supply to be situated clear of the hot parts of the engine and away from the magneto, and to see that the exhaust pipes are kept clear of the petrol pipes, and the exhaust discharge is in such a position that a spark cannot ignite any surplus petrol flowing away in the case of over-filling of tanks, or any vapour from exits or leakages. In some engines gauze boxes can be fitted to induction pipes, and the inlets to carburettors arranged to draw the air from outside the structure.

4. Experiments have been made on magnetos by making small alterations to enable them to be immersed in an inflammable vapour, and it has been found that after lowering and raising the pressure on such vapour it did not fire the mixture even when overflow sparks occurred at the safety gap. This preliminary study should be prosecuted, and could probably result in the general introduction of such magnetos. Meanwhile the whole petrol system is kept clear of electrical devices, such as magnetos and wireless, in case leakages of petrol should give rise to vapour in their vicinity. A desirable feature which has been suggested as useful is an arrangement for shutting off the petrol from the jet instantly. This might take the form of a spring-controlled mechanism acting on a needle fitted with a quick thread, which, through the action of a spring, could be made to stop up the jet orifice. The object, which is to ensure the engine stopping quickly when desired, could be effected in various ways, and here also is a field for experimental development. Incidentally this might avoid the danger of an engine running backwards if overheated.

5. All overflow pipes and pipes between the carburettor and the atmosphere are led well outboard, and care is taken in the making of exhaust manifold joints to avoid the danger of their blowing out. In the case of rotary engines, which usually have no exhaust pipes, it is usual to cowl them completely with metal cowls and to keep those supporting members which may come near the exhaust free from exposed inflammable material. Any fuel or oil that may be thrown out from the engine is kept within the cowl, and if it should catch fire no damage results. Nevertheless such cowls should be drained. The aircraft of to-day have, except in the case of airships only, small margin of useful load, and their utility is jeopardised by compulsory carrying of additional weights. Hence fire extinguishers do not form an obligatory equipment until the aeroplane attains considerable dimensions, but it is eminently desirable that they should be carried if possible. Small extinguishers should be available at all aerodromes, but they must not contain ingredients likely to harm fabric or wood work.

6. *Parachutes.*—In airships, kite balloons, and balloons, the use of these, though requiring decision and courage on the part of the user, does not offer the same difficulties as in the case of aeroplanes. It is, however, in the present stage of development inadvisable to jump in a parachute under a height of about 500 ft. As regards aeroplanes, opinion is divided as to the advisability of employing parachutes, both for the above reasons and because there is difficulty in fixing the parachute in such a position that no part of

the aeroplane will be fouled when the jump is taken. Moreover, a substantial proportion of the accidents which occur only become accidents after the ground has been reached, or too nearly approached for the parachute to be useful. The best position for a parachute would seem to be either on the underside or on the side of the body, and a comparatively flat and compact parachute case has already been designed for this, and has been successfully employed in experimental flights with airships.

It may be said that parachutes would only be employed in the case of a serious outbreak of fire, or the breakage of some vital part of the machine. In the latter case it would generally be problematical whether the parachute could be got free—in the former, the problem of fire is best dealt with by preventive measures. Meanwhile the carrying out of experiments is to be encouraged.

7. *Air or Land Brakes.*—These have a distinct promise of utility for landing in restricted areas. Several forms of air brake have already been tried with more or less success. As soon as engines have reached a high standard of reliability a promising form of air brake is the variable pitch and reversible air-screw. Land brakes might take the form of a plough either operated by hand or automatically making contact with the ground. A similar purpose would be served by wings of variable surface or with the camber and angle of incidence capable of being altered. This latter development might come with the further increase of flying speeds which is often foreshadowed.

8. *Instrument for Ascertaining the Attitude of an Aeroplane in a Cloud.*—It is understood that considerable importance is attached to this by pilots. Neither the ordinary spring-controlled air speed indicator nor the spirit level can be relied upon for this purpose. Only a gravity-controlled instrument gives for steady flight conditions the true angle of incidence irrespective of whether the machine is turning or not. It has been suggested that, but for the extreme weight of the gyrostat, a solution might be found in its adoption, the pilot putting his machine in a horizontal position before entering the cloud and starting the gyrostat, which would continue to indicate the direction in which the axis of the machine was lying at the instant of release. More important than this is the indication of turning, an instrument which shows whether a turn is or is not being made. This relieves us of the evil results of certain peculiarities of the aero compass.

9. *Landing at Night.*—Landing airships at night does not present any great difficulty. The best method has been found to be to place beacon lights on the sheds with a searchlight on the ground pointing up-wind, coupled with steaming lights. The trail rope is also painted white. Some similar system, or petrol or acetylene flares, is suggested for aeroplanes, perhaps coupled with carrying on the machine a searchlight and parachute flares, to illuminate the ground in the event of a forced landing.

10. *Navigation in Fog.*—This is in part a question of illuminating arrangements, as, generally speaking, the fog hardly ever extends beyond 2,000 ft. from the ground, and is purely local. The system adopted in France of firing star shells to burst over the fog might also be developed along commercial routes. Landing grounds should be selected as far as possible in fogless areas, and perhaps advantage for alighting might result from specially treating the ground to keep a dry surface. Research and experiment on the dispersal of fog would also be valuable.

11. *Multiplication of Power Plant in Aeroplanes.*—This has obvious merits in large machines as a guarantee against the results of engine failure. Three engines have some advantage over two.

Four-engined machines with one tractor engine on each wing, and behind it, a pusher engine with the crank-shaft in the same line, have been tried and promise well, though they have not yet been fully tried out.

As a matter of useful information required on this class of work it may be said that it has been found that in twin-engined machines it is not necessary to have opposite-handed engines, but that a machine can be flown quite successfully with two right-handed or two-left-handed engines. This is an important simplification for the upkeep of such craft.

E. M. MAITLAND,
Wing Captain.
MERVYN O'GORMAN,
Lt.-Colonel.

APPENDIX J.

Report by Lieut.-Colonel O'Gorman, Mr. Holt Thomas, and Mr. Lanchester on a Main or Terminal Aerodrome.

NOTE.—This report was drawn up in answer to a request by the Special Committee for a report upon a main or terminal aerodrome suitable for despatching and receiving 100 aeroplanes a day, with sufficient housing accommodation for a similar number.

A Main or Terminal Aerodrome.

We do not consider that it is possible to make any constructive report on this subject on the lines of 100 aeroplanes leaving and arriving per day and housing for 100 craft.

1. *Expenditure.*

The cost of terminal aerodromes is by no means so easily approximated to as that of intermediate grounds, for the reason that they will necessarily be at least on the outskirts of large centres of population. It is accordingly impossible to make any estimate of what expenditure might be involved. (It may be possible to discover what is the approximate ground-rent of Hendon Aerodrome, also its accurate acreage (approximately 200 acres), and to indicate whether such an aerodrome as this is the minimum which could be reasonably used for civil transport service in London, and whether it may be regarded as a minimum type of terminal aerodromes.)

2. *Size.*

The minimum size of an aerodrome from the point of view of the alighting of single machines, is obviously the size of the intermediate landing grounds indicated by Captain Robb in his paragraph 2 of Appendix K, but the actual size required at any terminal station for, e.g., 100 aeroplanes "leaving and arriving" per day depends upon the number of aeroplanes which may be expected to be arriving or leaving simultaneously, and it is difficult to forecast this with any attempt at precision, since no data exists on which to found an estimate of the times of starting and arriving. If we suppose that aeroplane flying will for preference take place by daylight, then it is to be supposed that the major part of the starting will take place in the morning and the major part of the arriving will take place after noon, since on broad lines it may be said that the reasonably long flights will be economically desirable. Nevertheless, where the air service is run to districts which have not got a good railway service, it will be found that short distance air journeys can be introduced, and accordingly a certain amount of use of the aerodrome throughout the middle hours of the day for leaving and arriving is to be expected. Under the circumstances, it is impossible to discuss the problem on a basis of a definite number per diem without making some assumption for which data do not at present exist; we have therefore substituted the rate per hour and assumed 15 leavings or arrivals per hour, without expressing our opinion as to whether this corresponds to 100 per diem. It is thought that an aerodrome of about 200 acres could handle this traffic, especially if the departures were reasonably distinct from the bulk of the arrivals, but for it to do so it would be necessary to have active and well organised gangs of men to arrange to clear the aerodrome of machines which may stop in an exposed position, and thus leave the aerodrome free for other machines. Compulsory powers of purchase or hiring in default of agreement will no doubt be necessary in some centres.

3. *Surface.*

In view of the extreme importance to be attached to high wing loading and rapid alighting, for the purpose of economy in aircraft construction and use, the surface of the aerodrome would have to be very much superior to that at present existing at Hendon, without actually pressing it to the point of being as level as an ordinary cricket field. Beyond that it would be imperative that all high buildings, high hedges and high trees in the immediate neighbourhood should as far as possible be avoided.

4. *Soil.*

It is clear from experience up to date of aerodromes, which are frequently on flat, low-lying land, that drainage would be required. Moreover, on a certain expanse in front of the sheds proposed, there should be tar macadam or other waterproof inexpensive flooring.

5. *Approaches.*

These should be similar to those mentioned in paragraph 5 of Appendix K.

6. *Surrounding Country.*

See Appendix K, paragraph 6.

7. *Preparations.*

See Appendix K, paragraph 7, save that since the terminal grounds will be larger they will be proportionately more costly.

8. *Accommodation.*

The housing for, say, 100 aeroplanes would necessarily involve petrol and oil stores, repair departments, standing buildings for ground-men, offices, store for the reception and delivery of goods, and, later, station room, perhaps, for passengers, garages for attendant motor-cars to convey the service to town centres, offices for inspectors and traffic chiefs, etc., and aeroplane sheds so built as to admit the largest probable aeroplanes. At the inception of the service on a small scale this expense could no doubt be deferred or minimised.

9. *Marking.*

It is probable that no specific marking will be required for terminal landing grounds, because their character will be so very obvious to fliers who are approaching the centre for which they are making, but arrangements for such devices as kite balloons for signalling the situation in time of fog, wireless appliances and meteorological observatory should be foreseen.

10. *Lighting.*

Paragraph 11 *re* lighting in Appendix K would also apply here.

11. *Maintenance.*

See paragraph 12 of Appendix K.

The installation of housing for 100 aeroplanes on transport work at the termini is clearly dependent upon a future state of civil aerial transport, and need not be at once instituted as a charge upon the nascent industry. Such charge could only be borne if alternative military and naval use of the facilities were to form a means of distributing the burden of the cost on other shoulders than the transit company's. The eventual need of such housing no doubt exists, but the cost of such housing will be so largely dependent on the size of aeroplanes used that an estimate would be unavoidably misleading and would differ at one terminal station from what it would be at another where smaller craft might be the main types.

23/10/17.

APPENDIX K.

Memorandum by Major E. Elvey Robb as to Intermediate Landing Grounds.**1. Distance apart.**

Mr. Hoyt Inomas, in his recent lecture before the Aeronautical Society, suggested that the distance between each landing ground on an aerial route should be ten miles, and at the inception of civil aerial transport the provision of landing grounds on this scale would appear essential in order to minimise risk of accident. Some economy might be effected by providing a regular landing ground with attendance and accommodation every twenty miles with facilities for forced landings midway between every two landing grounds. These facilities for forced landings on emergency grounds could be arranged by carrying out a limited amount of work in the way of removing hedges, felling trees, etc. Emergency grounds would only be used in case of absolute necessity.

2. Size.

Each landing ground should afford a clear run of 600 yards in every direction. If any serious obstacles exist on the approaches to the ground, the size of the ground may have to be increased. It is not essential to have a ground 600 yards square. An "L" shaped ground will suffice if it affords a clear run of 600 yards in any direction, provided each arm of the "L" is at least 300 yards wide. The area of landing grounds on this basis will average 60 acres.

3. Surface.

The surface should be level so that machines can normally land upon and taxi across the ground without injury.

4. Soil.

Selection will naturally be confined to the line of the aerial route, but, subject to this, landing grounds should, as far as practicable, be chosen on light, porous soil with natural drainage. Grounds with clay soil invariably require special drainage.

5. Approaches.

The approaches—or, at all events, the majority of the approaches—should be open and free from serious obstacles. It will frequently be necessary to fell trees, remove haystacks, etc., on adjoining grounds, and telephone and telegraph wires on roads bounding landing grounds will have to be lowered or carried underground. Statutory powers for those purposes will be required.

6. Surrounding country.

This should afford facilities for forced landings in case of engine failure when "taking off."

7. Preparation.

This will consist mainly of grubbing hedges, piping, and filling in or boarding over ditches and watercourses, levelling, tree-felling, etc. The cost of preparation will naturally vary according to the nature of the site and the amount of work involved. An average expenditure of £1,500 will cover the cost of preparing landing grounds. Compensation payable to the owner and occupier for disturbance (other than to crops) will average £500 per ground, making a total of £2,000 per ground. The cost of preparing "emergency grounds" will average £750 per ground, and £350 per ground should cover compensation (other than crops)—£1,100 per ground in all. Statutory powers authorising the necessary work of preparation in default of agreement, and prescribing a method of ascertaining the compensation will be necessary.

8. Accommodation.

At intermediate landing grounds not used for the reception of passengers or freight, and where no provision for carrying out serious repairs is contemplated, the only accommodation required for landing purposes will be:—

(a) Attendant's hut with exchange telephone connection;

(b) Small store for petrol and oil.

This accommodation can be provided for the average cost of £400, which includes provision for telephone connection, which will be a serious item in some districts.

9. Cost of hire.

This will average £1 per acre per annum throughout Great Britain. To this figure must be added, for the first year in the case of arable, £4 per acre, and in the case of pasture, £1 per acre for tenant right and disturbance of crops. These figures are additional to the compensation estimated in paragraph 7. This estimate is based on actual experience with military landing grounds, and it should be stated that the figures referred to have only been arrived

at by careful management. Grazing has been permitted subject to the restrictions mentioned below, and certain grounds have been put out of action during the months of May and June to enable them to be laid down to hay. In some cases, grounds managed on these lines, have shown a small profit and this has brought down the average cost to the figure mentioned. How far it would be possible to deal with landing grounds on an aerial route in this manner is a doubtful question. Grazing on landing grounds is a matter that requires very close attention, and it is necessary to pen the stock or place it under the control of a shepherd or dog. Experience has shown that in the daytime sheep only should be permitted to graze on landing grounds of which any extensive use is made. On grounds which are not in use during the night, stock of all descriptions can be grazed from dusk to dawn. If no arrangements for grazing or laying down to hay are permissible, the estimated cost of hire would be £1 10s. per acre. Compulsory powers for purchase or hiring in default of agreement will be necessary.

10. Marking.

It is difficult from the air to distinguish landing grounds from the surrounding country, and they, therefore, require marking in a distinctive manner. A chalk circle 100 feet in diameter and with a band 3 ft. wide, has proved very effective, and can be seen from practically any attainable height on a clear day. It is necessary to keep the sign a good white colour so that it stands out well, and this is done by lime-washing the chalk from time to time. The name of the ground should also be marked in chalk letters 15 feet long by 3 feet wide. Emergency grounds should have a distinctive sign to distinguish them from regular landing grounds.

11. Lighting.

Numerous experiments in methods of lighting landing grounds have been tried. The result of a large amount of experience in night flying is that pilots prefer simple methods. A number of paraffin or petrol flares, arranged in such a manner as to indicate the existence of a landing ground and to illuminate the landing area, has proved the most effective method. The position or number of the flares can be varied in a similar manner so as to indicate to a pilot the locality of the ground. In some cases, it is necessary to indicate obstacles on the approaches to and exits from landing grounds by red lamps.

There are various minor details in connection with the lighting of landing grounds which require consideration, as to which detailed information can be given if required. The above particulars will, however, suffice to show that in the ordinary way the lighting of these grounds is a simple and relatively inexpensive matter.

12. Maintenance of Landing Grounds

The grass requires cutting or grazing and the ground rolling from time to time.

13. Summary of estimated expenditure on preparation and hiring.

	Arable. £	Pasture £
(a) Landing Grounds (average, 60 acres).		
Preparation	1,500	1,500
Accommodation (including telephone connection) ...	400	400
Compensation (other than crops)	500	500
Compensation for crops ...	240	60
	<hr/>	<hr/>
	£2,640	£2,460
(b) Emergency Grounds.		
Preparation	750	750
Compensation (other than crops)	350	350
Compensation for crops ...	240	60
	<hr/>	<hr/>
	£1,340	£1,160

Hiring: This will average £60 per annum in each case, or, if no grazing or laying down to hay is permitted, £90 per annum.

APPENDIX III.

Final Report of Special Committee No. 2.

Special Committee No. 2 submit the following report, dealing as far as appears possible at present, with those matters referred to them which are not covered by their Interim Report.

AERIAL TRANSPORT OF PASSENGERS AND GOODS.

In considering the practical possibilities of aerial transport generally, the Special Committee, in their interim report, dealt more particularly (see page 43) with air mail services. In their present report the Committee propose to deal with the carriage of passengers and goods, including the question of the probability or otherwise of the use of privately-owned aircraft.

As to the types of machines which are likely to be used in commercial services, the Committee desire to emphasise one aspect of the technical reports of Colonel O'Gorman and Mr. Bairstow, which are appended to their interim report as Appendices A and C. These reports were furnished in answer to a request by the Committee that four widely different types of aeroplane now in military use should form the basis of a report as to the limits of the capacity of aeroplanes generally. The four types were selected so as to cover the whole range of existing machines, and the estimates given of the performances to be expected are illustrative of the possibilities of aeroplanes generally. Thus, the data set forth in these reports can be used as a basis for estimating the performance of the commercial aeroplane in the immediate post-war period. The variations in design which commercial services will render necessary are only of a secondary character. There is no difficulty in adapting aeroplanes to the carriage of passengers and goods, as well as of letter mails. The case is different with airships. As far as airships are concerned, it will be observed from the report by Wing Captain Maitland, which is attached hereto as Appendix A, that while the existing types, which possess a very large proportion of disposable lift, may be expected to prove, within limits, suitable for commercial work, far better results could be obtained by specially designed airships, as the lines of development, up to the present, which have been purely military, have not been such as to produce the most suitable airship for commercial purposes.

Generally speaking, the Committee are of opinion that the carriage in aircraft of mails, passengers, and goods will present no difficulty from the technical point of view. It would appear from their terms of reference, which mention the question of running costs, that the Committee were expected to attempt some forecast of the probabilities of the commercial success of such carriage. This has proved practically impossible from the lack of any experience of commercial aerial transport up to the present time. The amount of business over which a civil aerial transport company would have to spread its standing charges is therefore a matter of uncertainty. Moreover, in the absence of any reliable forecast of the amount of business over which aircraft manufacturers after the war will have to spread their standing charges, the prime cost after the war of the machines, upon which the cost of using them must largely depend, cannot be even approximately estimated. The Committee feel that they are safe in saying that, given a demand for the carriage of mails, passengers, and goods, there are no practical obstacles in the way of organising aerial services to meet that demand. The Committee would again point out that, in initiating aerial transport services, due advantage should be taken of the novel facilities offered by the use of aircraft, *e.g.*,

(1) In the case of mails, by competing with telegraphic services or in establishing a new type of express letter service;

(2) In the case of passengers, by competing with rail, marine, and road services over long distances, or where the journey either includes sea as well as land passages, or is between places not conveniently served by rail.

(3) In the case of goods, by enabling ordinary merchandise, commercial samples, and even (if necessary) spare parts of machinery urgently required, to be conveyed quickly to places otherwise inaccessible except by journeys involving great expenditure of time.

While it is quite possible that the earlier commercial use of aircraft will take the form of regular services, particularly in the case of letter mails, the Committee suggest that one of the first methods of employing aeroplanes for the transport of passengers may lie not in the flying of craft between cities at specified times, but in the occasional and increasing use of single machines for rapid journeys in any direction, rather than along a fixed route, carrying one or more occupants who may be prepared, owing to the urgency of their business, to pay special fees so as to secure the high speed of transit which will be possible by air.

Such first and occasional passenger work, which might increase until it provided an appreciable but not large source of revenue, would have the advantage of educating the public as to the rapidity of aerial transit—thus preparing them for the time when regular services were started—could be undertaken immediately peace comes, since it would not be open to the same objection as would any premature attempt to run a daily service to schedule irrespective of weather conditions.

After the war, therefore, we can contemplate the systematic organisation of existing resources in the shape of aerodromes, pilots, and suitable machines, so that passenger craft, flown by skilled and reliable men, could be hired at so much per mile or day for rapid journeys. It should be possible to arrange things so that a busy man might engage a machine for a journey from London to Dublin, Paris, Stockholm, or the like by telephone from any post office or convenient public office. The wide use of such a service would depend largely on the facilities being universally known and understood, and upon its being generally accessible under standard conditions. Otherwise it might become only an occasional convenience for people with sufficient leisure to make the necessary enquiries and arrangements. The development of services of this kind in their earlier stages might provide an outlet for a certain number of surplus military machines of a type adaptable to passenger carrying.

PRIVATELY OWNED AIRCRAFT.

The probable use of privately owned aircraft will largely depend on the development of aeronautics as a recreation and a sport. This, again, will depend largely on the cost of the acquisition and use of aircraft. But since there will exist at the end of the war sufficient facilities in the shape of landing grounds to render flying by day free from any particular risk, although defined routes may be lacking, the Committee suggest that for the general encouragement of aeronautics, the establishment of flying clubs might be valuable. Such clubs could be either promoted by the proprietors of aerodromes, who would be in a position to offer special facilities for storing machines and providing club premises, or could be formed by associations of flyers leaving the Services at the conclusion of the war, rather in the manner of non-proprietary social or sports clubs. Such flyers might thus be enabled to make use of aeroplanes at a reasonable expense and to keep themselves in practice. These clubs might find employment for a small percentage of such machines as may be surplus to naval and military requirements, and they would tend to stimulate the design and construction of pleasure and touring type machines.

AERIAL ROUTES.

The Committee have considered Item 6 of their terms of reference, viz.: What main aerial routes might be marked out and prepared for now for utilisation by an aircraft service. The Committee do not think that they can, in the light of information now available, usefully add anything to their interim report. With regard to the Atlantic route mentioned in that report, they have made further enquiries as to the prevalence of fog on the coast of Newfoundland from Sir E. Morris, and Mr. H. C. Thomson, of the Newfoundland Railway and Train Ferry Syndicate, Ltd. The answers to these enquiries, which are attached as Appendix B, confirm the view that the fog does not as a rule rise very high above the surface of the sea, and that it does not generally extend more than a mile or two inland.

Appendix
B, p. 58

AERIAL MAIL SERVICES.

The Committee desire to draw attention to a revised memorandum by Mr. Harper on an experimental air mail service from London to Glasgow, which is attached as Appendix C to this report. This super-Appendix C, p. 58
cedes the original memorandum (Appendix E to the interim report), and the times have been worked out on a load of 100 lbs. of mails with machines of a maximum speed of 150 m.p.h. and an average speed of 120 m.p.h.

PROHIBITED AREAS.

With regard to prohibited areas, and any regulations which should be made for their protection, the Special Committee are of opinion that these are matters the consideration of which should be deferred until after the war.

NIGHT FLYING.

* * * * *

Since the problems of night flying are at present under investigation, and the methods of ensuring safety in this kind of flying will be the subject of rapid development, the Special Committee do not put forward detailed recommendations, but they present the following summarised conclusions:—

- (1) Night flying will be valuable from the commercial point of view.
- (2) Improvements in the methods of illuminating landing grounds, both on the ground and from machines themselves, should be sought for.
- (3) The illumination of aerial routes as an aid to navigation (apart from landing facilities) is desirable
- (4) The development of directional wireless is of the highest importance.

ANNEX C. OF THE DRAFT INTERNATIONAL CONVENTION.

This Annex was referred to the Committee by Special Committee No. 1. It contains such regulations as to lighting of aircraft, rules of the air, and rules as to landing and distress signals as were agreed to by the delegates of the various European Powers attending the Paris Conference in 1910. Recent developments in aeronautical science and practice render necessary certain modifications of these regulations, more particularly because at the time of the Paris Conference the proposed regulations were considered more from the aspect of the use of airships than of aeroplanes. The detailed recommendations of the Special Committee are attached to this Report as *Appendix E.

R. M. Ruck, Maj.-Gen. (Chairman).
Leonard Bairstow.
†R. M. Groves, Wing Capt., R.N.
G. Holt Thomas.
E. M. Maitland, Wing Captain, R.N.
E. P. Morris.
G. E. P. Murray.
†Mervyn O'Gorman, Lt. Col.
Frank Pick.
J. C. Porte, Wing Commander, R.N.
J. W. Pringle, Colonel.
E. Elvey Robb, Captain.
W. P. Schreiner.
W. Sempill, Wing Commander, R.N.
T. Vincent Smith, Major.
T. Sopwith.
G. I. Taylor, Major.
E. R. Wayland, Lieut. Colonel.
H. G. Wells.
H. White Smith.

D. O. Malcolm (Secretary). January 21st, 1918.

APPENDIX A.

The Airship for Commercial Purposes.

In attempting to form an opinion of the capabilities of airships and aeroplanes respectively as commercial vehicles, it is important to bear in mind certain phases of past history.

In the first place, the design and construction of airships has up to the present in all countries been mainly confined to the Services, and where private firms have been concerned they have been engaged on producing airships suitable for military purposes. In taking airship performances during the war as a standard of future commercial development it should, therefore, be remembered how vastly different are the requirements of commercial- and passenger-carrying airships to those which have hitherto been paramount in the minds of constructors. The modern Zeppelin, for instance, is designed for rapidity of climb, the attainment of great heights, and the carrying of large quantities of bombs, speed being a secondary consideration.

In a commercial airship increased speed will be necessary if a regular service is to be maintained, while a height of 1,000 ft. will be ample for normal flying, though greater heights should be attainable if necessary. The weight-lifting feature would be retained for the carrying of goods and passengers.

Existing German military airships have proved themselves capable of attaining a maximum speed of over 60 m.p.h., with a "disposable lift" available for crew, fuel, bombs, etc., of over 30 tons, remaining in the air for something like 36 hours, and attaining a height when over this country of 18,000 or 19,000 ft.

There is little doubt that a commercial rigid airship could be constructed to-day with a maximum speed of 75-80 m.p.h., capable of covering 2,000 miles with a load of cargo of 12-15 tons; or 600 miles with 30 tons of cargo (or 210 passengers with 50 lbs. of luggage each).

With care in designing it should be possible to design an airship having the speed named with comparatively slight increase in engine power and of the same size as the present-day Zeppelins. The Germans, owing to the necessity for rapid output, have adopted a comparatively inefficient form, from the aerodynamic point of view, but with an airship of true stream-line form the higher speeds should be easily attainable.

* * * * *

The fact that a number of Zeppelins have been brought down over this country and in France does not affect the value of airships for commercial purposes, as the inflammability of the gas with which they are filled does not give rise to any danger in normal flying. In spite of the enormous amount of flying which has been carried out by airships in this country during the war, there has been no case of the destruction of one of these craft owing to its catching fire in the air.

One of the objections to airships which is frequently raised is their inability to fly in strong winds. This is in part due to the comparatively slow speeds which have been obtained up to the present, for the reasons stated above, and which can undoubtedly be improved upon with careful attention to design having that end in view. It is, however, largely due to the difficulty of handling airships on the ground in high winds owing to the large surface they offer to the wind. There is no doubt that this difficulty would be, to a considerable extent, overcome by the adoption of revolving sheds on land or floating sheds on water. The best method, however, undoubtedly, would be to abolish sheds altogether—except for docking purposes—and maintain the airships permanently moored out.

* * * * *

The many practical advantages which the airship possesses for commercial purposes are not, perhaps, always appreciated.

Present-day airships, which in no way approach the limit of size, as has already been pointed out, have a disposable lift of over 30 tons, which enables them to embark on long flights without the necessity of descending for replenishment of fuel.

The initial weight of the power plant is, for the same reason, of less consequence than in the case of the aeroplane, which renders efficient silencing possible, and at the same time simplifies design owing to the weights not having to be cut down to so fine a point. There is no reason why an airship should not be fitted with engines as silent as those of a motor-car. Sleeping accommodation can, in any case, be provided well away from the power plant, and there is complete absence of such noises as the singing of wires which would detract from the comfort of passengers in an aeroplane. In this connection it may be pointed out that in this country airships have up to the present—owing to the

* Since this report was presented to the Main Committee, the detailed recommendations in Appendix E have been incorporated in Appendix A to the Report of Special Committee No. 1. See p. 32.

† Reservations by General Groves and Colonel O'Gorman as to Appendix E will be found at the end of Appendix A to the Report of Special Committee No. 1. See p. 35.

limitations of output—necessarily been fitted with engines designed for aeroplanes. The special requirements of an airship engine are too detailed to be gone into here, but great improvements are undoubtedly obtainable by the use of such engines. An airship can remain in the air however low the speed may be, so that the engines can be throttled down when required, thus effecting considerable economy in petrol consumption; while the fact that the engines need not necessarily be run for long periods of time at full speed has obvious advantages from the design standpoint.

The power plant can be readily split up into as many units as desired—there being no advantage in concentrating the weights—and failure in the power-plant does not involve immediate descent, while running repairs can easily be effected in the air.

Even with landing grounds only ten miles apart an aeroplane would be compelled to fly at a minimum height of about 3,000 ft., whereas an airship can cruise with safety a few hundred feet above the ground, which considerably enhances the pleasure of passengers by affording them an opportunity of enjoying the scenery.

The difficulty which an aeroplane pilot has in judging the attitude of his machine to the horizontal at night, or in fog,

mist, or cloud, does not obtain in an airship, which always remains on an even keel.

An airship can set out on long flights over the sea or marshy and wooded country without fearing engine failure. At intermediate stopping places it can come down to within a few hundred feet of the ground and moor to a grapnel (or drogue if over the sea) to replenish fuel, without actually landing. Similarly, an airship can fly at night with complete safety, navigation being carried out by the ordinary naval instruments and observations of the stars made from a steady platform on the top surface.

In conclusion, the commercial airship of the not-far distant future will have a "disposable lift" available for crew, fuel, and merchandise, or passengers of 50 to 60 tons or more. It will have a speed of 90 to 100 miles per hour, with ample accommodation for passengers in the shape of saloon, drawing-room, smoking-room and state-rooms, with a lift giving access to a roof garden on the top, and will be able to remain in the air for a week or more at a time. After a journey it will return to moorings like a water-borne ship, only being housed in a shed for periodic overhaul.

E. M. MAITLAND,
Wing-Captain.

December, 1917.

APPENDIX B.

Correspondence Relating to Fog on the Newfoundland Coast.

Copy of letter from Sir E. Morris, to Lt.-Col. Wayland, dated 3rd Jan., 1918.

"I am much interested in the question of fog on the coast of Newfoundland in its bearing on the question now being considered by the Civil Aerial Transport Committee. I have lived all my life in Newfoundland, and have frequently sailed in the spring, summer and autumn seasons around the coasts of the country and Labrador. Between the ages of fifteen and eighteen I lived at a place in Placentia Bay, probably the bay in Newfoundland having the highest percentage of fog. During these years I cruised and sailed a small pleasure yacht, and I can speak with a certain amount of personal experience. Generally speaking, Newfoundland inland or along her coasts has no fog which could correctly be designated as 'local.' Our fog comes in from the Atlantic Ocean when the winds are between North-East and South-West. There are seasons when even with a S.-W. or N.-E. wind we may not have a fog. We never by any chance have fog when the winds are from any point between S.-W. going West around to the N.-E. It follows that as our prevailing winds, sometimes continuously for months, are from the W. and N.-W. we have very little fog. I have seen a whole season from April to November pass without rain or fog. When the fog does come in from some atmospheric cause, it lies low right down on the water, and it is a common occurrence to see the sun shining on the hill-tops and fog down on the sea. So much so is this the rule that the practice is to build our lighthouses on high promontories from five to six hundred feet high. Further, as a rule, the fog does not penetrate inland very far, but is eaten up and absorbed by the land over which it hangs and it is a usual and common daily occurrence to see a bank of fog outside the harbour and a glorious sunny day inside without a vestige of fog. Further, the fog is perfectly white, and although at times thick, would not, I fancy, be found too dense for landing from the air, as I think it will be found that the fog does not reach the height at which airmen fly. Under all the circumstances, I think it will be found that there are no special difficulties in the way of Newfoundland being the landing station on the western side of the Atlantic for any aeroplane service after the war. Further, I think on enquiry

it will not be difficult to procure evidence to support this position."

Copy of letter from Mr. H. C. Thomson to Lt.-Col. Wayland, dated 14th Dec., 1917.

"In reply to your request for further information about the nature of the Newfoundland fog, I may say from my own experience that the fog does not, as a rule, rise very high above the surface of the sea. From some little way off it can often be seen lying on the sea like a regular bank of fog with clear sky above it. Sometimes, too, when it is so dense on the water's edge that one can hardly see a ship's length off, it is so thin above that the sky can just be made out. Very often, too, there is a clear belt between the fog and the land—the land, as the sailors say, 'eats the fog,' and even when it closes right in on the coast, it only extends a very short distance inland. I have often seen St. John's so enveloped in fog that the harbour cannot be seen at all, whilst a mile or two inland there is bright sunshine.

"In the interior there is very little fog indeed. I write from recollection, but I think Lord Northcliffe drew attention to this in a speech he made some four or five years ago at a meeting of the Anglo-Newfoundland Development Company.

"I will try and get this for you next week. There is also a remarkably clear belt stretching across the Gulf of St. Lawrence from St. George's Bay on the west coast of Newfoundland to Chatham in New Brunswick.

"The average of fog in St. George's Bay, you will see from the lighthouse percentages I send you, is so small as to be practically negligible, and the enclosed correspondence and the statistics furnished by the Meteorological Office some years ago shows that the fog at Chatham is also exceedingly small, much less than either to the North or to the South of it.

"There are many excellent landing places round St. John's, and as it is the capital of the island it would probably be the best halting place for passengers; and the flight from there to St. George's Bay would be over the land all the way, and freer from fog than if a landing were made near Cape Race and the flight continued from there."

APPENDIX C.

Revised Memorandum by the Assistant Secretary (Technical) as to an Express Air-Mail Service between London and Glasgow, via Newcastle and Edinburgh.

It is assumed that in an experimental express service, started immediately after the war, only a limited quantity of urgent mails would be carried, at a special fee, and that the bulk of the mails would still go, as at present, by land. The service contemplated in this memorandum is a purely express service. Others will doubtless be established, such, for example, as those in which large machines will carry passengers and parcels as well as mails.

A London-Glasgow service has been chosen for illustration for several reasons. In the first place, it requires at least a 250 miles' flight, at an average, say, of 120 miles an hour, such as that from London to Newcastle, to demonstrate the speed of an express air service, and for this speed to offer a sufficiently marked saving of time over railway transit, remembering that one must reckon the time taken in establishing the land connections of an air service.

By instituting a London-Glasgow express service, and by so arranging the time-table that a business man could post an urgent letter during the morning in London or

Glasgow, and for this letter to reach its destination well before the close of the business day, one would offer a facility which cannot be offered by existing means of communication; and it is argued that, when given this new facility, the business world would learn to make use of it.

The aeroplanes employed on the service are assumed to be machines which, carrying a pilot and 100 lbs. of mails, will attain a maximum speed of 150 miles an hour, and maintain an average of 120 miles an hour.

The land communications of an express air service must be taken into consideration as having an important bearing on the time-table of the service as a whole. The organisation of such land communications is a matter within the purview of the Post Office, since the collection of mails at the outgoing office, and their distribution from the office of arrival, must of necessity be under their control. It has been found impossible in this memorandum to assign any specific time for the sorting and distribution of letters, and therefore no estimate of the time taken in the land communications has been attempted, other than the time

for the conveyance of outgoing mails from the Post Office to the aerodrome, which has been assumed to be forty minutes.

A time-table of the aerial carriage of the mails is now submitted:—

LONDON-GLASGOW. GLASGOW-LONDON.
One Machine each way daily.

Posting is allowed up to 11.30 a.m., when the mail-bags are closed, and carried to the London terminal aerodrome. The time-table is then as follows:—

12.10 to 2.25 Carriage of the mails by air from London to Newcastle. The aeroplane does not alight at Newcastle, but drops the Newcastle mail into a net.

2.25 to 3.10 The aeroplane continues its flight to Edinburgh. It does not stop at Edinburgh, the mail-bag for that city being dropped into a net.

3.10 to 3.30 The aeroplane completes its last stage to Glasgow.

GLASGOW-LONDON.

Posting is allowed in Glasgow up to 11.30 a.m., when the mail-bags are closed and taken to the aerodrome. The time-table is then as follows:—

12.10 to 12.30 The aeroplane flies from Glasgow to Edinburgh, alighting to pick up mails.

12.35 to 1.20 The aeroplane continues its flight to Newcastle, where it alights to unload and also

to pick up. Newcastle firms wishing to send a letter by air to London would be able to post as late as 12.45.

1.25 to 3.40 The aeroplane continues its flight from Newcastle to London.

It may be useful to give an illustration of the facilities offered by such an express service:—

The Glasgow recipient of an urgent letter, say, from London, after acquainting himself with its contents, might be able in some cases to answer at once by telephone or telegram, or he might prefer to write a more detailed answer, which would go to London in the ordinary way by the evening mail, being received in London the next morning. If the recipient of the letter adopted the last-mentioned course, the air-mail being used only one way, there would still be a clear saving in time of a day, as compared with the existing routine of correspondence, in which a letter is posted in the evening in London, received in Glasgow the next morning, the answer being written and posted that day, reaching London on the third morning.

January 1st, 1918.

HARRY HARPER.

NOTE.—In the event of the Main Committee deciding to incorporate any of the contents of this memorandum in a report to the Air Ministry, it is suggested that the various times contained in it should be substituted for those which appear in the original memorandum. (Appendix E. to the Interim Report of the Special Committee.)

APPENDIX IV.

Report of Special Committee No. 3.

1. The Special Committee were asked to advise as to the development and organisation of aircraft production from a commercial and financial point of view, with special reference to—

- (1) The encouragement of the production throughout the Empire of the various types of aircraft required for organised aerial services, particularly so as to ensure a sufficient margin of supply for military and naval requirements.
- (2) The probable availability of capital for use in the production of aircraft and in organising aerial services, and the possible necessity of State ownership or of State aid to private enterprise in these respects, either by direct subvention or by specially favourable treatment of some other kind.
- (3) The possible necessity for some special control over the raising of fresh capital by companies or firms engaged in the production of aircraft and the running of aerial services.
- (4) The possible necessity, after the conclusion of the war, of immediate measures to protect such existing trade interests as are dependent upon war contracts.
- (5) The extent to which existing organisations, working under war pressure conditions, will require to be modified in order to establish them on a permanent peace basis.
- (6) The consideration of the cost of production of aircraft.

2. At the outset of their enquiry the Committee have met with certain difficulties which are necessarily inherent in the problems on which they have been asked to advise. The aircraft industry, as it exists to-day, is an organisation amply equipped with capital, material, machinery, expert knowledge, and trained labour; but at the same time it owes its development and its present position wholly to the phenomenal war demands of the naval and military authorities. For this reason it cannot be regarded in relation to post-war problems of reconstruction in the same light as other established British industries. There is no past experience of trade on a peace basis to guide the Committee, and, since the post-war aerial programme of the Government must necessarily depend on a number of military, naval, and financial considerations, which it is impossible at this stage to forecast, and indeed upon the result of the war itself, it cannot be expected that any authoritative information can be furnished as to the probable direct Government demand for aircraft on a peace basis.

3. Assuming, however, that there will be some considerable diminution of direct Government orders at the end of the war, the Committee have thought it advisable to consider first of all the position of the aircraft industry generally at that time, and more particularly during the interval which may be expected to occur between the probable diminution of naval and military orders for the Air Forces at the conclusion of peace (whatever the extent of such diminution may be) and the renewal of such orders coupled with some possible orders for civil aerial transport purposes; and, secondly, the constructive steps which should be taken to bridge that interval.

4. In presenting their views and recommendations, the Special Committee desire to emphasise what they regard throughout as an incontestable assumption, namely, that aerial power will be as necessary for the protection of Great Britain and the existence of the Empire in the future as naval power has been in the past. The Committee are accordingly of opinion that it will be necessary, after the conclusion of the War, to take such measures as will maintain the power of production in this country, with its attendant power of design and progressive experiment. Without continuity it would be impossible to have the organisation immediately available when required. Furthermore, if such a policy for National Aerial Defence is adopted as will have the effect of maintaining the aircraft industry on a reasonably sound basis, the development of aviation for civil aerial transport should be the more rapid, inasmuch as those engaged in the industry will possess this power of design and production, backed by the necessary financial resources available for extension to the development of aviation in its civil and commercial aspects.

5. If the expectation is justified that at the end of the war there will be a considerable falling off in direct Government orders—and it has to be borne in mind that even if the same aerial force that exists at the end of the war is to be maintained on a peace basis the falling off will be great, owing to the much longer expectation of life of aircraft under peace as compared with war conditions—the conclusion of peace will bring with it a reduction not only in the number of firms engaged in the industry, but also, by the cessation of overtime and night shifts, in the output of the remaining firms. But, when such establishments as are at present engaged as a temporary war measure in aircraft building have reverted to their normal pre-war businesses, the productive capacity of the remaining establishments may still be more than is necessary to maintain the National Aerial Services.

6. With regard to the probable development of aerial transport services, the Special Committee would refer to the facilities which this form of transport will provide in letter mail services and in journeys over long distances, or where other means of transport are undeveloped or do not furnish direct connections. It is thought that fast aerial mail services should soon be able to compete with expensive long-distance cable services, as, for instance, from London to South Africa. Yet their development will be gradual, and the number of aircraft they will employ, in the earlier years, at any rate, will be small, because, even on a sanguine view of the amount of letters which will be sent by air mail at a high rate of postage, the weight of them will not be great, while passengers will be few. It is hardly to be supposed that newspapers and printed matter will be sent in large quantities by air mail for some time to come. It has to be borne in mind, too, that air routes will be mainly international, and that foreign countries will expect that a share in the business will be given to their own aircraft. Viewed, therefore, as a commercial proposition, the Committee do not think that civil aerial transport is likely, at least for some years to come, to develop to such an extent as to involve any appreciable volume of orders being placed with the productive side of the industry in this country. As far as the immediate post-war period is concerned, it should be remembered that machines for civil and commercial purposes will unquestionably need to be specially developed, and any considerable volume of orders will have to await the completion of this process of development. The Committee, therefore, come to the conclusion that, while aerial transport services will ultimately offer hopeful prospects from the financial point of view, the construction of aircraft for that purpose, even if

the services attain to the fullest dimensions that can reasonably be anticipated, could for some time to come only reach comparatively negligible proportions, and will be such as to be by itself wholly inadequate for the maintenance of the aircraft industry, even on a greatly reduced basis.

7. The conclusions of the Committee as to the first question mentioned in paragraph 3 above may be summarised as follows:—

- (a) The Committee are unable to foresee any such early development of civil aerial transport as could by itself keep the aircraft manufacturing industry alive.
- (b) It is essential that the services of the aircraft manufacturing industry continue to be employed for the design and development of naval and military aircraft, and for the carrying out of the national constructional requirements of the future. If that is done, then no special steps would seem to be required in connection with civil aerial transport to establish the industry on a permanent peace basis.
- (c) Failing the employment of the aircraft manufacturing industry for the purposes and to the full extent above indicated, then the industry could only be kept alive for civil aerial transport purposes by active Government assistance, not necessarily in the form of subsidies on manufacture, continued over several years to come.

The foregoing conclusions point to the necessity of some constructive steps being taken to ensure the maintenance of the aircraft industry.

Appendix.

8. In considering the position of the aircraft industry on the termination of the war the Committee have had before them an interesting memorandum by Mr. A. E. Turner, which is presented as an Appendix to the present Report.

9. Before offering suggestions as to the constructive steps to be taken, the Committee desire to point out that it is of the first importance that the task of considering and of dealing with constructive proposals in regard to all aeronautical matters after the war should be definitely assigned without delay to some one Government Department which would, of course, only act after consultation with such other Government Departments as might be concerned. It appears to the Committee that such matters should be dealt with by a single Central Government Authority, but that, to be effective for this purpose the Authority should work in conjunction with a body representing the Industry.

10. The Committee are of opinion that the solution of the problem of the constructive steps to be taken, and with it the solution of the problem raised in the second heading of the terms of reference to the Main Committee as to the disposal of the surplus of machines likely to be in the hands of the Naval and Military authorities after the war, should be sought along the lines of so using this surplus as to stimulate immediately a demand for aeroplanes in some new direction. The Committee therefore recommend:—

- (a) That an offer should be made by the Home Government to the larger self-governing Dominions and to Egypt and India to supply a definite number of machines, free of cost, as soon as they become available, conditionally on these countries, in the meantime, submitting approved schemes for the formation of units of an Imperial Air Force.
- (b) That the Government should announce that in the event of the formation of companies for aerial transport services, or other commercial purposes, they would be prepared to afford facilities for the purchase of machines at a reduced price (say, one-quarter or less fraction of the original cost) to substantial companies. This will operate to facilitate the employment of pilots who will be returning to civil life on demobilisation.

These two proposals taken jointly would relieve the Government of heavy expenses in providing storage accommodation for machines which are too valuable for destruction, and should also relieve the stagnation in the design of military types which would inevitably occur if the necessity of using up large stocks of surplus aeroplanes prevented the authorities from placing any but the smallest possible orders for machines of new design. The design of aeroplanes expressly for civil purposes would also receive a stimulus, as the companies would early begin to find points in which the machines thus taken over were susceptible of improvement from the point of view of the new use to which they were being put.

11. On the broad question which was raised at the first meeting of the Main Committee of State ownership against private enterprise, the Special Committee hold the view that the industry of aircraft production and transport should be so dealt with as to interfere as little as possible with individual enterprise.

12. The foregoing paragraphs cover, so far as seems possible in the light of such information as is available, the subject matter of headings (1), (2), (4), and (5) of the terms of reference to the Committee. Data are wholly lacking by which to estimate the cost of production of aircraft or the running costs of civil aerial services after the war, and the Committee fear that detailed discussion of the subject matter of headings (3) and (6) of their terms of reference would be premature at the present stage, and could serve no good purpose.

H. White Smith (Chairman).
 Alan E. L. Chorlton.
 L. N. Guillemard.
 G. Holt Thomas.
 E. P. Morris (with certain reservations).
 G. E. P. Murray.
 *Mervyn O'Gorman, Lt.-Colonel.
 *W. P. Schreiner.
 J. D. Siddeley.
 T. Sopwith.
 *A. E. Turner.
 E. R. Wayland, Lt.-Colonel.

D. O. Malcolm
 (Secretary). January 11th, 1918.

Those members whose names are marked with an asterisk append the following reservations:—

I do not consider that the aerial mail service will actually compete with (see line 4 of paragraph 6 of the report), but that it will be complementary to, and will probably activate the use of long distance communication by electric cable.

Mervyn O'Gorman, Lt.-Colonel.

1. While I accept the conclusion that present conditions do not justify the advice that the State here should immediately itself undertake the industry of aircraft production, and that, therefore, constructive steps are necessary to ensure the maintenance of that industry by the enterprise of the firms and companies which hold the field, I consider that before long the wisdom of establishing State control of and active participation in that industry will be recognised, and practical steps will be taken in that direction for the benefit of the nation.

2. I do not discern any insuperable* obstacles in the way of an early practical commencement of civil aerial transport within the United Kingdom as a State undertaking, or under direct State control, and I regret that it has not been found possible to include in this report practical suggestions for experiments in that direction at the earliest possible moment.

W. P. Schreiner.

I desire to add, by way of reservation, that in my opinion paragraph 6 of the report gives an unduly gloomy impression of the prospects of civil aerial transport in the near future, especially in regard to passenger carrying.

A. E. Turner.

*APPENDIX.

**Memorandum by Mr. A. E. Turner on the position of the Aeronautical Industry
on the Termination of Hostilities.**

APPENDIX V.

Supplementary Report of Special Committee No. 3.

1. The Special Committee have been asked to consider certain points raised by Captain Groves in a Notice of Motion handed in to the Main Committee. The Special Committee had not previously dealt with these points because by their terms of reference they were called upon rather to advise as to the probable position of the aircraft manufacturing industry in this country at the end of the war, than to consider whether it was necessary in the general interest of the State to take special steps to foster the civil use of aircraft.

2. They have now considered the further points referred to them, and desire to emphasise that it is of great importance, in the national interest, that the use of aircraft for civil purposes should by some means or other be fostered to the utmost extent, and with the utmost rapidity possible, immediately after the war.

One reason is that the civil use of aircraft will ultimately play an important part in the commerce and transport of the future, and it is undesirable that the British Empire should fail, through allowing other countries to be first in the field, to secure its due share of such commerce and transport.

A second and very vital reason is that in any future war the air will play a more important part than ever, and unless the State is to maintain on a peace establishment a naval and military air force as large as it will require in any future war, there must be a reservoir of aerial power capable of meeting a sudden demand for the expansion of the naval and military air force, just as the shipbuilding industry and the Mercantile Marine are capable of meeting such a demand on the part of the Admiralty.

3. It has been shown in the previous report of the Special Committee that if the aircraft manufacturing industry is to be almost wholly dependent on direct State orders for naval and military aircraft, and such orders fall off greatly at the end of the war, as it is only prudent to assume that they will do, the aircraft manufacturing industry will dwindle with great rapidity. Therefore, in order to keep the manufacturing industry in a state of healthy activity, and to secure that there shall be as large as possible a number of aircraft and of skilled and practised flyers in existence available to be drawn upon by the State, it is vitally important that a market should be created for aircraft other than that provided by the State's direct naval and military orders.

4. It is not enough merely to maintain the aircraft manufacturing industry in a static condition: it is necessary, particularly in an industry which is still at so early a stage of its growth, that there should be every opportunity and inducement for the inventor and for progressive development and improvement in design. This consideration only serves to emphasise the importance of immediate steps being taken to foster the civil commercial use of aircraft. Progress and improvement are likely to be best stimulated by the hope of commercial gain, as has been shown in the history of other industries, notably that of shipbuilding.

5. The Special Committee adhere to the view expressed in their earlier report that it is impossible to foresee any such early development of civil aerial transport as could by itself keep the aircraft manufacturing industry alive; but it follows from what has been said above that it must be developed at any rate to such an extent as will ensure that the resulting orders will suffice, along with such direct naval and military orders as continue to be given after the war, to secure the end in view.

This end will have been achieved when a system of properly planned and predetermined air routes has been instituted, with their aerodromes and other requirements, satisfying both military and commercial needs, between which there is no real conflict. On these routes there should be civil aerial services wherever there is a reasonable demand for the facilities of aerial traffic and irrespective of the test of financial success. Such services should ensure a large reserve of skilled airmen and of aircraft available for, at any rate, subsidiary military purposes, and should afford a market for aircraft manufacture sufficient to maintain the manufacturing industry on a scale allowing of a prompt and large expansion of the industry for war purposes.

6. The development of civil aerial transport to the extent outlined in the preceding paragraph cannot, in the opinion of the Special Committee, be brought about without some State action.

The State may:—

- (A) Give its assistance in one or more of many possible forms to private enterprise; or
- (B) may itself own and operate or participate in the ownership and operation of aerial transport undertakings.

7. These alternative policies have been very fully discussed by this Committee, and it is thought desirable that the respective arguments in support of both policies should be set out.

Alternative (A):—

On behalf of this course, which is that favoured in the earlier report of the Special Committee, paragraph 11, it is urged that, as in the case of manufacture, so also in the case of the civil use of aircraft, the hope of commercial return is the most effective stimulus to enterprise, and that the experience of almost all other enterprises, at least in the United Kingdom, supports this view.

In support of private enterprise, whether entered into by firms or companies, it is argued that progress is much more rapid than has been found possible under the machinery of Government Departments. The case of civil aerial transport seems to be one which calls for special enterprise of a peculiarly open-minded character. The exploration of the possibilities of civil aerial transport must be undertaken in a spirit untrammelled by those methods which have hitherto been usually associated with Government control. Rapid progress in this new field of transport is essential if this country is to hold its own.

It is urged against the exclusive operation of aerial transport services by the State that this system would mean that the State would be the only purchaser of aircraft, and that this would necessarily discourage the

desired development of invention and design, and might involve the necessity of the State taking the business of manufacture as well as of the use of aircraft into its own hands, a course which, for the reasons given in paragraph 4 above, is to be deprecated.

It is urged further, therefore, that :—

- (a) Firms or companies should without interference be allowed to undertake commercial services where they are willing to do so.
- (b) Firms or companies which undertake services desired by the State, but likely in themselves to be unremunerative, should be assisted by the State to the extent calculated to provide a reasonable return on the capital invested. Such assistance might take the form of a guarantee of a minimum rate of interest on capital, or even of cash subsidies fixed according to the number of aircraft and skilled flyers kept in continuous employment. Precedents for arrangements of this kind are to be found in cases where the State has assisted steamship companies by providing, on very easy terms, part of the capital cost of ships constructed to certain approved specifications or by subsidising the ocean carriage of mails.

Among other methods by which the State could assist private enterprise where such assistance is required, are the following :—

- (1) Charters might be granted to properly organised companies, giving them exclusive running rights for defined aerial routes, either in the United Kingdom or in the British Dominions and Colonies.
- (2) Aerodromes, landing places, meteorological stations and wireless telegraphic installations which will, in any case, have to be provided for the naval and military air force throughout the country, might be put freely at the disposal of private flyers and commercial undertakings as the roads are put at the disposal of the travelling public.
- (3) The establishment of high-speed land transport by motor vehicles and otherwise between aerodromes in the vicinity of large towns and the business centres of such towns.
- (4) The State might encourage, by liberal contracts, the carriage of mails and parcels by air, or might undertake to take up a certain proportion of the accommodation provided for such carriage.
- (5) Facilities might be offered for the purchase or hire, at low prices, of aircraft surplus to military requirements at the end of the war.
- (6) A retaining fee might be paid to such owners of aircraft as agree to hold them at the disposal of the State.

Alternative (B) :—

On behalf of the State ownership of civil aerial transport services, either exclusively or in partnership with private enterprises, it is argued :—

- (a) That since it is admitted that State assistance is in any case necessary for the development of the civil use of aircraft to the extent necessary in the national interest, a system under which all chances of profit are left to private companies, while the State undertakes a great part of the risk, and the certainty of expense, is the least desirable system from the public point of view, and the most exposed to justifiable criticism.
- (b) That if the State must undertake civil aerial transport services in the national interest, it should at least undertake or participate in owning and controlling those services which promise to yield a profit as well as those which do not.
- (c) That such a system would avoid the possibility of confusion and economic waste through unnecessary competition between private companies in a field in which the State protected them from loss, and the certainty of waste involved in private companies obtaining Provisional Orders or Private Acts of Parliament, and in such directions as the expense of company promotion and the unnecessary multiplication of directing staffs.
- (d) That State ownership or participation with private enterprise need not be an unsuccessful method of development.
- (e) That while the ownership by the State of commercial enterprises may lie under the burden in each case of justifying its own necessity, it may fairly be said that in this instance the insufficiency or unsatisfactory character of the alternatives put forward furnishes the required proof, and that transport has always been one of the first fields in which public ownership has shown itself successful, as witness even in Great Britain many municipal tramway enterprises.
- (f) That, moreover, in this particular instance the matter is so bound up with national defence that any State would be justified in going far beyond its accustomed limits in commercial undertakings in order to make certain of creating the equipment of men and material and the sources of production needed for its own protection, and that whatever may be the normally held view of State ownership, State ownership of aerial transport services including all ancillary equipment is forced upon the community as an unavoidable measure of national self-protection.

8.—The Special Committee feel that the questions of principle and policy involved in the two alternative views described above raise such grave issues that it is for the Main Committee itself to judge between them; but in any case it seems necessary that the steps to be taken to secure the main object aimed at, namely, the provision of the indispensable reservoir of aerial power, should be considered and determined upon by His Majesty's Government at once, as it will be too late to consider them after the war. If at the conclusion of peace direct naval and military orders fall off very greatly, and no steps have been taken in advance to create other markets for the manufacturing industry, the manufacturing industry will dwindle with great rapidity and may well cease altogether to exist, except to the extent necessary to comply with such diminished naval and military orders as the State may still continue to give. It cannot

last without orders while the State is considering what steps can be taken to develop the commercial use of aircraft—a process that is likely to occupy some time.

H. White Smith (Chairman).
 *L. N. Guillemard.
 R. O. Cary.
 Alan E. L. Chorlton.
 R. M. Groves, Wing Capt., R.N.
 G. Holt Thomas.
 J. W. McCay, Major-General.
 *G. E. P. Murray.
 Mervyn O'Gorman, Lt.-Col.
 Frank Pick.
 W. P. Schreiner.
 J. D. Siddeley.
 T. Sopwith.
 Arthur E. Turner.
 E. R. Wayland, Lt.-Colonel.

D. O. MALCOLM,
 Secretary.

March 8th, 1918.

*In signing this Report we wish to point out that it is based on the supposition that strategic requirements will necessitate the maintenance of a larger productive capacity than commercial demands can absorb, and that our acquiescence in the measures recommended is conditioned by that supposition.

L. N. Guillemard.
 G. E. P. Murray.

NOTE.—A summary by the Chairman, Mr. White Smith, of the two reports of Special Committee No. 3 is attached.

Brief Summary of First and Supplementary Reports.

Special Committee No. 3.

The questions originally put to the Committee and the conclusions arrived at can be briefly stated as follows:—

What will be the position of the aircraft designing and constructing industry at the conclusion of the War, and how far can the industry provide for the requirements of civil aerial transport for aircraft? It was immediately found that, so far from there being any difficulty in meeting the requirements for aircraft, the demands for civil aerial transport, for some time, would be quite inadequate to keep the industry alive. It was considered essential in the interests of National Defence that the industry should be kept alive. The Committee, therefore, felt that, in order to keep the industry in such a condition as to be always able to respond to war emergencies, the services of the industry should continue to be employed for the design and development of naval and military aircraft, and for the carrying out of the national construction of aircraft for the future, and this would enable the design and construction for civil aerial transport to grow on a sound and permanent basis.

In effect, while the Committee have always felt complete confidence in the eventual success of civil and commercial transport, yet they felt that, for some time to come, it could not be looked upon to support the industry.

The other phase of the question which is dealt with by the supplementary report may be summarised that—

- (a) Cost what it may, this country must lead the world in civil aerial transport.
- (b) The State must have a reservoir of aerial power capable of meeting a sudden demand for expansion of the Naval and Military Air Forces.

Put shortly, we may say, "It must be done." Approaching the question, therefore, from this point of view, it becomes evident that, if civil aerial transport is so necessary to national interests, every step possible must be taken by this country and the Empire to foster the rapid development of this form of aerial power, and by it the power of production in this country.

The development of civil aerial transport to the extent outlined in the preceding paragraph cannot, in the opinion of the Special Committee, be brought about without some State action.

The State may:—

- (a) Give its assistance in one or more of many possible forms to private enterprise; or
- (b) May itself own and operate, or participate in the ownership and operation of, aerial transport undertakings.

The arguments in support of each of these policies have been very fully discussed by the Committee, and are set out fully in their Report. It is desired that the members of the Main Committee shall consider them in full as set out, and for this reason no résumé has been attempted.

In conclusion, the Special Committee feel that the questions of principle and policy involved in the two alternative views described above raise such grave issues that it is for the Main Committee itself to judge between them; but in any case, it seems necessary that the steps to be taken to secure the main object aimed at, namely, the provision of the indispensable reservoir of aerial power, should be considered and determined upon by His Majesty's Government at once, as it will be too late to consider them after the War. If at the conclusion of peace direct naval and military orders fall off very greatly, and no steps have been taken in advance to create other markets for the manufacturing industry, the manufacturing industry will dwindle with great rapidity and may well cease altogether to exist, except to the extent necessary to comply with such diminished naval and military orders as the State may still continue to give. It cannot last without orders while the State is considering what steps can be taken to develop the commercial use of aircraft—a process that is likely to occupy some time.

(Sgd.) H White Smith,
 Chairman.

APPENDIX VI.

Report of Special Committee No. 4.*

This Special Committee were appointed to advise the Main Committee upon the problems of labour and of the technical education of artisans and mechanics, male and female, arising in the development of civil aeronautics with special reference to :—

- (1) The possibility of setting up a model type of industrial organisation applicable either to the whole of labour employed in aircraft manufacture and in aerial transport, or, if necessary, to separate groups of labour so employed, for the purpose of avoiding the friction and conflicts which characterise present labour disputes.
- (2) Problems connected with dilution of labour, and the rates of and methods of calculating wages.
- (3) The necessity for some scheme of technical education applicable to artisans and mechanics, male and female, employed in aircraft manufacture and in aerial transport, and the extent (if any) to which such a scheme should be dependent upon State or municipal assistance.
- (4) The necessity for an administrative body or bodies to control the entire industry of aeronautics with regard to labour and labour conditions, including technical education, as above mentioned, and the question of the representation on such body or bodies of the State, the employer and labour, and the limits within which the control of such a body should be exercised.

1. The Special Committee have given their most careful consideration to the questions submitted to them by the Main Committee. Before proceeding to deal with detailed points arising on its terms of reference, the Special Committee have thought it advisable to submit at the outset of their report the conclusions they have arrived at in relation to the four headings to which special attention is directed in those terms of reference. These conclusions are submitted in the form of answers to the specific questions raised in these four headings :—

- (1) (a) There is no possibility of setting up a model type of industrial organisation applicable either to the whole of the labour employed in aircraft manufacture or to separate groups of labour so employed. At the same time the Committee think that the suggestions contained in the Report of the Sub-Committee of the Reconstruction Committee on the relations between employers and employed (generally known as the Whitley Report) are no less applicable to the relations of labour and capital in aircraft manufacture than to labour employed in the whole group of engineering industries.
(b) The Committee come to the same conclusion with regard to labour or groups of labour employed in aerial transport services; but they would suggest that, since at present there does not exist an organised body of labour employed in aerial transport services, such a body might offer a specially favourable field for the realisation of the ideals outlined in the Whitley Report.
- (2) There are no special problems connected with the dilution of labour and the rates and methods of calculating wages peculiar to labour employed in aircraft manufacture or in aerial transport services as such.
- (3) There is no necessity for any special scheme of technical education applicable to artisans and mechanics, male and female, employed in aircraft manufacture and in aerial transport services, as distinct from similar persons employed in other occupations; but the Committee think that any schemes of technical education of persons employed in the engineering industries generally are particularly suitable to persons employed in the aircraft industry, and that such schemes should be so arranged as to include the technical education of the latter class.
- (4) There is no necessity for the creation of an administrative body or bodies to control the entire industry of aeronautics with regard to labour and labour conditions other than the machinery of the Joint Standing Industrial Councils recommended in the Whitley Report.

In submitting these conclusions to the Main Committee, the Special Committee have divided the main problem referred to it into two general headings, viz., the problem of labour in aircraft manufacture and the problem of labour in aerial transport services. The grounds upon which these conclusions are based are contained in the following paragraphs of this report.

Labour in the Industry.

2. In this body of labour there were employed in 1916 about 100,000 persons, of whom about 25,000 were women or boys under military age. These numbers are constantly increasing. They are, indeed, growing so rapidly with the growing demand of the Government for aircraft—which demand has of late been suddenly and very greatly expanded—that reliable statistics are very difficult to obtain. Even if they could be obtained they would at once become out of date, as fresh firms come into operation as aircraft constructors. So long as the war lasts, there is likely to be continuous increase in the number of persons employed. The construction of aircraft engines is a specialised and highly important section of engineering, and it necessitates the employment of a considerable number of skilled mechanics—fitters, turners, coppersmiths, sheet-metal workers, etc.—as well as a due proportion of semi-skilled and unskilled workers. The construction of aircraft, in which woodwork is at present the principal factor, involves the employment of woodworkers of varying degrees of skill, and to meet the demand for additional labour brought about by the war, large numbers of woodworkers have been drawn into the industry from other trades, including the building trade, furniture trade, coachbuilding, etc. In both sections of the industry (engines and aircraft) there has been not only “dilution,” but also the introduction of female labour to new work prior to the war. The employment of women has steadily extended.

* Mr. H. G. Wells, the Chairman of this Special Committee, appends a Minority Report which is set out at the end of this report.

3. The Committee discussed the possibility of dealing with the industry as a distinct economic organisation, and dismissed this as entirely impracticable. Mainly, the industry is a branch of engineering of a similar nature to the automobile industry. It seems impossible to sub-divide the engineering industry anywhere by vertical lines of division. Skilled and semi-skilled labour flows to and fro, in its own trade, between one department of engineering work and another. Engineering labour organisation and engineering technical education, the Committee are persuaded, are each whole and indivisible problems.

4. The Committee find that under the Reconstruction Committee there have been appointed Sub-Committees on relations between employers and employed, and on War Pledges, while Committees have also been appointed on the engineering trades; on the textile trades; on the teaching of science; and on juvenile education in relation to employment after the War. Of the bodies above mentioned, the Committee are informed that the terms of reference to the War Pledges Sub-Committee of the Reconstruction Committee merely deal with the legal steps that would be necessary on the assumption that all the pledges given to organised labour during the war in connection with dilution, the employment of women, and the like, are to be carried out in their entirety, a matter which is not directly the concern of this Committee. The Committee on Science in the Educational System are as yet only at an early stage of their enquiry. The Report of the Committee on Juvenile Education in relation to employment after the war has been published as a Parliamentary Paper (Cd. 8512), and forms the basis of the Education Bill.

5. The Sub-Committee of the Reconstruction Committee on relations between employers and employed under the Chairmanship of Mr. J. H. Whitley, M.P., is the body most directly concerned with the post-war problem of the relations between labour and capital, and has issued an Interim Report on Joint Standing Industrial Councils, which has been published as a Parliamentary Paper C.D. 8606. The Committees appointed to consider the position after the war of the great groups of industries classified under the head of engineering have been content to leave this aspect of their problem to be dealt with by Mr. Whitley's Committee, and we feel that a Committee dealing with the as yet comparatively small aircraft industry, especially as it depends so largely on the engineering industry, may well follow their example. The rapid expansion of the manufacture of aeroplanes and airships has, however, attracted to the aircraft industry a large and miscellaneous body of labour whose elements were formerly connected with trades other than the engineering trade, and whose members belong to Trade Unions concerned with entirely different trades, e.g., the various branches of the building trade, coach and carriage building and upholstering, cabinet making, organ building, etc. The majority of these workpeople are woodworkers, and while many of them are skilled men, possessing the degree of skill necessary for their previous occupations, the skill called for by the aircraft industry is not a highly specialised skill, which cannot be used in other woodworking industries. It may be that many of those who, prior to the special demand of the Government for aircraft for war purposes, were employed in other industries, will return to those industries if the end of the war brings with it a great diminution in the demand for aircraft; it must, however, be assumed that the aircraft industry will exist in the future to a very much greater extent than was the case before the war, and it follows, therefore, that the labour problems connected with the industry will be influenced by the "new blood" which has come into the industry, and by the forces with which that "new blood" is connected. The possibility must not be overlooked that in the future wood may be more or less replaced by metal in the manufacture of aircraft, and that consequently the total number of woodworkers employed in the industry will be uncertain.

6. It is impossible to forecast at present the special labour problems that are likely to arise in the industry, and it is useless, therefore, to attempt any detailed suggestions as to how they may be dealt with when they do arise. But there are one or two features which it may be worth while briefly to mention, as they will serve to show in what respects the industry differs from the ordinary well-defined industry and to indicate the type of problem with which those who are concerned in the industry may be faced.

7. At the moment the aircraft industry is more closely allied to the engineering trade than to other trades, and the principal firms are members of the Engineering Employers' Associations in the districts in which their respective works are situated; the industry is, therefore, linked on the employers' side, with the organisation of the Engineering Employers' Federation, while the skilled engineers are members of the various skilled Trade Unions connected with the engineering trade. On the other hand, the Trade Unions to which the bulk of the woodworkers belong (and they are numerically a very large proportion of the industry) are not primarily connected with the engineering trade; they are connected with trades such as the building trades, and they have the associations and traditions of those trades. The third class (and it is an important one) consists of the women, who are employed on the engineering side, the woodworking side, and as fabric hands, and who, in so far as they are organised, are members of the National Federation of Women Workers or of one of the general workers' unions who specialise in female members. These three groups of trade unions have not hitherto been identified with a single industry, and their traditional interests may tend to be divergent. The position is one that calls for special consideration on the part of the employers, and it may, no doubt, be assumed that it is already receiving such consideration at the hands of the employers' organisations. We feel that it is for those organisations, in conjunction with the labour organisations, to consider for themselves how the special circumstances may best be met and that it would not be helpful for this Committee to attempt to advise them.

8. How far the various labour organisations within the aircraft industry may be able to reconcile their interests, it is impracticable now to say. Some of the woodworkers, themselves members of the various woodworking unions, have formed woodworkers' aircraft committees in various centres, and if it should happen that the women's organisations are able to join with such Committees, there would exist a fairly well-defined "labour side" to the industry, consisting, on the one hand, of the engineering section (represented as stated above, by the skilled Engineering Trade Unions), and on the other hand of the woodworking and fabric sections (represented by some joint body of woodworkers' unions, plus the women's organisations).

9. Having regard to the special development and rapid growth of the industry, and to the somewhat peculiar character of the trade (being linked with but not entirely covered by the engineering trade as ordinarily understood), there may be difficulties in adopting directly for the aircraft industry the scheme of Joint Councils recommended by the Whitley Committee. The consideration and solution of these difficulties are, in our view, matters for the parties directly concerned rather than for this Committee, and we think

our participation in the question should begin and end with the recommendation that in the consideration of the subject the parties should have in mind the principles underlying the Whitley Report, and should approach the problems in the spirit indicated in that Report.

Labour in the Air Service.

10. The Committee have also given their careful attention to the question of the labour connected with air routes and services. Exact figures of the labour likely to be so employed cannot be hoped for at the present time, but it seems improbable that the civil use of aircraft can immediately absorb any appreciable fraction of the trained personnel, which the conclusion of peace may leave surplus to the requirements of the naval and military air services.

Education of Labour in the Service and Industry.

11. The Committee are of opinion that the technical education of aircraft workers cannot be conveniently treated as a special subject; like the labour itself, the educational work is divided between the engineering and the woodworkers' trades, and the Committee see no advantage in adding anything here to the counsels of other bodies well able to deal with those matters, such as the recently formed central organisation for the correlation and improvement of engineering training.

*A. E. Berriman.
Nevile G. Gwynne.
Arthur Morley.
W. P. Schreiner.
J. D. Siddeley.
E. R. Wayland, Lt. Colonel.
H. J. Wilson.

D. O. Malcolm
(Secretary). November 7th, 1917.

Minority Report by the Chairman.

In presenting the findings of Special Committee No. 4, the Chairman would like to add a few dissentient observations.

While the engineering employers have been fully and ably represented on the Committee, the ideals of labour have had little or no expression, and there has been, he thinks, a disposition to exaggerate the importance of the welfare of the industry in relation to the destinies of the Empire. This is particularly manifest in the shortness and quality of the paragraph relating to the Air Services. An excess of tenderness for the no doubt deserving private groups that may wish to undertake "air" transport at the end of the war, and an excess of financial timidity, seem to have blinded the Special Committee to the supreme importance to the Empire of the immediate establishment of Imperial Air Services at the Peace. For such an end the business adventurer in air exploitation should be as willing to face stress and ruin as our common soldiers have been to face toil and death in Flanders.

The British Islands are small islands, and our people numerically a little people; their only claim to world importance depends on their courage and enterprise, and a people who will not stand up to the necessity of an Air Service planned on a world scale and taking over thousands of aeroplanes and thousands of men from the very onset of peace, has no business to pretend to anything more than a second-rate position in the world. We cannot be both Imperial and mean. For this reason the Chairman dissents altogether from the timid findings of the Special Committee set out in paragraph 10.

Assuming, as he does, that a boldly conceived world air service is essential to our Imperial pretensions, the Chairman deplores the narrowness of outlook that has debarred the Special Committee from seizing its opportunity to plan an Air Service not only great in scale but great in spirit. This Civil Air Service afforded the possibility of a new departure in the organisation of our workers, and the Chairman of Special Committee No. 4 appeals from that Special Committee to the Main Civil Aerial Transport Committee to consider, before it is too late, the possibility of creating from the first a great service with a common spirit. Here, at least, we could anticipate and avoid the clash of direction and labour. It would be possible to associate from the first the entire personnel of the service with the management. It would be practicable and in accordance with the more constructive ideas that now animate labour circles to give everyone employed, from traffic manager and pilot to groundmen, a representation upon the general management. What is proposed here is no mere "labour" delegate. What is desirable is a state of affairs in which everyone in the management will feel concerned in the mental and bodily welfare of the personnel, and in which every worker, whether on the directive or the operative side, will consider himself concerned for the efficiency of the Service. Everyone in the Service could have a voice in the appointment of these suggested representative members of the management. There are two chief interests in every service of public utility; the first of these is the general community, for which, logically, a portion of the management appointed by the State should stand; the second is the Service itself, for which stand the representatives of the directing staff and of all engaged in the Service. In the case of a State-owned Service, these two elements would constitute the entire management; in the case where private enterprise was a factor it would also provide a third factor in the general management. Suppose, for example, an aerial transport company, fostered by the State for reasons of policy by the grant of monopoly running rights over given routes, or by a guarantee of a minimum rate of interest on its capital. It might be managed by a Board of Directors, some appointed by the shareholders in the ordinary way, some by the State to watch its interests, and some by the employees. If it be admitted that such an arrangement would tend to prevent disputes and strikes, it is probable that it would commend itself to the State. The State would have a direct interest in the smooth and continuous working of the Service. This interest would be presupposed in the grant of monopoly running rights or in a guarantee of a minimum rate of interest on capital, and the State might even make the adoption of an arrangement of the nature suggested a condition of its grant of such privileges. But these possibilities have been disregarded by the Special Com-

* Mr. Berriman signs this report subject to the deletion of the following words in paragraph 11, "like the labour itself, the educational work is divided between the engineering and the woodworkers' trades."

mittee as a whole. Many of its members seem to have been obsessed by a conception of private enterprise working its way slowly to an efficient air service at the expense of casually employed workers. From the first the workers under such conditions will be forced into the self-protective and hostile attitude too characteristic of British labour. Unhappily for the British employer it is incredible that Berlin, America, or the world generally will wait while these time-honoured British methods feel their way through a cycle of labour adjustments to a minimum of efficiency in a maximum of time. The Air Service of the world will inevitably be taken out of British hands—if this is our way to Civil Air Transport. Unless we are prepared to plan now for a great public air service, generously served by generously treated workers, it is childish to anticipate any great future for our Empire in the air.

The Chairman also regrets that the Special Committee has been unable, as a whole, to make any recommendations with regard to the employment of discharged sailors and soldiers. There are at present numerous opportunities for the utilisation of partially disabled sailors and soldiers in the aeroplane factory, and there is no conclusive reason why much of that employment should not continue after the war, due regard being shown to Trade Union interests. There are many occupations, both in the aeroplane factory and in the aerodrome, where physical disabilities of a not too serious nature do not debar men from useful work—in some cases after a preliminary period of practical training. Splicing of wire cable, for instance, and acetylene welding are sedentary jobs requiring no great exertion, which can be done by any man possessing the full use of his hands, arms, and eyesight. These jobs are successfully undertaken by women, but at the present time there are probably not enough women trained to meet the demand. Many other jobs could also be undertaken by men of this kind, such as those of storekeepers, record and issuing clerks, watchmen, caretakers, and works' police: also those of gatekeepers and turnstile keepers at aerodromes, and of groundmen for keeping aerodromes in proper condition. The intermittent nature of aerodrome employment makes it peculiarly suitable for men whose injuries, while leaving them capable of occasional activity, unfit them for continued hard work. And these remarks apply not only to those engaged in actual labour, but also to those who may be engaged in the management of these various grounds. It is to be noted that the Ministry of Munitions Dilution Department is giving attention to this particular problem, and will probably accumulate some valuable experiences.

Generally, these men will be in receipt of pensions, and there seems to be no justification for the rule understood to prevail in the case of men directly employed by Government, under which a man in receipt of a pension is not allowed to draw in the shape of pension and wages combined more than the rate of wages ordinarily given for work of the nature of that in which he is employed. It would appear that a man in receipt of a pension of 25s. a week, if employed by Government on a job for which the ordinary rate of wages was 25s. a week or over, would draw no pension at all while so employed; or, if employed by Government on a job for which the ordinary rate of wages was less than 25s. a week, would draw only so much of his pension as would bring his total weekly emoluments up to 25s. This rule must, it would seem, put a premium on idleness and upon taking service with a private employer rather than with the Government, for in the service of a private employer a pensioner would draw his wages and his full pension as well. It is certainly worth while to draw attention to this point, although it does not arise exclusively in connection with the aircraft industry.

It is possible that a difficulty may arise in connection with the employment of disabled sailors and soldiers if their injuries are such as to incapacitate them from earning Trade Union rates of wages, owing to objections on the part of the Unions to their being employed at lower rates; but such objections ought not to be insuperable, provided none but ex-sailors and ex-soldiers in receipt of pensions are employed at less than Union rates, and provided that they are so employed that the wages which they can fairly earn, when added to their pensions, makes up a total emolument equal to or greater (by an agreed upon amount) than the Union rate of wages, and that their employment is not more profitable to the employer. This is a question upon which a speedy agreement with the Trade Unions is most desirable. What is needed is some general decision upon the rules under which disabled soldiers shall be employed. It may be suggested that the Trade Unions should themselves propose a classification of disabled men, and should suggest a minimum wage for each class—on the assumption that employment will not diminish the amount of the man's pension.

There is a third matter in which the Special Committee has failed to rise to its opportunities, and that is in connection with the possibilities of developing an imaginative solidarity in the Air Industry and Services. To be frank upon a matter of public importance too urgent for euphemisms, the bulk of employers in Great Britain appear to be men differing rather in tenacity of character than in breadth of outlook from the workmen they employ, and they do not seem to understand that elementary psychology of modern industrial employment. They do not see their duty and opportunity of mental leadership; they decline flatly to be the captains instead of the exploiters of industry. The modern worker reads, thinks, and has his imagination stimulated in a hundred ways that did not exist in the dull round of the mid-Victorian wages-serfs' experience. In addition, we shall presently be seeing the return to industry of great numbers of workers whose minds have been further quickened by the war. It is the interest, therefore, quite as much as the public duty of the modern employer to do his utmost to give the worker a living interest in his work, to make him, or her, feel, not a driven "hand," but a person sharing the effort and triumphs of the industry. The alternative is that disastrous and dangerous modern product, the professed "rebel." Something more than merely technical training is wanted for a proper industrial mentality; imaginative training is about equally important. Among other devices that should be employed in the organisation of a modern industry, is a "trade" paper brought within the reach and attention of every worker; a paper to sustain the living interest of the worker in his industry, to facilitate understandings, stimulate ambition, and keep him or her alive. In the case of the Air Industry and Service, a weekly illustrated paper devoted to the enterprise of, and innovations in, aeronautics, to the illustration of model works at home and abroad, to the discussion of new methods and trade problems, and to the impartial discussion, by means of correspondence, of current labour difficulties, is required. The free and full development of the latter feature is highly important. Every competent authority upon labour troubles agrees that the essence of these troubles is suspicion, and the way out of a suspicious situation is for management and worker alike to cultivate outspokenness and "play with the cards on the table." With this proposed trade paper a method of tuition by correspondence and self-education could be very easily combined. What is here suggested is not a paper merely for the discussion of "shop"; its aim and effect would be to lift every worker in both branches of this field out of the little rut of merely mechanical participation into an understanding of the story of this new and wonderful field of human effort.

Aeronautics presents as marvellous and romantic a story as any in the human record. That wonder and romance are in themselves a force which, to put it at the lowest level, it is unbusinesslike to waste. But many employers seem unable to appreciate the rôle of such a stimulant. Indeed, some of them seem to regard the proposal with terror, as an unjustifiable illumination of the privacies of business enterprise.

How the paper could be produced and supplied is a question of some delicacy. It might, perhaps, be produced by a special joint committee, representing the directors and labour of the industry, maintained by a capitation tax upon the employer of a 1d. or so per head of the number of workers employed, and distributed gratis at pay day. But such official papers are apt to lack the spirit and interest of periodicals conducted upon more normal lines. Probably it would be less expensive to the employer and altogether more successful to select one or several of the existing "Air" weeklies and, subject to their agreement to insert certain definite features, to purchase and distribute in large quantities. It would not be difficult to arrange for an added page edited by a special joint committee of directors and labour on the model of the added page in the ordinary parochial magazine. A wholesome competitive element would be introduced by allowing each worker to choose which of the several selected papers should be given him.

Another important factor in the consolidation of the Aeroplane Industry and Service which Special Committee No. 4 has preferred to ignore, is the use of the Cinema by the organised industry. This could be made of the utmost service in attracting young people to the industry, and keeping the general public intelligently sympathetic with its progress. It is as much the business of modern industry to cheer, interest, educate, and invigorate its workers, and keep the public in touch with its activities as it is to get machinery of the highest efficiency. A business that bores or exasperates its employees or the public is a badly-organised business.

This much the Chairman of Special Committee No. 4 begs to add to the report that he here presents. His differences from his colleagues are probably all to be traced in the end to a difference in their and his interpretation of the aim of the Civil Aerial Transport Committee. Several of the recommendations embodied in this minority report have indeed been set aside by Special Committee No. 4 only because they are judged to be beyond the scope of that Special Committee. But the Civil Aerial Transport Committee as a whole, he holds, is a Committee not to make decisions, but projects, and a freedom and boldness with regard to the terms of reference and to new ideas are more in the spirit of its creation than a careful restriction within its literal terms of reference. He believes that what the Air Board wants from the Civil Aerial Transport Committee is not discreet answers to set questions, but comprehensive plans and a general review of all possibilities (of which labour troubles are not the least) affecting the peace future of the Empire in the Air.

H. G. Wells.

November 10th, 1917.

APPENDIX VII.

Interim and Final Reports of Special Committee No. 5.

INTERIM REPORT.

The Committee were asked to advise upon research and the special scientific education of expert designers, engineers, and pilots, with special reference to certain details of those lines of enquiry which are dealt with seriatim in the present report. The two subjects of research and education form convenient main divisions as a basis for their report, and the Committee propose to take them into consideration in the order named.

I. RESEARCH.

1. In classifying the different headings into which the general subject of research most conveniently falls, the Special Committee have adopted the following division:—

- (a) Invention in regard to aeronautics.
- (b) Experiments in regard to aeronautics.
- (c) Research in regard to meteorology.
- (d) Accident investigation.

2. In so far as the headings (a) and (b) are viewed in the light of any scheme for the encouragement and development of research, they are so closely connected that the Committee find it convenient to deal with them together.

The development of aeronautical science has been very rapid, both before and during the war, and, owing to the necessity in military and naval interests of keeping inventions and data connected with this science secret, the full publication of results in the interests of the aircraft industry has been impossible. During the years preceding the war the Secretary of the Advisory Committee on Aeronautics prepared abstracts of foreign scientific literature, which were published as an appendix to the yearly reports of the Committee. These reports only contained the results of such scientific work as had then been published (as distinct from work accomplished which far exceeded that made public at any rate in Great Britain), but even these were not available to the ordinary investigator in a comprehensive or convenient form. The same remark probably applies to similar reports from scientific institutions on the Continent. There now exists a vast body of information which when made available in some well ordered form after the war will be of vital importance to the development of aeronautical science. The chief mines of such information are:—

- A. The Advisory Committee on Aeronautics.
- B. The Technical Offices of the Air Board.
- C. The National Physical Laboratory and the Royal Aircraft Factory.

3. The Committee hold a strong view that as a basis for research this information must be collected and arranged. This will involve considerable labour, which the Committee think can be divided as follows:—

- (a) The compilation of a bibliography and of short abstracts of the principal papers;
- (b) the publication of an aeronautical treatise embodying a full account and critical analysis of the information available;
- (c) the publication of reliable text books, based on such well verified conclusions as can be drawn from this information.

Of these the most important is the preparation of the treatise mentioned in (b), and the Committee refer with approval to a report on this question by Sir R. T. Glazebrook and Professor Petavel, which is attached as Appendix A to this report. They draw attention to the outline scheme setting out the different sections of aeronautical science which such a treatise should cover. Appendix
A, p. 77

4. It seems clear to the Committee that the work comprised in headings (a) and (b) in the preceding paragraph should be undertaken by the same organisation, and the question arises as to the constitution, finance, and control of such an organisation. The results of the work so undertaken would benefit the Government, the industry, and the public, but the most direct benefit would be that to the Government. The sources of information are under Government control; but the information itself is in such a scattered and disjointed form as to be only understandable by those who have in fact followed the details step by step, within the Government offices, and only with considerable difficulty even by them. Accordingly, the Committee recommend the institution of a bureau for collecting and disseminating aero-technical knowledge in the interests of civil aeronautics, which, pending the establishment of a Research Association for the industry, should be financed by a grant from the Department of Scientific and Industrial Research. The bureau might, perhaps, be attached during the war period to the National Physical Laboratory, and could be staffed by an expert investigator with assistance and the necessary clerks. An estimate has been received that a sum of, say, £2,000 per annum would be sufficient to meet the cost, both of the bureau and of producing the treatise referred to in (b) in the preceding paragraph. The initiation of this work is so important, and the process of collecting the existing data must necessarily be so slow that the Committee think that the bureau should be set up without delay during the war, accepting the view that it will probably be necessary to treat the information prepared as confidential, but in the hope that secret information will in due course become available for the British investigator.

5. As to the publication of reliable text books mentioned in paragraph 3 (b) above, the Committee doubt whether this will require Government intervention. The production of such text books might, no doubt, be left to private enterprise, but their initiation is of great importance and urgency, and there is danger that, in the absence of an appropriate grant from the Government, a very long time would elapse before such a venture would offer sufficient inducement to any private individual to make the effort to start it.

6. The foregoing paragraphs deal with the materials upon which a certain part of aeronautical research can be based. There remain to be considered the problems of finding what machinery or organisation shall carry on (a) tests and investigation of finished products—aircraft, engines, and sundries, and (b) further

research, including physical, model and full scale. The Committee desire to emphasise the close association of these two different functions of the research organisation, because the proper carrying out of any tests of performance under (a) essentially involves the use of a skilled staff such as could well be drawn from a body engaged in research of the kind indicated in (b). The important question of the certification of the routine products of manufacture as distinct from experimental construction, though closely related to the problem submitted to the Special Committee, falls outside their terms of reference.

7. The Committee appreciate the fact that much useful research work is being done, and will be done in Universities and Technical Institutes, and they note with satisfaction the recent announcement that the Research Department have made a grant to Professor Bryan, F.R.S., of the University College of North Wales, to enable him for a whole session to carry on aeronautical research. At the same time, they feel that, since it is desirable to maintain in practice the close connection between research and test work, the institution, for the benefit of all constructors, of a Central Research Laboratory is desirable. Connected with such a Laboratory the Committee recommend the establishment of a Central Aircraft Test Ground and Testing Establishment. The aim of the former would be to form a centre of study of aeronautical problems, and the aim of the latter to provide reliable and impartial test results to the constructors and designers of the country, whether on their experimental or on their routine production. The Committee think that it is essential that the Laboratory and the Test Ground should be combined in one establishment.

8. At present the Society of British Aircraft Constructors are considering the formation of a Research Association in conformity with the rules laid down by the Department of Scientific and Industrial Research. The proposal to form such an Association has already been approved in principle. No details of organisation, control, or finance are as yet available; but it is assumed that it will be in receipt of funds contributed by the firms who are members of the Society of British Aircraft Constructors, many of whose individual engineers will also be represented as members of the Aeronautical Society on the Board of the Research Association.

9. It is thought desirable that the Laboratory and the Testing Establishment should be in one place, and the following scheme represents what the Committee are prepared to recommend in the light of their present information:—

- I. A Bureau for the preparation of the bibliography and treatise proposed above (paragraphs 3 and 4) to be established at the National Physical Laboratory under the control of, and paid for from State funds made available for that Institution.
- II. A Central Research Laboratory (see above paragraph 7).
- III. A Central Aircraft Test Ground and Testing Establishment (see above paragraph 7).

If II. and III. should be, like I., under the control of the National Physical Laboratory, they should undoubtedly be established at some place where there is ample room for a ground of adequate size, if not on an existing aerodrome, near a centre of scientific effort, such as London. This is of the essence of the matter, and makes it impossible to recommend that the establishment should be at Teddington, where sufficient space is not available. The funds required for II. and III. should be provided by grants from the Department of Scientific and Industrial Research and by contributions from the industry, which, for this purpose, means the Research Association mentioned above in paragraph 8. Suitable fees might be charged to individuals for tests carried out on their behalf by the Testing Establishment. The results of such tests could and should be treated as confidential whenever the individuals on whose behalf they are made desire it.

10. The importance of meteorology in the development of aeronautics can hardly be over-estimated. The Committee were entrusted only with the question of research in regard to meteorology, and they understand that the question of the dissemination of meteorological information after it has been obtained, is being dealt with by Special Committee No. 2. The problems of meteorological research have been dealt with in

Appendices B & C
p p. 78 & 79.

memoranda by Major Lyons and Sir Napier Shaw, which are appended to this report (Appendices B and C). In these memoranda the Committee desire to draw attention to the following points:—

- (a) The necessity for a closer study of atmospheric conditions at great heights.
- (b) The investigation of the phenomena of mist and fog and abnormal air currents in special localities.
- (c) The necessity for an organised scheme for improving the supply of information from the meteorologist to the flyer and vice versa.
- (d) The desirability of preparing meteorological information in a form most suitable for aviators from the existing material, not only for the United Kingdom, but for so much of Europe and for such air routes as may be selected.

11. In the case of meteorology, it is practically impossible to divide research proper from the dissemination of the results of that research. For this reason the Committee approve of the conclusions drawn by Sir Napier Shaw in paragraphs 2 and 3 of his memorandum (Appendix C), and they strongly support the other recommendations contained in the two memoranda (Appendices B and C), which may be summarised as follows:—

- (a) The necessity for increased facilities for aeronautical research at the Meteorological Office.
- (b) The necessity for local meteorological establishments at appropriate terminal aerodromes, connected by telephone with the Meteorological Office and with each other.
- (c) The necessity for instituting meteorological research centres in connection with Universities and other centres of education.
- (d) The necessity for the issue of suitable handbooks for the purpose of instructing flyers in meteorology.

12. In connection with the proposed local meteorological establishments mentioned in (b) of the preceding paragraph, the Committee recommend that the practical suggestions in matters of detail put forward in a letter from Sir Napier Shaw dated August 25th, 1917 (Appendix D) should be adopted. Army Meteorological Stations now established in France, and a considerable number of Naval Meteorological Stations in the United Kingdom will serve as models for these local stations, and the experience gained in the former will be available. Recommendations (a) and (d) of the preceding paragraph should be pressed upon the attention of H.M. Government, and recommendation (c) should be brought to the notice of the Universities and leading Technical Institutions of the United Kingdom.

13. The foregoing recommendations will render necessary an increase in the staff of the Meteorological

Office, particularly as the Committee is disposed to think that all the local meteorological establishments should be under the direct control of that Office. In the case of State owned aerodromes the matter is clearly capable of easy arrangement between the Meteorological Office and the Department controlling the aerodrome, while in private aerodromes the advantages to the owner of the presence of a meteorological station are so obvious that it is not to be supposed that he would raise any objection. Any expense consequent upon the provision of these meteorological stations should fall upon Government funds, and the working out of the necessary details should be left in the hands of the Meteorological Office. The Committee further desire to emphasise the necessity of ensuring co-operation between the Meteorological Office and the Dominion Authorities responsible for the organisation of meteorological stations in the Dominions.

14. It will be observed that the Committee have not dealt with the problem of accident investigation mentioned in paragraph 1 of this report. They are proposing to consider this question with the assistance of a memorandum thereon by Mr. Harper and Captain Hucks. The Committee's views on this point and their conclusions as to the special scientific education of expert designers, engineers, and pilots, particularly in relation to navigation, will be included in a second report to the Main Committee.

Mervyn O'Gorman, Lt.-Colonel (Chairman).
 Leonard Bairstow.
 H. T. Baker, Major.
 A. E. Berriman.
 R. T. Glazebrook.
 H. Frank Heath.
 H. G. Lyons, Major.
 E. M. Maitland, Wing Captain.
 Arthur Morley.
 J. E. Petavel.
 J. C. Porte, Wing Commander.
 R. M. Ruck, Major-General.
 W. P. Schreiner.
 G. I. Taylor, Major.
 E. R. Wayland, Lt.-Colonel.
 H. White Smith.

D. O. Malcolm (Secretary). November 17, 1917.

FINAL REPORT.

As stated in the final paragraph of their interim report, the Special Committee propose to deal in the present report with the subject of accident investigation, being the remaining heading of the branch of their enquiry relating to Research, and with the second branch of their enquiry, viz., Special scientific education of expert engineers, designers, and pilots.

I. RESEARCH (continued).

15. The investigation of accidents has been considered by the Committee from two points of view, namely, how far such investigation is necessary in the interests of public safety, and how far it will be of assistance in the advancement of aeronautical research, and in the improvement of design, construction, and piloting. In a general view of accident investigation the Committee have been greatly assisted by a detailed memorandum prepared for their use by Mr. Harper and Captain Hucks, which is attached to this report as Appendix E. This memorandum deals with the subject under different heads, and contains much useful information of a technical character, including a summary of the work, prior to the war, of the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society. Appendix E, p. 80.

16. There appears to the Committee to be a broad distinction between accidents occurring to aircraft carrying passengers for hire and those occurring to aircraft privately owned and used. In the former case investigation of an official nature seems necessary in the interests of the public and the analogy is suggested of the investigation undertaken by the Railway Department of the Board of Trade of accidents of a serious nature on railways. The Board of Trade enquiries are undertaken by officials possessing a wide expert knowledge of their subject, and it seems to the Committee that the investigation in the case of aircraft should similarly be undertaken either by or with the assistance of experts. The Committee, therefore, recommend that all accidents of a serious nature to aircraft carrying passengers for hire should be the subject of an official investigation, and that power should be conferred on the appropriate Government department, whether it be the Board of Trade or the Air Ministry, to compel such investigation and to regulate the manner in which it should be undertaken. In view of their opinion as to the necessity of expert assistance, the Committee further recommend that in carrying out their duties in this respect, the Government department should invite the co-operation of the research organisation referred to in their Interim Report.

17. In the case of accidents to aircraft privately owned and used it appears to the Committee that investigation should not be made a matter of compulsion. The information obtained therefrom may, however, be of the greatest assistance in the advancement of aeronautical knowledge, and should be regarded as an aid to research generally. Before the war the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society were able, without possessing any compulsory powers, to obtain much useful information as to the causes and prevention of accidents. The Committee recommend that after the war steps should be taken to ensure the continuance of this or a similar Committee to carry on the work of investigation of accidents other than those referred to in paragraph 16, and that such Committee should co-operate with the research organisation in furnishing to them the data obtained in their investigations.

11. EDUCATION.

18. The modifications in the conditions of civil life introduced by new inventions have in the past followed a gradual development. Progress in design and construction has resulted from experience gained in everyday use. Rail and road transport are but two illustrations of this process. Aerial transport will probably form a unique exception to the rule. The aeronautical industry was in its infancy when the war started, and, when peace is declared, will find itself grown up with the advantage of a great body of accumulated knowledge. This knowledge will have been acquired solely from the military use of aircraft, and may not be immediately applicable in all respects to the problems of civil aeronautics. Some period of time will, no doubt, have to be devoted to the design of purely commercial machines. Nevertheless, there is every reason to expect that the industry will be in a position to meet efficiently and adequately the urgent demand for more rapid transit, and that aerial transport will pass, though not without an awkward transition stage, into the routine of civil life.

19. The requirements of military aeronautics will by no means cease with the war. The country has no doubt realised that safety requires the maintenance of two fleets, and the necessity of shouldering the financial burden involved in the maintenance of an efficient aerial navy. We may, therefore, conclude that aeronautical construction will, whether measured by the capital invested or the labour employed, eventually rank among our most important industries. The prosperity of an industry depends in the first instance on the demand for its products, and in the long run on the efficiency of the production; it is first stimulated by national requirements, later on by international competition. Where the manufacture is a matter of old-established routine and custom, its rise or fall is slow, but rapid where sound scientific knowledge and high technical skill are essential.

20. We are thus led to the conclusion that the demand for the best training in aeronautics is urgent, and that, including all classes, from the skilled artisan to the scientifically trained engineer, and from the air mechanic to the pilot working on international lines of communication, the numbers of men to be trained will be considerable. At the present moment the war has emptied the Universities and Technical Colleges, and consequently there is no supply of men whose scientific education and engineering training would otherwise have been in progress or in course of completion. The recommendations which follow should, therefore, be read as applicable to a future period when the disturbance caused by the war, particularly in educational progress, has ceased.

Engineers and Designers.

21. It is not proposed to deal here with the training of the mechanics or artisans, who, of course, form numerically the largest portion of the total; this matter has been referred to another Special Committee. Their training will doubtless entail the formation of special classes at the principal technical schools, more especially at those situated in the neighbourhood of important works or aerodromes. At these institutions classes will also be organised suitable for engineers and draughtsmen who wish to improve their theoretical knowledge while engaged in practical work. On the other hand the engineering schools at most Universities will doubtless recognise that, just as under present circumstances the education of a mechanical engineer is incomplete without some general knowledge of electrical engineering, so, in future, all engineers should have at least a superficial knowledge of aeronautical engineering. For the civil engineer it will offer some instructive instances in the study of structural design, and some reference to aeronautical engines will necessarily form part of any mechanical engineering course.

22. The least numerous, but not the least important, class to be provided for is that which includes the men who, in due course, will direct research, design, and construction. Aeronautical engineers must, in the first instance, be fully qualified mechanical engineers, having had a sound, practical and an advanced theoretical training. They should, in addition, have had an opportunity of devoting adequate time to the scientific study of aeronautics, and be familiar with the details of aircraft design and construction. It is evident that the period of study will be longer, and the test of ability more stringent, than in many other branches of the engineering profession.

23. The Universities provide courses in Mechanical Engineering which extend over three years. Such courses would form a satisfactory preliminary to the more specialised training. During this period the student intending to specialise in aeronautics would spend his long vacation in aircraft works, and thus acquire some practical knowledge. The fourth year would be devoted entirely to specialised study, and would be followed by one or two years' experience in works, including a period in the drawing office and a period on an aerodrome. After such a training the student would be fitted for a position of some responsibility, and should have a reasonable prospect of rising, in due course, to the top of his profession as a consulting engineer, a managing-director, a chief engineer, chief designer, or chief draughtsman.

24. As outlined above, the specialised training of the aeronautical engineer would be a post-graduate course, and the question arises as to the nature of the institutions at which such courses should be organised. It has already been pointed out that whatever the development of the industry may be, the number of posts suitable for men of the highest standard of training is necessarily limited, and it is equally obvious that men possessing the combination of theoretical aptitude and practical ability required to profit by such a training are not numerous. Before the war the total yearly number of honours graduates in engineering, including civil, mechanical, electrical engineering, and naval architecture, etc., from all the Universities in the United Kingdom averaged about two hundred.

25. It would appear, therefore, that one or two institutions could deal with the demand which will arise for the highest specialised training in aeronautical engineering. Such an institution should certainly exist in the London district, and one in the North of England or in Scotland would probably also be required. The London school might either be:—

- (a) Attached to the Imperial College, where the students would have the advantage of coming in contact with the members of a distinguished teaching staff, and could conveniently make use of many of the existing laboratories; or
- (b) it might be attached to some research and testing institution, established on an aerodrome, and, in connection with its educational work, be recognised by the University of London.

If the school were attached to the Imperial College, the buildings might be situated on the ground of the Central Research Laboratory suggested in paragraph 9 of our interim report. Those attending the school would then be under the Imperial College for all purposes of teaching, but would have access to the Central Research Laboratory for the purpose of studying experimental work. Such an arrangement would involve co-operation between the bodies named, the student dividing his time between the two.

26. There are, of course, men who could ill afford the considerable expense involved by so prolonged a period of training. An adequate system of scholarships, financed by the Board of Education, should be established, so that no student of exceptional ability need abandon his studies through the want of the necessary financial resources. On the other hand, many men likely to prove of great value to the industry may not possess the necessary aptitude or the inclination to carry their theoretical studies to the highest point.

27. The system of education should be sufficiently flexible to provide for the full development of any exceptional ability in whatever direction it may be. In the present case it would be desirable for the Central Institution recommended in paragraph 25 also to provide courses based on a sound general engineering knowledge. Men attending these courses would presumably be required to have studied for two years at some recognised institution, either a University or a higher Technical School, and to have had some works experience.

The establishment of such an Institution would involve a considerable expenditure of capital. No such institution is self-supporting, the fees forming usually but a small proportion of the total expenditure. A yearly sum of about £6,000 would be required.

Training of Flyers and Pilots.

28. It is not possible to outline a scheme for the training of civil flyers and pilots without first considering briefly the new conditions which will follow any extended adoption of aircraft for transport work.

It may be assumed that, apart from naval and military aircraft, two classes of aircraft will exist :—

- (a) Those owned by companies which will maintain passenger or despatch services, or be chartered for special journeys.
- (b) Those owned by private individuals, which will occupy a position between the yacht used exclusively for pleasure and exploration and the private motor car used for pleasure and business.

These will naturally be employed on various services which may be sub-divided into :—

- (i.) Local.
- (ii.) National.
- (iii.) International.

29. Before the war there were in this country some five thousand yachts and several hundred thousand private cars. With regard to numbers, the privately-owned aircraft may eventually be expected to reach an intermediate place. In many cases the owner will qualify as a flyer, and some of his employees will, presumably, be primarily expected to look after the upkeep of the machine, but will doubtless be required to be capable of flying it also. The owner's training will depend on the time he devotes to it, and his desire to excel in it. No definite rules can be laid down for his training; but we can assume that a considerable number of pupils of this kind will present themselves at the various training grounds.

30. Those who adopt flying as an employment (apart from a few amateurs, who might receive a nominal remuneration, and would expect to be provided with a staff of mechanics to keep the machine in order) will probably be drawn from two classes :—

- (a) The professional flyer, who will receive a substantial remuneration, and will be the responsible supervisor of a staff who will attend to mechanical matters;
- (b) The chauffeur-flyer, who will be expected to clean and repair the machine, and be capable of flying it when required.

These classes will, no doubt, hold a certificate awarded on the successful completion of some prescribed course of tuition in flying. The chauffeur-flyer will, in addition, be required to possess the qualifications of a skilled mechanic, and in the event of such a flyer taking charge of passenger aircraft plying for hire, there will be special obligatory tests of qualification to ensure adequate protection for the public.

31. The three classes of commercial transport will call for men of different training :—

- (a) For local transport, proficiency in flying and knowledge of the rules of the air and of agreed signals will be essential qualifications.
- (b) For national transport, involving long journeys in the United Kingdom, e.g., from London to Glasgow, a knowledge of map-reading and some knowledge of meteorology will be necessary as additional qualifications.
- (c) For most international transport routes a knowledge of navigation and a more complete knowledge of meteorology will be required, in addition to the qualifications mentioned in (a) and (b).

It is indispensable in all cases that there should be a proper understanding of all the instruments employed and of the elements of the scientific reasons for their use.

It is probable that aircraft used on international lines of communication will eventually be of large size. In this case the man at the controls becomes the helmsman, and the craft is under the command of a captain or pilot. *Mutatis mutandis*, the training required for this post is that received by the navigating officer of a liner. An appreciation of the functions of wireless telegraphy will also be needed.

32. The above forecast appears to indicate that a large number of schools will be required for tuition in flying, whether or not special flying certificates are sought. Presumably most main aerodromes will have a flying school attached. The object of the tuition in such schools has in the past been to reach the standard

set by the certificate* of the Royal Aero Club, and the Committee consider that there would be advantages in continuing this system.

33. In addition, at least one school of aerial navigation will be required, at which, amongst other necessary subjects, map reading, the use of the compass, astronomy, signalling, and wireless telegraphy and meteorology will be taught.

34. The standard required for the flying certificate should be reached after a few months' training in an aerodrome. It would imply the ability to fly any usual type of machine, and a number of extended cross-country flights would be required. It would not imply any special engineering training, but merely the knowledge required to verify the adjustment of the rigging, to start and control the engine satisfactorily, and to adjust and replace valves and minor fittings. The courses at the school of navigation would extend over one year, at the end of which time the students would be required to pass an examination in the subjects taught. The training in navigation could not, however, be regarded as complete until the student could give proof of continuous and satisfactory practical experience extending over a period of time.

Mervyn O'Gorman, Lt.-Colonel (Chairman).

Leonard Bairstow.

A. E. Berriman.

R. T. Glazebrook.

H. Frank Heath.

H. G. Lyons, Major.

E. M. Maitland, Wing Captain.

Arthur Morley.

J. E. Petavel.

J. C. Porte, Wing Commander.

R. M. Ruck, Major-General.

† W. P. Schreiner.

G. I. Taylor, Major.

E. R. Wayland, Lt.-Colonel.

H. White Smith.

D. O. Malcolm (Secretary).

December 29th, 1917.

* The term "flying certificate" is probably more appropriate than "pilot's certificate," when flying alone has formed the object of tuition.

† I doubt whether the power to order official investigation of accidents should be limited, as is proposed, to cases where the aircraft is carrying passengers for hire, and whether higher educational facilities should be limited to one or two institutions as is proposed. I sign this Report with reservation on these points.—W. P. Schreiner.

Report on the Preparation of an Aeronautical Treatise.

At the June meeting of the Committee, a Panel, consisting of Major Taylor, Professor Petavel, Mr. Berriman, and Mr. Selby was appointed to draw up some suggestions for a treatise on aeronautics, to give effect to Professor Petavel's proposal No. 3. The main purpose of such a treatise would be to put in a convenient form the present results of scientific inquiry into aeronautics. The material for such a treatise would be found in the Technical Reports of the Advisory Committee for Aeronautics, the publications of M. Eiffel, and the papers issued from the Aeronautical Institutes at Gottingen, Koutchino, and elsewhere. Other important sources of supply will be the Transactions of the Aeronautical Society, the various technical journals, English and foreign, and existing books.

Such a treatise would be the work of various writers; the first step would be to find an editor, who would, no doubt, write some parts of the book himself, but whose main work would be to obtain and edit the various contributions which would go to compose the treatise.

If a scheme for issuing abstracts is developed, it might perhaps be arranged that the same man should act as editor for this, but that ought not to be looked upon as essential.

Some estimate of the time required and the funds necessary to pay the editor and staff must be formed. It is difficult to do this with any completeness until the editor has been provisionally selected, and some scheme for the contents of the book has been approved. Some portion, at any rate, of the cost ought to be recovered from the sale of the book.

It would, no doubt, be desirable for the Sub-Committee to indicate the name of a possible editor, to make some suggestion as to the remuneration he should receive, and, if possible, to frame an estimate of the time required to write the book, but under present war conditions it has not proved feasible to do this. The Sub-Committee, however, have reason to hope that Mr. Bairstow would undertake the duty on the conclusion of peace, or failing this, we may look for assistance as editor from Mr. Selby.

Mr. Selby has prepared a schedule of the suggested contents of the Report, as an indication of what the Committee have in view, not with the intention of settling its future contents now; this must be left to the editor.

R. T. GLAZEBROOK.
J. E. PETAVEL.

10th October, 1917.

Rough Outline Scheme for Report on Present State of Knowledge in Regard to Aeronautics.

1. *General Principles and Theorems in Aerodynamics (and Hydrodynamics).*

Brief account of general theory. Motion of a solid through a fluid; comparison of air and water (air incompressible). Skin friction. Eddy motion. Theory of model experiments. Principle of dynamical similarity. Motion of fluids in pipes (heat and momentum), etc., etc.

2. *Methods of Measurements for Models.*

Velocity measurement. Resistance measurement; wind channels and whirling arm. Photographic examination of flow, etc.

3. *Resistance Determinations in Simple Cases.*

Experiments on square and rectangular plates, spheres, cylinders and wires (normal and inclined), stream-line wires and struts, stream-line bodies. Distribution of pressure.

4. *Experiments on Aerofoils.*

Inclined planes. Single wings; aspect ratio; camber of surfaces, position of max, ordinate, form of wing tips, etc. Biplanes, etc. Pressure distribution.

5. *Experiments on Bodies and other Parts of Aeroplanes.*

Bodies (and control surfaces). Struts—effect of yaw. Stream-line wires. Wheels, etc.

6. *Experiments on Complete Models.*

7. *Airscrew Theory and Experiment.*

8. *Engines.*

Experimental investigations; heat flow, compression ratio; effect of altitude, starting, etc., etc.

Radiators. Design: air-cooled and water-cooled. Methods of test.

9. *Application to Full Scale Machine.*

Aerodynamic performance, methods of calculation, R.A.F. diagram, ascending and descending flight, etc., etc. Loads taken in flight. Full scale experiments.

10. *Stability.*

Theory and determination of rotary co-efficients, effect of controls, etc. Practice.

11. *Design and Strength.*

General procedure and different types of machine. Stress calculations, methods of test. Stresses in wing fabric. Propeller design. Experimental work bearing on strength, vibration of wires, tail vibration.

12. *Seaplanes.*

Float experiments and water performance. Aerodynamic performance.

13. *Airships.*

Model experiments—pressure distribution, fins, etc. Airship sheds and screening. General conditions of motion. Stability. Strength and design. Hydrogen, ballast, etc.

14. *Materials of Construction.*

Fabrics, airship } with methods of test.
Fabrics, aeroplane }

Dopes, varnishes, etc. Timber. Light alloys. Special steels.

15. *Instruments for Use on Aircraft.*

16. *Aircraft in Warfare.*

Bombs and bomb dropping. Attack of aircraft from aircraft, etc.

17. *Meteorology.*

General. Application to (i) airships, (ii) aeroplanes.

Memorandum on Research in Regard to Meteorology.

The increase of aviation which will be brought about by the introduction of aerial transport on a commercial basis will greatly enlarge the demands made upon both practical and theoretical meteorology, in order that the dangers and obstacles due to meteorological conditions may be reduced so far as may be practicable.

These demands must be met by both special investigations into various meteorological problems, and the provision, in forms suitable to the needs of aviation, of the information which has been accumulated during more than half a century of co-operative effort.

Modern meteorology has been built up on the study of the physics of the atmosphere, and further advance will be attained by the same method. The investigation of such phenomena as the formation of mist and fog, conditions which affect visibility, turbulence in the lower strata of the atmosphere, which are already being studied, are types of the work required, and other problems will doubtless be suggested at the meetings of this Committee. The Central Institute, the Meteorological Office, and its Observatories, will naturally be largely occupied with this form of research, but it may be assumed that, as soon as the universities provide facilities for the study of advanced meteorology, such investigations will be undertaken there also.

Weather changes, forecasts, and warnings can only be adequately studied at the Central Institute, where large-scale working maps are prepared regularly, at which data are received several times daily and where a very complete collection of meteorological data from all countries is available for comparison study, so that the practicability of extending the period for which weather changes can be foretold must be undertaken there.

The study of the special features of the weather in localities where winds of exceptional violence, great turbulence of air currents or other abnormal phenomena occur, will be important, and this will necessitate a scheme of suitably planned observations taken on the spot, together with their critical discussion by competent meteorologists.

While pure research, the investigation of phenomena under well defined conditions will always go on more or less steadily, provision must be made for the further study of the phenomena under various meteorological conditions to determine the modifications which may be caused. This extension of the work is essential in order that the results of meteorological research may be of practical utility.

Intimately connected with such investigations are the collection and discussion of the material on which they are based. Observations of pressure, wind, temperature, rain-fall, fog, &c., have been accumulated for many years past, but both those of this country and those from many places abroad will require re-discussion in order to provide the special kind of information which is now required, and which differs from that which is used for climatic studies. Observations of the upper air have become very numerous and are constantly increasing; they, too, have to be compiled and prepared for ready reference. In this field particularly a closer connection between the practical experiences of the pilot and the investigations of the scientific meteorologist is most desirable, for what is a matter of common knowledge to the one may provide confirmatory evidence for which the other has been vainly seeking.

The present supply of data from ships will need increasing

where routes cross the sea, in order that the information available on land may be extended to the sea area with confidence; and to this will now be added the observations made or obtained by aviators during their flights. To combine these satisfactorily with those representing the conditions over neighbouring areas will require the same careful organisation as was necessary for marine observations when wireless telegraphy was first introduced, for incorrect observations or data obtained by faulty instruments lead to false conclusions which may not be merely useless, but even dangerous.

The incorporation, discussion or recasting, as may be necessary, of the meteorological data of foreign countries, as it becomes available, will also be an important duty of the Central Institute.

The speed of modern aircraft moving along air routes will presumably necessitate some rearrangement in the provision of forecasts and weather warnings. While the Central Institute will receive reports from a very wide area and deduce from them the probable changes which will occur, a well-selected network of secondary stations will also be necessary. These stations will receive, besides their own observations, reports from the Central Institute and other stations, which will enable them to prepare a weather-map of their district and to follow the weather changes over it in greater detail than at the Central Institute. They would be ready to furnish short-period forecasts or warnings to aviators in the district or on the section of a route passing near it. Thus the necessary organisation will include:— (a) Central Institute; (b) Local Warning Stations; (c) numerous Observing Stations, besides certain Institutes.

The Central Institute is represented by the Meteorological Office, with its observatories, where phenomena can be investigated and the results brought into touch with the practical application of Meteorology, and the existence of six observatories dependent on the Meteorological Office in different parts of Great Britain provides large opportunities for such work. At the Meteorological Office also the accumulated observations of over sixty years from many stations at home and abroad, which have been tabulated and discussed, provide a rich store of material ready for the investigation of special subjects, and the preparation of new data could be economically met by an extension of the present arrangements.

The Forecasting service will probably have to be arranged on the basis of continuous duty, so that inquiries can be dealt with at any time, and, besides the general forecasts issued at fixed hours, the Forecast Service should telegraph sufficient meteorological data to Local Warning Stations to enable them to follow the weather conditions of their districts and to give warnings of disturbances likely to affect them.

The connection between Meteorological Research and Practical Aviation could be facilitated at Aeronautical Research Centres, where a trained meteorologist could not only contribute his own observations, but also bring the practical experience of pilots to the knowledge of meteorologists, and demonstrate the bearing of advances in meteorology on aeronautics.

H. G. LYONS.

Meteorological Office, London,
27th July, 1917.

Meteorological Services in aid of Aerial Transport.

Meteorological Office,
South Kensington,
London, S.W.7
11th August, 1917.

D. O. Malcolm, Esq.,
Civil Aerial Transport Committee.

Dear Sir,

In reply to your letter of August 4th, I quite agree with the lines of Major Lyons' Memorandum of 27th July, 1917. I should add to the preamble some words about taking advantage of favourable meteorological conditions as well as "reducing the dangers and obstacles" of unfavourable ones, because, on the whole, the weather is benignant, and its favourable moods are as well worth considering as its occasional ill-temperers. That, however, is merely a matter of form.

2. In substance, I gather, Major Lyons suggests an extension of the present public meteorological service to meet the special and local needs of a regular service of aerial transport. A public meteorological service is essentially an organised "enquire within" upon all questions in which the weather is concerned. It must be prepared on demand to supply an answer to any question about the weather past, present or future, in any part of the world to which, in the present state of our knowledge, an answer can be given. It must, therefore, have all its information and its knowledge ready in advance before it knows what question is going to be asked. We are quite used to that situation so far as surface weather is concerned. The underlying principles of the present scheme of the meteorological service are:—

- (1) The collection and organised arrangement of trustworthy information about past weather from every part of the globe.
- (2) The periodical notification by telegraph of the present weather from stations representing as wide an area as possible surrounding the United Kingdom, to form the basis of maps upon which forecasts of weather are based in accordance with the recognised teachings of meteorological science.
- (3) The distribution of the information so collected either in summary or detail in reply to specific enquiries or in anticipation of enquiries in common form.
- (4) The study of the information collected in conjunction with that obtained at the special observatories and stations of the Office in order to improve, by investigation and research, the position of the Office in relation to replies to enquiries of every kind.

3. The new features introduced by the needs of aerial transport are, first, that the subject of possible questions is extended to include the atmosphere up to 20,000 feet, a region that, until recently, we have studied only for the light that it throws upon meteorological science; secondly, that the scientific questions that arise are rather more recondite and require more specific answers than those which have commonly been addressed to us from outside the Office in the past; and, thirdly, that the airman's horizontal range is wider: he needs to draw upon information from a wider area, and to have the information at his disposal in a compendious form practically at any aerodrome and at any time of the day or night. In other words, there must be provision for studying the structure and properties of the atmosphere from the special point of view of aircraft, which involves some extension of our organisation for study and research, and for obtaining the material necessary for that study; and there must be some extension of our means of communicating general and special information to those interested in aircraft.

4. What Major Lyons obviously realises is that the provision for conveying information to aircraft pilots is not complete unless the pilot has an opportunity of discussing the situation with a meteorological expert, by which I do not mean an inspired weather-prophet who makes an oracular statement that enables the pilot to dismiss the weather from his thoughts, but simply an educated person who knows what information weather maps do, and do not, contain, and what it means; what additional information is available and where and how it is to be found. In fact, a pilot wants access to a "map room," where he can consult a weather map just as he would consult a topographical map; but as the weather map is changeable from day to day, and even from hour to hour, it cannot be drawn once and for all and carried in the pocket on a long journey; it must be redrawn periodically on the spot, and the person who drew it should be there to explain its meaning.

5. At present the only public provision for consultation of this kind is at the Meteorological Office in London. Many useful consultations with balloonists have been held there, but that is not sufficient for regular aerial transport. Adequate information of the same kind is wanted in other localities. The recognised provision at present for other places is to send a copy of the Daily Weather Report, which is then somewhat belated, and has generally to be read without the advantage of an expert to consult. The alternative to posting or delivering the Daily Weather Report is to make

a reply to a definite question sent by telegraph; but one question and one answer are insufficient, everyone wants to ask further questions in case the answer to the first is not exhaustive, as it seldom is.

6. Assuming that aerodromes will be connected by telephone with what, on the analogy of railways, may be called "termini," an obvious step would be to have local meteorological establishments at those termini, such as Edinburgh or Glasgow, Liverpool, Dublin, Queenstown, Cardiff, Plymouth, and, perhaps, other places. Each establishment should consist of a "map room" in charge of an expert, who would keep a suitable library of reference and would discuss the meteorological situation orally or over the telephone with pilots and others. These experts should be attached to the staff of the Meteorological Office and take regular turns of duty at the Office, so that they may be kept quite up to date both as to information and methods. Each expert would require a junior as learner, or two if the station is to be open continuously. These are the Local Warning Stations which Major Lyons enumerates under (b). The men to be employed on these posts should be men with ample knowledge and practice of mathematics and physics, who have had a regular course of training at a University or Technical Institute.

7. Provision of this kind is necessary in the public interest, not only for the information of airmen, but also for all the many classes of the community who are interested in an adequate knowledge of the ways of the weather as affecting, e.g., shipping and other forms of transport—agriculture and horticulture—and catering. It has already been undertaken by the Office for the Air Services at South Farnborough and for the Armies in France and Salonika. The principal difficulty that has had to be met is the lack of men with suitable training. When the war began there were not more than twenty all told on the Office establishments. Some fifty more have been passed through the Office for the meteorological service of the Armies, and many of these will be available after the war.

8. Another different but equally important part of the programme is the instruction of pilots and others in the methods of modern meteorology, carried sufficiently far for them to know the kind of question to which meteorological science can give an answer, so that they may not find themselves at cross-purposes in consultation with a meteorological expert. This requires the preparation of suitable official handbooks, and some provision by way of lectures or teaching for discussing the contents with the airmen. It seems important that the handbooks should be official, because they should be guides to the use of official intelligence, and that object wants to be kept steadily in view; but it will require some pressure on the Meteorological Office to get handbooks prepared, because when a subject is developing daily under one's own hands it is very difficult to shut off and stereotype one's knowledge in a book. In a university or technical institute there are long vacations when other work is shut down, but in an office the increase of information goes on continuously, and to the writer the work gets out of date while it is in his hands. Still, it is important that this work should be done by the Office Staff.

9. There remain what Major Lyons calls "aeronautical research centres." It would be natural that these should be organised in connection with courses of aeronautical engineering and aeronautical theory at teaching centres—universities or technical institutes. The aeronautical researchers should, somehow or other, be in close communication with the aviators, but a much-frequented aerodrome in the highway of aerial traffic is not a good place for meteorological apparatus that has to project a considerable way from the ground, or that uses steel wire, as for kites and captive balloons, so the communication is best arranged through a teaching centre which is common ground. Moreover, the direction of experimental researches in the physics and dynamics of the atmosphere requires not only high professional qualifications, but also the assistance of a body of students with a good deal of available time.

10. I have set these things out at length in order to lead up to the vital question of your letter; by what means the Civil Aerial Transport Committee could best assist in seeing that Major Lyons' suggestions should be carried out. The best means seem to me to be, first, to ask the Meteorological Committee, which has the requisite experience, to set up by way of experiment at one of the terminals mentioned a local meteorological establishment of this kind which I have indicated herein as necessary for the purpose which the Committee has in view; and, secondly, to ask the Imperial College of Science and Technology and/or the Universities or Technical Institutes of Edinburgh, Glasgow, Dublin, Liverpool, Cardiff, Southampton and Plymouth, to set up a teaching centre for Aeronautical Engineering, Aeronautical Theory and the structure of the atmosphere; or perhaps a circular prepared by the Committee asking universities and technical institutes to make a point of giving students the opportunity of learning those subjects which would lead to the provision which is required.

(Signed) NAPIER SHAW.

†APPENDIX D.

Meteorological Establishments.

APPENDIX E.

Memorandum by Captain B. C. Hucks, R.A.F., and the Assistant Secretary (Technical), as to Accidents and Accident Investigation, with an Annex Summarising the Work, Prior to the War, of the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society.

It is proposed to deal with the subject under the following heads:—

- I An outline of the most common forms of accident at the present time.
- II The necessity for an investigation of accidents, even some of those not having serious results, with a view to the determination of their causes.
- III Methods of obtaining reliable information.
- IV The necessity for an expert examination and classification of data obtained.
- V The use to which the results of examination can be put.

I.

CAUSES OF ACCIDENTS.

Aeroplane accidents are, as a rule, due to one or other of the following causes, or sometimes to a combination of such causes:—

- A. Engine stoppage, etc.
- B. Errors in Piloting. 1.—Want of experience and hurried teaching. 2.—Real errors of judgment. 3.—Rashness.
- C. Faulty construction. 1.—Design. 2.—Construction. 3.—Materials.
- D. Dangerous manœuvres.
- E. Meteorological conditions.
- F. Fires.
- G. Illness of a pilot while in flight.

Before examining very briefly some of the accidents due to one or other of these causes, or a combination of any of them, it should be noted that, with pilots who are fully experienced and know their engines, grounds, winds and weather signs, accidents under the peace conditions of flying should become rare.

A. *Engine Stoppage, etc.*

The stoppage of an engine in the air should not, under favourable circumstances, imply any serious risk of accident. His mechanical power gone, the flyer must necessarily descend. He can and must maintain the forward speed of his machine and the support of its planes, by gliding downward in a gradually descending path; but if he is over thickly-wooded, broken, or mountainous country, it may be difficult for him to find a suitable landing point, and he may, should he make his contact with bad ground, break some portion of his alighting gear, or perhaps damage his machine more seriously. But if he is dexterous he may, and usually does, save himself and his passengers from serious injury.

To many flyers the sudden stoppage of their engine is disconcerting, leading them to errors of judgment they would not be guilty of under normal conditions. So it may happen that at a moment when exceptional judgment is demanded of him, a flyer is not in a condition to act correctly and with unswerving precision.

When his engine has failed a flyer's first thought, naturally, is to make a descent at some point where the ground is suitable, and where he will avoid damaging his machine, or injuring himself or his passengers. If he is near an aerodrome he will endeavour to reach this aerodrome. It has in the past happened not infrequently that an engine has failed—say through some disorganisation in the petrol pressure feed as a result of "taxying" a machine prior to a flight—not long after a machine has left the ground and before it has gained altitude. The instinct of the flyer under such conditions is to endeavour to turn his machine in the air and glide back to the aerodrome rather than make a landing in any field or open space which may lie within reach. But while in the act of turning—remembering that he has been more or less disconcerted by the sudden failure of his motor, and remembering also that owing to the rapid growth of the art of flying thoroughly experienced pilots are few—he may make the mistake of gliding at so flat an angle while on the

turn that the air pressure under the inner wing of his machine falls so low that it is insufficient for the support of that side of the machine; whereupon the aeroplane begins a side-slip which may turn into a spinning nose-dive—and this means that, for the moment at any rate, the craft has passed beyond the flyer's control. If, however, he is at a sufficient altitude when this happens, he may be able to extricate the aeroplane from its spinning dive; but should he be near the ground when his machine side-slips he will probably be unable to regain control before it crashes.*

It would be safer in some cases after an engine has failed, and particularly when failure takes place with the aeroplane at a low altitude, if flyers glided on straight ahead and did not endeavour to turn. This might, it is true, involve a descent on unsuitable ground, with some slight damage, perhaps, to the undercarriage, but this would be far better than losing control altogether. A fact to be remembered is that if an aeroplane loses flying speed while moving straight ahead it not only loses height less rapidly, but there is far less risk of a side-slip, as all stable machines tend, when the flying speed is reduced below a certain point, to take up automatically a safe gliding angle.

Probably the origin of the majority of accidents at the present time is stoppage of the engine, after which a flyer is frequently guilty of some error of judgment, or of piloting, or of both; and such errors are due in most cases to the anxiety of the flyer to reach some specific landing ground—an anxiety which will be all the more acute should engine failure have occurred when the machine is low.

This points to the fact that when airways are established, with landing grounds fairly close together along each route, the main cause of accidents will have been removed. Under such improved conditions, should an engine fail while an aeroplane is in flight, an aviator will not find it necessary to turn and manœuvre in the air, during a glide without motive power, in order to reach some landing ground that is not readily accessible. Subject to his being at a sufficient altitude, he will be able to glide to whichever alighting place on the chain of grounds may lie before him, and make a landing under favourable conditions on a sufficiently smooth ground.

Even with such landing places available, an engine may fail so soon after a pilot has left the ground that he is unable to reach the next alighting point, though this may be only a few miles distant. Under such conditions, assuming he has insufficient altitude at which to make a safe turn, he should glide down in the open country and pick the best landing he can. It is worth while, therefore, to bear this contingency in mind, and to see that the land is fairly open in the immediate vicinity of aerodromes.*

Improved reliability of engines, and the rapid growth of skill, experience, and a sense of responsibility in ground men and mechanics, should render improbable cases of engine failure occurring almost directly after an aeroplane has left

*Note by Major G. I. Taylor.

"Many accidents occur when an engine stops shortly after a machine has left the ground, and before it has attained a height of more than a few hundred feet. Under these circumstances, if the readings of the instruments are used intelligently, it is frequently possible to turn back into the aerodrome; but what often happens is that the pilot, instead of looking at the instruments, looks only at the ground. Under these circumstances, after he has turned across the wind, the ground may appear to him—if the turn has been correctly banked—to be moving sideways under him, and in the direction it would appear to move if he were doing a very much over-banked turn at a greater height above the ground. The pilot's instinct is therefore to hold the lower wing up, and to make an under-banked turn. The number of accidents due to faulty piloting, on the part of inexperienced pilots during a turn near the ground, might be greatly reduced by better education, and also by a greater confidence in the instruments, which are now extremely reliable."

the ground; while the careful training of flyers should prevent them from falling into the error of starting away on a flight with a motor that is not running well.

B. Errors in Piloting

Errors in piloting, so far as one can isolate them as a cause of accident, are not likely to involve a flyer in much danger so long as he is at a sufficient altitude. Peace flying will also remove the necessity from all civil flyers of making those extreme manoeuvres which are called for in war in darting from or at an enemy, or spinning down to get out of his reach, so that all errors connected with practising these evolutions will be absent.

The comparative leisure of peace flying should tend also to prevent accidents due to hurried teaching, or to errors of judgment on the part of instructors in ordering pupils to make flights or carry out manoeuvres for which their degree of proficiency has not prepared them. Rashness on the part of young flyers, and the taking of unnecessary risks, should also be discouraged more effectually when a longer period can be allowed for tuition, and when there are not the exigencies of war to justify such risks.

Errors in piloting, when an aviator is making his contact with the ground after a flight, account for a large number of accidents, though these, generally speaking, are not attended by serious consequences. A broken under-carriage is, as a rule, the worst that happens, and though experience shows that an aeroplane may overturn occasionally and be damaged badly, its occupants generally escape. Landing with the wind instead of against it will often lead to a machine being damaged by collision through a pilot failing to bring it to a standstill within the length of run he normally expects.

Another error of piloting when in the act of descending is to alight side to wind. In this case, if the aeroplane has a sideway as well as a forward motion at the moment of contact with the ground the running wheels may buckle, and the breakage of the entire chassis, and perhaps the overturning of the machine, may result.

Such accidents in landing are not always to be laid to the door of the flyer. It may happen, through the absence of any wind-vane or smoke, which gives him a reliable indication, that he is unable to judge accurately the direction of the ground wind. When chains of aerodromes are in existence it will be easy and inexpensive to place on each, in a position where it is seen easily by a pilot while descending, some standard type of wind-direction indicator.

C. Faulty Construction.

Accidents due to faulty construction are becoming far less frequent owing to the increasing knowledge and skill of designers and constructors, the adoption of ample factors of strength, and the care which is exercised in the choice and inspection of materials employed. At present, however, greatly though design and construction have improved, it is possible for a machine in the course of the violent manoeuvres dictated by war service, to be subjected to such abnormal strains that some part of it collapses and robs the pilot of control.

Another risk of structural breakage which must be reckoned with is that of a rough landing having done some damage to a machine—say to the rear of the fuselage. This, if it escapes detection at the time, may lead afterwards, when a machine is subjected to strain, to a collapse in flight.

Constructional risks may be encountered, even in future, by flyers who are called upon to handle machines of an experimental type, the behaviour of which, when actually in flight, is being determined by practical tests. These risks affect only indirectly the general public or potential passengers, who would not be introduced till long after such risks had been studied and eliminated.

D. Dangerous Manœuvres.

There should be a distinction, of course, between dangerous manoeuvres which are unnecessary and those which are called for in learning, and in afterwards performing, the abrupt and often violent evolutions which must be made in aerial fighting. The risks attached to the latter are inevitable while we are at war; but in commercial or pleasure flying, when only safe and reasonable piloting will be required, accidents under this heading should become extremely rare. In the Air Force naturally, even under peace conditions, dangerous manoeuvres must be carried out on occasion; but there will be no justification for them in civil flying.

E. Meteorological Conditions.

Certain accidents, have, it seems probable, been due to abnormal atmospheric conditions, or at least to the discomfort of the pilot by such conditions; and data in this regard—though a certain amount of information is already available—need to be far more extensive. We refer to this question, briefly, under a later heading.

F. Fires.

This cause of accident, occurring when a machine is in flight, or when it has crashed after a bad landing, is now receiving the closest attention, and, under the less arduous conditions of peace flying, and with the experience and

data already obtained, it should become possible very greatly to minimise this danger.

G. Illness of a Pilot.

In the Annex to the Appendix, a case is mentioned of an accident which was assumed to be due to the indisposition of the flyer, and there have been other obscure cases which have been attributed to the same cause. In war flying, under the strain of ascending rapidly to high altitudes, in diving steeply, or in spiralling or other violent movements, cases are to be expected of giddiness, or of temporary loss of consciousness. In peace flying there should, ordinarily, be none of these extreme physical strains; and medical examinations, carried out periodically, should obviate the risk of a commercial pilot, while in charge say of a passenger craft, losing control of his machine through any sudden attack of illness.

II.

THE NEED FOR INVESTIGATING ACCIDENTS.

Before the war the Royal Aero Club and the Aeronautical Society, through their Accidents' Investigation Committee, whose findings in twenty-six enquiries we summarise as an Annex, were in the process of obtaining valuable data; while recently a committee has been appointed by the Air Board, under the presidency of Col. O'Gorman, to examine when called upon by the Services the causes of accidents which befall naval and military pilots and machines.

Hitherto, however, and at the present time, an accident has as a rule to be very serious, and generally fatal, before it is investigated; and while we are at war it is unreasonable to expect that each minor mishap shall be investigated. But when peace comes, and we enter on the era of civil aerial transport, it will be found no doubt that firms will investigate every accident which happens to their craft, even though this should be no more serious than the compulsory descent of an aeroplane, made without hurt to anyone on an aerodrome, through, let us say, some slight engine defect. Enterprising firms may be expected, in fact, to study the details of everything that happens which should not happen: of every mechanical breakdown, no matter how insignificant, which serves to delay or interrupt a flight; of every kind of atmospheric condition, abnormal or otherwise, which affects the travel of a machine from point to point, or produces conditions which a flyer has not experienced before.

The fatal accident is often the worst to approach from the point of view of investigation. Both the occupants of a machine, if there is a passenger as well as pilot, may be killed, while the machine itself, as the result of its crash, presents in the majority of cases such a hopeless mass of wreckage that nothing definite can be learned from it. But where we should learn valuable lessons under peace conditions, is from those small accidents which, if they are not investigated and their causes discovered and eliminated, may lead eventually to serious accidents and loss of life.

In minor mishaps the conditions are often favourable for investigation. Apart from any testimony which may be obtained from expert eyewitnesses, there are accessible the statements of those actually in the aeroplane; while there is also the machine itself, which, though it may be somewhat damaged, is rarely damaged badly enough to prevent a critical examination.

III.

METHODS OF OBTAINING RELIABLE INFORMATION.

The testimony of lay witnesses to an accident who possess no technical knowledge is generally unreliable. A man may say he heard an explosion in the air, and then, shortly afterwards, saw a machine fall. This gives the impression that the accident was due primarily to engine failure. What may have happened, in fact, is that the pilot merely switched off in the ordinary way and that his engine gave the not unusual exhaust pop, or backfired harmlessly, making the noise the lay witness heard. In reality the pilot, while gliding, may have lost control of his machine as the result of some error of judgment absolutely unconnected with the switching off of his engine. If too much reliance is placed on non-technical evidence, the trend of an enquiry may be misdirected; but at the same time it should often be possible, by a series of questions carefully framed, to gain useful information from a non-technical witness.

Before the war the Royal Aero Club, jointly with the Aeronautical Society, in their scheme of accident investigation, appointed technical representatives on the principal aerodromes whose duty was, when a fatality occurred, to collect all details possible, to examine the machine before it was moved, and to prepare a report which could be considered—if necessary with other evidence—by the Accidents' Committee. Here was the nucleus of an organisa-

tion, although the fifteen representatives which were all that had been appointed, prior to the war, will need to be increased in numbers after the war. The representatives on the flying grounds, as appointed before the war, were not accident investigators pure and simple; their main and permanent occupation lay generally in some executive or other work in connection with an aerodrome. Accident investigation was a side issue with them, which they took up voluntarily. It might happen, therefore, under such conditions of appointment, that they were not present on an aerodrome when an accident took place. It was with such a contingency in mind that more than one accident representative was appointed on the principal aerodromes. This arrangement proved adequate in pre-war times, when only very serious accidents were investigated, but after the war it is submitted that the permanent appointment of suitable and salaried persons will be necessary. Their duty should be to investigate accidents which happen in their respective jurisdictions, and to report to some central authority, such as the Research Association. These investigators could be stationed at chosen aerodromes, and it seems probable that the widening of the field of investigation before referred to, and an increasing volume of aerial traffic would have the effect of keeping them occupied.

It is suggested that the investigators at main aerodromes should have a certain number of the subsidiary grounds in their neighbourhood placed within their jurisdiction. At these smaller grounds the expert investigator from the main aerodrome could, from among the staff available, appoint someone to represent him in the case of an accident, and to make any preliminary investigation that might be necessary before he (the expert investigator) arrived. In this way, with permanent investigators on the principal aerodromes, and with these men appointing representatives on intermediate grounds, a system of investigation might be built up.

It will be necessary to obtain the co-operation of aviators and to represent to them the value of accident investigation. This co-operation should take the form of reports by flyers not only as to mishaps, but also as to other unusual experiences due to meteorological or other causes.

IV.

THE NECESSITY FOR AN EXPERT EXAMINATION AND CLASSIFICATION OF THE DATA OBTAINED.

In the pre-war system the Accidents' Committee of the Royal Aero Club and the Aeronautical Society, after considering a fatality and agreeing as to its view of what had occurred, issued a report. In this report, as occasion demanded, the Committee drew the attention of designers, constructors, flyers, and others to any feature of the report which seemed of importance for the purpose of preventing the recurrence of an accident from any cause established by the report.

After the war, however, when small mishaps as well as large become matters for investigation, there should be a volume of material with which to deal which should be sufficiently large to justify the establishment of a bureau, with a permanent office and staff, for the purpose of dealing with accident reports. The officials of this bureau could classify reports, at first roughly and then in greater detail, and accumulate by degrees prepared data which should, when examined finally and reported on, throw a valuable light on the question of accident prevention.

As to the institution of such a bureau, it would seem that much may be expected from the proposed formation by the aeronautical industry of a Research Association, which it is hoped will be aided by financial grants from the Department of Scientific and Industrial Research, to amplify sums obtained from the industry. To the research work of this Association might, it is submitted, be added the work of a permanent bureau for the examination and

classification of the reports which would be obtained from accident investigators. The bureau would have to be in free and constant touch with the industry it served (not forgetting, of course, that it would also be serving the public), and the industry as a whole would be benefited very greatly and the safety of flying increased, if there were proper access, for well-recognised persons and firms, to information in regard to accidents.

In the investigation of small accidents and mishaps, which would probably form the bulk of the work of the bureau, each case would, no doubt, be classified under some special heading, without an individual report being issued concerning it, and when there was a sufficient number of cases from which to draw definite conclusions, the director of the bureau would issue a memorandum. This would be made accessible to those engaged in the industry, and probably also to the technical and general Press.

V.

THE USE TO WHICH THE RESULTS OF EXPERT EXAMINATION CAN BE PUT.

It is necessary to consider what use may be made of accident reports after they have been examined and classified, and are presented in the form of summaries and statistics.

In the case of engines, it is hoped that it may be possible to discover, from an examination and classification of accidents, just what parts of any particular engine or engines are proved to be most likely to give trouble under certain given circumstances.

With designers and constructors, also, it should be possible—after a sufficient amount of accident data had been classified—to point out to them, so far as some particular machine was concerned, that a weakness lay here or there, or that the testimony of pilots was that certain small improvements were necessary to facilitate control.

It will be desirable, during the immediate post-war development of commercial flying, to secure close co-operation between the makers of aircraft and of engines and the users of such apparatus.

Apart from accidents due, say, to engine stoppage, there will be others no doubt caused by errors of judgment on the part of aviators. In such cases, when sufficient data have been obtained from which to draw conclusions the accidents bureau would probably report to that branch of the Research Association which is considering the training of flyers, and suggest improvements or modifications in tuition. It is assumed that after the war adequate tests will be enforced before a flyer is given a certificate of proficiency, and particularly that he should have had sufficient experience to enable him to cope successfully with any predicament which is likely to arise in cross-country flying, as distinct from aerodrome flying.

One respect in which the Accidents' Bureau can help in the general work of research will be in placing before the meteorological department of the Research Association all data it may be able to obtain as to the part played in any particular accident by the atmospheric conditions prevailing at the time.

Looking into the future, one sees that four factors, in addition to a scheme of accident investigation, are of importance. These are:—

1. An increase in the number of alighting grounds.
2. The elimination of engine failure.
3. The careful training of flyers.
4. The forecasting of the weather for as long a period as possible ahead, and some system of distributing these forecasts rapidly to aerodromes throughout the country; also warnings of approaching weather changes of any importance.

With all these, the investigation of accidents is either directly or indirectly connected.

ANNEX.

Summary of the Work, Prior to the War, of the Public Safety and Accidents Investigation Committee of the Royal Aero Club and Aeronautical Society.

In 1912 the Royal Aero Club, jointly with the Aeronautical Society, appointed a Special Committee known as the Public Safety and Accidents Investigation Committee, to obtain reports as to aeroplane accidents, and to endeavour to discover the causes of such accidents, and to express an opinion, whenever possible, as to how they might be avoided in future. Official representatives were appointed on the principal aerodromes, whose duty it was, should an accident occur, to gain all information possible concerning it, to examine the wrecked machine, and to bring before the Committee all the information which could be secured.

Between 1912 and 1914—when the outbreak of war interrupted the work of the Committee—twenty-six fatalities had been investigated.

The main causes of accidents before the war, as shown by an examination of the Committee's reports, were:—

1. Errors of judgment on the part of a flyer.
2. The structural breakage of some part of an aeroplane while in flight.

Nine of the twenty-six fatalities were due to errors of judgment.

In two cases accidents were shown to be due to a pilot attempting a flight in a machine which was out of adjustment, with the result that it side-slipped while turning.

In two others, pilots dived their machines so suddenly and steeply that they were jerked forward on to their controls, accentuating the descent to such a degree that they fell from their machines while in the air.

In two more cases, the accident was caused by a machine nose-diving, while gliding, through the pilot allowing it to lose flying speed.

The remaining three cases may be summarised as follows:—

- (i) A pilot was making a series of spectacular evolutions, low down over an aerodrome, when his machine side-slipped.
- (ii) A pilot over-banked while turning at a low altitude, and this was followed by a nose-dive.
- (iii) A pilot dived steeply, then flattened out too suddenly, fracturing a wing.

Of accidents due primarily to engine failure, or engine trouble, the Committee investigated three—though it should be noted that, in each case, and subsequent to the trouble with his engine, the flyer was guilty of some error of judgment. These cases are summarised herewith:—

- (i) A pilot's engine was observed to stop when he was at an altitude of about 200 feet. Shortly afterwards the machine nose-dived. In the Committee's opinion, the accident was due to the aviator failing to appreciate the danger of keeping his craft in a horizontal position after the engine had stopped, thereby losing flying speed.
- (ii) A pilot, finding his engine running badly after leaving an aerodrome, turned in the air in order to fly back to his starting point; but in making the turn he lost speed and altitude to a dangerous extent, and while passing low near a belt of trees, which may have set up disturbed air in the neighbourhood of his machine, the craft was seen to dive.
- (iii) A pilot attempted a flight with an engine that was not working properly, with the result that the machine gradually lost altitude until it fell into a river.

Eight of the twenty-six accidents investigated were shown to be due to the breakage of some part of a machine. These may be summarised as follows:—

- (i) A quick-release device of a wing-cable opened and the cable came adrift, flapping up and piercing the fabric of a wing, which then burst and allowed the machine to fall.
- (ii) An aircraft collapsed in flight through the breakage of the wires supporting a wing, following upon some derangement of the cabane, this derangement being due either to a portion of the revolving engine fouling the engine cowl, or by a partial failure or breakage of the propeller, which threw the rotating system out of

balance, and set up stresses which caused the engine to shift.

- (iii) The wings of an aircraft collapsed while the machine was flying in an extremely high wind.
- (iv) An elevating plane broke and allowed a machine to dive so steeply that the main planes collapsed.
- (v) A wing broke as the result of a faulty repair to a main-spar.
- (vi) A wing failed, owing to want of sufficient strength to withstand the stresses produced either by a violent wind or sudden warping.
- (vii) An aircraft collapsed while in flight owing to inherent structural weakness.
- (viii) A rudder became detached from a machine in flight owing (in the opinion of the Committee) to its being insufficiently strong to resist a sudden and abnormal strain, and owing also to the fact that it had probably been strained in a previous flight.

In connection with accidents due to structural weakness, the Committee made two recommendations. One was that, as aircraft are built of perishable materials, all machines which have been in existence for some time should undergo a critical examination, both as regards framework and fabric.

The second recommendation was that all repairs to a machine must be carried out under expert and responsible supervision. As to the remaining six accidents, making up the total of twenty-six, their causes are summarised below:—

- (i) The pilot of an experimental machine lost control in a gusty wind.
- (ii) A pilot ascended while in an unfit state of health, and apparently lost consciousness while his machine was gliding.
- (iii) A pilot lost control through his foot slipping on the rudder-bar.
- (iv) A pilot who was giving a public demonstration on an aerodrome of insufficient size turned sharply to avoid endangering spectators, with the result that his machine side-slipped from a low altitude.
- (v) A pupil, flying with an instructor in a dual-control machine, appeared to resist for some unknown reason the ruddering action of the latter, with the result that the machine became uncontrollable.
- (vi) A pilot who was landing, and whose view was obstructed to some extent by his radiator, ran into some people who had encroached on the flying ground, with the result that one person was killed and several injured.

The Committee found it necessary, in its endeavour to determine the causes of accidents, to request local authorities, in cases where aircraft fell in open country, to prevent the wreckage of the machine being moved until it had been examined by experts, and this will assuredly have to be carried out after the war.

FINAL NOTE.

Looking at pre-war accidents in the light of conditions such as will exist, probably, when peace comes, one very appreciable element of risk, that of structural collapse, should be eliminated almost entirely.

This being so, we find that what we shall have left, as a main risk of accident, will be engine failure, followed perhaps by an error of judgment on the part of the flyer. To lessen this risk we must, of course, perfect our aero-engines, and eliminate by degrees those small causes of stoppage, or of trouble, which (insignificant in themselves) may lead none the less to a serious accident.

It should be noted again that, when an aviator who encounters engine trouble has a chain of alighting grounds along his flying route, he will be far less likely to find himself in a critical position; also that, when we have the comparative leisure of peace in which to train flyers more carefully, and also more scientifically, they should be less likely to be guilty of errors of judgment.

B. C. HUCKS, Captain, R.F.C.
HARRY HARPER.

December, 1917.

