

**THE AIRPLANE: A  
PRACTICAL DISCUSSION  
OF THE PRINCIPLES  
OF AIRPLANE FLIGHT**

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The Airplane: A Practical Discussion of the Principles of Airplane Flight by Frederick Bedell

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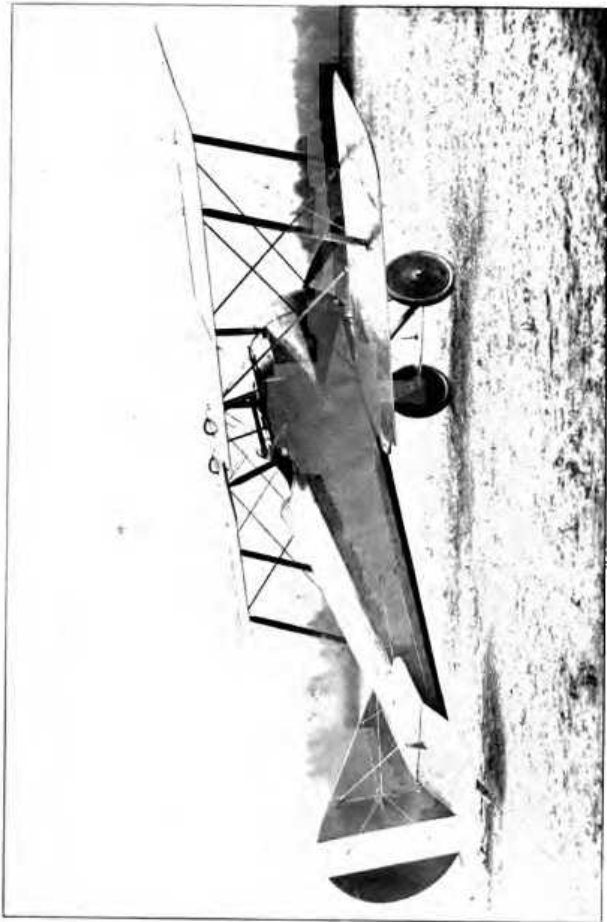
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THOMAS-MORSE SCOUT

# THE AIRPLANE

A practical discussion of the  
principles of airplane flight

BY

FREDERICK BEDELL, PH.D.

*Author of Airplane Characteristics, The Air Propeller, etc.*

Member Aero Club of America, Fellow and member Technical Advisory Committee Aerial League of America, Pioneer Member Aeronautical Society of America, Honorary Member Aero Club of Ithaca, Honorary Member Cornell Flying Club, Member and Past Vice-President American Institute of Electrical Engineers, Fellow American Physical Society, etc.

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## PREFACE

The material that forms six of the thirteen chapters of this book, previously published by the author under the titles *Airplane Characteristics* (1918, two issues) and *The Air Propeller* (1919), has been thoroughly revised and in part rewritten. The material for the seven other chapters now appears for the first time and completes the plan of the author to present a well-rounded treatment of the airplane covering the general principles of airplane flight in a manner that is simple and at the same time reasonably complete and accurate.

The author has benefitted by the kindly criticisms of the two preceding works and has been spurred on in his attempt to meet the needs of flyer and designer on the one hand and of the general reader on the other. The interest taken in the work by ex-service men and members of the aeronautic profession, as well as by those whose point of view is scientific or educational rather than practical, leads the author to hope that the book may find a useful field.

The aims of the author are stated in the prefaces to *Airplane Characteristics* and *The Air Propeller*. These prefaces are here reproduced as they apply to the present as well as to the earlier publications.

The author desires to express his indebtedness to his students, many of them returned from service, for aid in preparing the book for press and to his friends in the Thomas-Morse Aircraft Corporation for valuable suggestions and for looking over some of the proof.

Cornell University,

June, 1920.



## PREFACE TO AIRPLANE CHARACTERISTICS

Any contribution to aviation, however small, needs today no justification. The airplane is an accomplished fact and concerning it there is no longer any room for apology or speculation. So far has the art of flying progressed that the principles of flight can in the main be set forth as definite and without surmise, and a collection of the essential elements can now be made that will apply to all airplanes, irrespective of type or structure. Not that there is nothing further to be learned or discovered in aviation—for, far from it, there is ample opportunity for discovery and invention in this direction—but a codification of the well-known ground work can now be made that may be an aid to those who are advancing the art, as well as to those who are learning it.

The introductory discussion in this volume is a contribution to such a codification, which, it is hoped, will prove useful not only to the flyer and designer, for whom the book is primarily intended, but to students and engineers and to others who have only a general interest in aviation. Indeed, so important is the place now taken by the airplane that there are many who desire a knowledge of the principles of its operation.

It is the author's purpose to present the principles of airplane sustentation and stability and the characteristics of an airplane in flight in a way that is direct and simple and at the same time reasonably precise, laying particular stress on that which is vital. Except in minor ways, no claim is made for originality other than in presentation; in fact, the aim has been to include only those things that are essential and are accordingly well known to those versed in the subject. To those not thus well versed, the characteristics of an airplane

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are, however, not so well known as they should be; discussion of the subject is apt to be either superficial and inadequate or involved and complicated. The author has endeavored to give a treatment that is adequate but simple, and without the use of higher mathematics.

Logical sequence, rather than historical development has been kept in mind and no attempt has been made to ascribe particular features to their inventor or author. Military uses of the airplane, as well as its history, are left to others who may more appropriately discuss such phases of the subject. The author has confined his attention to the principles of airplane flight and has given no discussion of materials of construction—very important, of course, in airplane building—nor of the gas engine, on which there are many specialized treatises.

The author had occasion, as a member of a commission for planning the courses in our SCHOOLS OF MILITARY AERONAUTICS, to study carefully the needs of such courses. He has had occasion, also, to conduct several classes in aerodynamics and the principles of flight, made up not only of those with a direct practical interest in flight, as future pilots and designers, but likewise of others with an indirect interest—students in civil and mechanical engineering and physics—who have been interested in the airplane as in any of the mechanisms of our present day civilization. He has noted particularly those parts of the subject that have proved vital and of interest to all,—no matter from what angle the subject is approached.

It is planned that the book—with the added chapters now in preparation—shall be self-contained and complete in its own field, i. e., as an introduction; final practical instruction for flyer or designer must needs be obtained at the flying

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field or in the designing room. The author has had flying experience only as passenger and would make no attempt at specific flying instruction.

In view of the present emergency, it is thought best to issue the material contained in this first edition without delay, and to reserve for subsequent publication the material now in preparation (referred to in the Table of Contents) that is needed to complete the work. The author will be glad to have his attention called to any error or obscurity in this presentation and will particularly appreciate constructive suggestions from those practically engaged in airplane operation or development.

ITHACA, N. Y.,  
July 30, 1918.

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#### PREFACE TO SECOND ISSUE OF FIRST EDITION

So close upon the heels of the first issue is this second issue that no general revision has been possible. Some corrections and additions are given on the following page. The author thanks those readers who have called his attention to errors and repeats his request for suggestions.