

REVIEWS

Aerodynamik der Schaufelgitter. Band 1. By N. SCHOLZ. G. Braun, 1965.
547 pp. DM 142.

This book deals with the aerodynamic problems which arise in connexion with flows through cascades of aerofoils. A knowledge of these flows is needed in the design of all kinds of turbomachines: in brief, all machines for generating or transmitting power in which the motion of fluids or gases provides the essential mechanism for producing forces.

The engineering design of the various flow machines has different and sometimes ancient roots and traditions, and until fairly recently it has developed along different and independent lines, mostly dominated by the concepts of hydraulics. Developments in aviation have, in two ways and by a gradual infiltration of aerodynamic concepts, brought about a transformation of turbomachine design which is nothing short of a revolution. On the one hand, a good deal of knowledge has been accumulated which is immediately applicable to turbomachines; on the other hand, the stringent requirements for very high performances, especially in aircraft engines such as turbojets, have made the intensive utilization of this knowledge a vital need—traditional hydraulics simply were not good enough. This development led to the more specific work on cascade flows and, while the first book touching on the subject (by F. Weinig) appeared 30 years ago, the first systematic cascade experiments on an extensive scale were carried out in England only during the Second World War. After that, H. Schlichting among others devoted a great deal of research effort in his Brunswick institute to this subject, and the present book by one of his former collaborators is the outcome of this work carried out over the last 20 years. It may be said, therefore, that this book and its subject are in the nature of technical 'fall-out' from aviation, and the book bears this stamp in more than one respect.

A characteristic problem in obtaining effective utilization of fall-out products is to overcome a certain lack of receptivity and a good deal of conservative resistance to innovation among prospective users. Realizing this, the author has intentionally gone to great lengths to make his information palatable and easily digestible for his intended readers. A few examples may illustrate this point.

The first chapter, giving the required fundamentals, not for their own sake but for later reference, includes in a short section on the dynamics of inviscid flows no less than five extensive tables: the equations of motion in three different systems of coordinates; expressions for the velocity vector, its curl, and its divergence, in terms of the velocity potential and of the stream function, again in different systems of co-ordinates; induced velocity components according to Biot-Savart's law in various forms; and the theorems for the conservation of mass, momentum, and energy in three co-ordinate systems. A section on gas-dynamics includes a table with expressions and some numerical values for ten different combinations of the ratio of specific heats and the gas constant, as they occur in equations for various physical quantities; a table giving universal relations between various physical quantities; another with the same relations

in their linearized forms; a table listing six different ways of writing Bernoulli's equation; and extensive numerical tables of functions frequently occurring in gasdynamics. A section on boundary layers includes a detailed scheme for calculating the three characteristic boundary-layer thicknesses in twenty-one steps. And a brief section on similarity laws includes a table summarizing the definitions and physical meanings of the main similarity parameters. This practice is continued throughout the whole book and tables are presented even of various calculation methods listing their particular features and ranges of applicability.

Apart from making his information readily digestible, the author has seen the special need for following right through to the application of the results obtained and of the methods presented in actual engineering design. Not only are the more theoretical aspects of the subject matter presented in a mathematical form which should be well within the grasp of engineers, but the presentation is systematically of a kind which is meant to inspire confidence in the applicability and relevance of the matter to practical problems. Above all, the work involved in various applications is facilitated by the inclusion of numerous tables, numerical schemes, calculated examples and working charts on a scale large enough for immediate use. This purpose is pursued with remarkable singlemindedness and the result is an impressively consistent and closely knit framework. If a demonstration is wanted of how fundamental research and general work in a wide field can be filtered and focused on some particular technology, this book provides an excellent example.

After the first introductory chapter on the fundamentals of thermodynamics and fluid dynamics and another on various turbomachines in general, the remaining seven chapters deal with all the theoretical aspects of the flow through cascades, in an ascending order of complexity. The treatment may fairly be called exhaustive and up-to-date. As this is the first of two volumes, it deals mainly with the theory of two-dimensional flows; experimental methods and results as well as three-dimensional flows will be dealt with in the second volume.

A definite school of thought and certain preferences are discernible, but this is to some extent unavoidably linked to the general tenor of the book. Similarly, a certain optimism prevails, and it may turn out that the author is occasionally rather too successful in inspiring confidence in the methods presented.

The author regards this book as a monograph, a handbook, and a textbook, all in one. The reviewer can largely confirm this, and if he has any reservations, they concern its usefulness as a textbook. He would at least suggest that a student might profitably supplement his reading by turning his attention to another book in the same important series, *Introduction to the Theory of Flow Machines*, by A. Betz, an English translation of which is about to be published by Pergamon Press. There he will find an original and illuminating account of the underlying physical principles and phenomena. Nevertheless, the book under review is a monumental effort of impressive merits and extraordinary usefulness. It leaves the reviewer very pleased to see yet another demonstration of how fundamental research work tends to lead to a useful application; and also rather disturbed to see how much there is to know even in a single field.

D. KÜCHEMANN