PREFACE

Rapid advances made during the past decade on problems associated with high speed flight have brought into ever sharper focus the need for a comprehensive and competent treatment of the fundamental aspects of the aerodynamic and propulsion problems of high speed flight, together with a survey of those aspects of the underlying basic sciences cognate to such problems. The need for a treatment of this type has been long felt in research institutions, universities, and private industry and its potential reflected importance in the advanced training of nascent aeronautical scientists has also been an important motivation in this undertaking.

The entire program is the cumulative work of over one hundred scientists and engineers, representing many different branches of engineering and fields of science both in this country and abroad.

The work consists of twelve volumes treating in sequence elements of the properties of gases, liquids, and solids; combustion processes and chemical kinetics; fundamentals of gas dynamics; viscous phenomena; turbulence; heat transfer; theoretical methods in high speed aerodynamics; applications to wings, bodies and complete aircraft; nonsteady aerodynamics; principles of physical measurements; experimental methods in high speed aerodynamics and combustion; aerodynamic problems of turbo machines; the combination of aerodynamic and combustion principles in combustor design; and finally, problems of complete power plants. The intent has been to emphasize the fundamental aspects of jet propulsion and high speed aerodynamics, to develop the theoretical tools for attack on these problems, and to seek to highlight the directions in which research may be potentially most fruitful.

Preliminary discussions, which ultimately led to the foundation of the present program, were held in 1947 and 1948 and, in large measure, by virtue of the enthusiasm, inspiration, and encouragement of Dr. Theodore von Kármán and later the invaluable assistance of Dr. Hugh L. Dryden and Dean Hugh Taylor as members of the Editorial Board, these discussions ultimately saw their fruition in the formal establishment of the Aeronautics Publication Program at Princeton University in the fall of 1949.

The contributing authors and, in particular, the volume editors, have sacrificed generously of their spare time under present-day emergency conditions where continuing demands on their energies have been great. The program is also indebted to the work of Dr. Martin Summerfield who guided the planning work as General Editor from 1949–1952. The cooperation and assistance of the personnel of Princeton University Press

and of the staff of this office has been noteworthy. In particular, Mr. H. S. Bailey, Jr., the Director of the Press, and Mr. R. S. Snedeker, who has supervised the project at the Press have been of great help. The figures were prepared by Mr. Zane Anderson. Special mention is also due Mrs. E. W. Wetterau of this office who has handled the bulk of the detailed editorial work for the program.

Coleman duP. Donaldson
General Editor

PREFACE TO VOLUME X

This volume deals with the problems of the flows in gas turbines and compressors. Such flows are complex, and there is an obvious difficulty in any attempt to describe comprehensively the flow in say, a compressor or a turbine in an exact and rigorous fashion. The choice of topics for the Sections and each author's treatment of any one topic reflect this difficulty. Originally, the application of aerodynamic theory to flow through axial compressors and turbines followed the blade element theory of propellers. Sections B, E, G and K which discuss sub- and supersonic flow and unsteady flow in cascades develop this approach. The next step, that of describing the three-dimensional aspects of the flow, is exemplified in the ideal flow theory developed in Section C. In Sections F and H the attempt is made to describe more completely the flow in axial compressor and turbine stages. With each step towards the final goal the approximations required increase and the unsatisfactory gaps in exact knowledge become more obvious.

The vast effort which has been expended in experimental research, development and testing has warranted the presentation of an account of experimental techniques, Section D. The radial flow turbine and the centrifugal compressor are briefly described in Sections I and J.

As in one or two other volumes in the Series the dates of completion or final revision of the articles have stretched over a period of years. Two manuscripts (Sections K and J) were completed in 1951 and 1952. Sections B, G, I, E and C were completed in their final form between 1956 and 1958, and the remaining three (H, D and F) were finished in 1960. It is regrettable that the publication of the earlier manuscripts has been subject to such vexatious delays. However, although some recent work has inevitably not been included, it is hoped that some of the timeless quality which the authors have aimed at has been achieved.

My sincere thanks go to all the authors for their patience and hard work, to Dr. Coleman duP. Donaldson for his assistance and his friendly but firm pressure, and to the Princeton University Press for their careful work.

W. R. Hawthorne
Volume Editor