

REVIEW

Flow Visualization. By WOLFGANG MERZKIRCH. Academic Press, 1974. 250 pp. £12.50.

The term visualization is used to describe a wide variety of experimental techniques in fluid mechanics, covering the optical techniques of compressible flow, which do not in any way interfere with the flow, techniques which rely on the introduction of foreign tracer materials into the flow, and those methods which serve to visualize not so much the flow itself as the effects it has on various types of surface coating. The techniques are used not only to obtain flow pictures but also in most cases to give quantitative information about the details of the flow.

The proper use of visualization techniques requires very considerable skill and is a craft which cannot be learned from textbooks. The most a text can hope to give is a factual description of the procedure and evaluation technique pointing out the main sources of error, and even so the worker will often have to refer back to the original papers or laboratory reports for the details or rely on practical experience already available in his laboratory.

A thorough understanding of the principles and limitations is not only necessary for the experimenter, but also for the generally much larger number of workers who will want to interpret his results. Examples of misunderstanding and misinterpretation of flow pictures are not uncommon.

Details of visualization techniques are often buried in papers or reports whose titles give no clue that they contain such information, and a text by an author who has taken the trouble to search out the relevant sources is therefore most valuable. Very few books, if any, have appeared devoted entirely to visualization but Merzkirch makes it obvious that the subject is now more than large enough to fill a volume on its own.

The optical methods which detect the changes of the refractive index of a gas with density (or composition) changes occupy more than half of the book. The basic principles of these methods were known a century ago and their applications were developed to a high degree of perfection after the war during the period of rapid advance of supersonic wind tunnels and shock tubes. The book describes the state of the art at that time, thus covering much material which can be found in earlier texts. Its great value is that it brings the subject up to date and discusses in considerable detail the many advances which have been made since then, in particular in the field of holography and indirectly owing to the advent of lasers (e.g. laser-Doppler techniques). The difficulties in interpretation of two-dimensional pictures of essentially three-dimensional flows are here as elsewhere clearly stated. The discussion is confined almost entirely to the study of gas flows and one could have wished for more attention being paid to the very considerable advances that have been made in recent years in the use of these methods for the study of flows of density-stratified liquids.

The section on the addition of foreign material into gas and liquid flows

describes the classical smoke and dye techniques and clearly emphasizes the important differences between streamlines, filament lines and particle paths, differences which have often caused confusion in the interpretation of flow pictures. The subject is brought up-to-date by a description of the more recent electrolytic techniques using hydrogen bubbles and electrolytic and photo-chemical dyes.

A short section discusses the methods which are described as flow-field-marking by heat and energy addition and include artificially introduced density changes by means of sparks, velocity marking by spark tracer techniques, electron-beam flow visualization, and glow discharge and chemiluminescence.

Special techniques discussed are streaming double refraction, and, somewhat outside the general scope of the book, there is a brief discussion of the hydraulic analogy. One or two boundary-layer visualization techniques are included.

The book concludes with a short section on high-speed photography.

Throughout, the text is clear and authoritative and lavishly illustrated and appears to me to give an admirable coverage of the subject right up to the present date. There is an extensive list of references, more than two-thirds of which have appeared in the last 10 years.

All in all the book, which is beautifully produced, can be recommended not only to experimentalists but also to the much wider public which finds pleasure and enlightenment in looking at flow pictures.

N. H. JOHANNESSEN