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BOOK REVIEWS

Optical Metrology for Fluids, Combustion and Solids. Edited by Carolyn Mercer. Kluwer, 2003. 460 pp. ISBN 1 4020 7407 7. €199 or £125 or $219 (hardback).
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This collection of articles on measurement techniques for fluids and solids is a very useful and timely reference on the latest developments for the researcher or professional in the aerospace field. The chapters cover a range of techniques, from simple line-of-sight, semi-quantitative schlieren techniques to the latest laser surface interferometric techniques.

The chapters provide both an introduction to and review of the history of each technique, as well as a brief introduction to the technique, and an example of its application. Comparisons of different implementations of each method and/or data processing techniques are also discussed in most chapters.

The four articles on fluid flow provide a very nice introduction to two ‘workhorses’ in fluid mechanics: schlieren and DPIV. The DPIV chapter is particularly well written and discussed, with copious references to the literature.

The combustion section is somewhat biased towards sprays and particle measurements, but it is still a very useful reference, particularly on the very recent developments in the use and calibration of laser induced incandescence. The chapter on fluorescence and elastic scattering is relatively limited in its scope, focusing on experiments on a single high pressure facility investigating the distribution of fuel and OH. There is of course a very wide literature on the subject, ranging in applications from ambient pressure flames to unsteady engine combustion, but the focus is firmly on applications to gas turbines. The TDLAS chapter offers a very short introduction, and a variation on material that has appeared in other compilations, but is still useful as a quick reference.

The chapter on surface optical measurements is somewhat uneven. The article on pyrometry, although in principle useful, has lacked editorial care, and the equations are unreadable; presumably this will be fixed in any future editions. The same lack of care also appears in the index. On the other hand, the article on the practical use of luminescent paints and data processing techniques for the interpretation of results is quite useful, with many good examples.

A CD is included with animations of the results of some of the techniques. Some of the videos are of dubious value, however, in one case showing a diffusion flame being approached by a physical probe, and in another images of a flying eagle.

In spite of these small caveats, the book is a very useful and timely reference, coupled with a very extensive set of references for each topic.

Simone Hochgreb

A Gallery of Fluid Motion. Edited By M. Samimy, K. S. Breuer, L. G. Leal & P. H. Steen. Cambridge University Press, 2004. 119 pp. ISBN 0521 82773 6, £65.00 (hardback) or ISBN 0521 53500 X, £19.99 (paperback).
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Whilst now I know that my early perception that all fluid dynamicists have blue eyes is wrong, I should not be surprised to discover that a large majority do share an appreciation of (if not excitement in) the singular beauty of the wonderful patterns produced or induced by, or derived from, fluid motions. Such patterns are familiar at home and outdoors, instilling an appreciation of pattern and form, of movement, light and colour from the earliest days of childhood. They are manifest in splashes in the bathtub, the wonderfully smooth and elegant tube of water falling from a tap into a sink or a column of treacle writhing as it meets the surface of a bowl of porridge, the transparent ribbons formed by raindrops running down a window pane, the curling and breaking of waves on a sandy beach and the ripples left in the sand once the tide has fallen, or the magnificence of towering cumulus clouds, and (perhaps later in life) the dispersion of cream in a coffee cup or the rise of bubbles and the formation of foam in a glass of beer. Does the enjoyment and wonder in such images still draw young scholars to the study of fluid dynamics? If so, this book may help to encourage more of them into this field of science.

The *An Album of Fluid Motion* by Milton Van Dyke, published in black and white in 1982 was, I think, the first collection of photographs illustrating and celebrating a broad range of flow phenomena, although many photographs had been published in scientific papers during the preceding hundred years, and there are other specialist collections that illustrate particular aspects of fluid motion, for example of clouds or waves. Inspired by Van Dyke's book, the Division of Fluid Dynamics of the American Physical Society (APS) has, at all its annual meetings since 1983, sponsored a competition for visual images of fluids in motion, the best being judged on the basis of two criteria: artistic beauty and novelty, and the contribution to improved understanding of fluid motion. Since 1986, the winning entries have been published in the journal, *Physics of Fluids*. The present book, *A Gallery of Fluid Motion*, is a selection of 104 of these published and entered in the competitions between 1985 and 2002. Most include several images. The majority, about 60%, are in colour. Each entry is presented on a single page and is accompanied by the (often highly technical) descriptions provided with the original entry, and these, together with the space taken up by rather large titles, the authors' names and affiliations, and by keywords, occupy some 40% of each page. Nine of the entries are numerical simulations, one is of a natural phenomenon (the eddies in the tidal Naruto Strait, Japan), and the remainder are photographs taken in laboratory or controlled conditions. About 75% are from US-based scientists. The images cannot be regarded as entirely representative of the international or broad field of fluid mechanics; few, if any, are 'Geophysical Fluid Dynamics' or 'Biological Fluid Dynamics' in context. But this does not detract from the enjoyment that all interested in fluids will gain from this collection.

Many of the images are of great beauty, some startling in their magnificence. The majority of photographs are of high quality, sharp and distinct, demonstrating the care, skill, ingenuity and originality of the investigators. Flow features are illustrated that can only be seen by use of novel or specialist techniques involving, for example, fluorescent dyes, nematic or thermochromic liquid crystals, Mie scattering, colour schlieren, or pulsed ruby laser illumination, together with imaging using high-speed photography, sometimes with microscopic resolution. Techniques have developed or changed since the 1980s. So have the subjects of interest. Like Van Dyke, the editors select eleven subject areas. Van Dyke chose: 'creeping flow', 'laminar flow', 'separation', 'vortices', 'instability', 'turbulence,' 'free-surface flow', 'natural convection', 'subsonic flow', 'shock waves' and 'supersonic flow'. The present editors use the headings: 'jets and mixing layers', 'vortices', 'patterns' (a variety of images which, although very pretty, might have better been included below other of the selected headings), 'drops and bubbles', 'complex fluids' (mostly related to solid particles), 'flows with interfaces' (notably the collision of two jets and the motion of interfaces in Hele-Shaw cells), 'free surface interaction' (including the impact of drops and disturbed jets on a water surface), 'combustion', 'instability', 'transition and turbulence' and 'compressible flows'. The low-Reynolds-number phenomena have less prominence than in Van Dyke's *Album* (but are still featured), but there are images of novel subjects, for example granular motion, freezing or solidification effects, flows in soap films, and polymers. Effects of micro-gravity can now be studied and are illustrated in two entries. In some cases the use of colour provides far more information and better contrast than black and white, as well as contributing to the enjoyment and artistic quality of the images.

The editors express the hope that the *Gallery* will be of interest to both the research specialist and the general public. Specialists may encounter useful and novel techniques and the images may well stimulate new ideas, although only one or two may be within a specialist's immediate field. Few of the 'general public' will find many of the captions helpful or even comprehensible (and some will be incomprehensible to relative experts), and many may wonder about the reason why the studies relating to the images were made or how they may be 'useful'; rarely is the purpose explained. The editors could have been bolder. They might have replaced the original entry texts with brief explanations of each illustration, giving only one or two references for specialists to follow up, perhaps (with permission) reducing the number of images provided by each contributor and enlarging them to make the intricate details (wherein often lies the fascination of the images) more apparent. On average the images are only about a third of the size of those in Van Dyke's *Album*, and some readers will find many too small to be fully appreciated without the aid of a magnifying glass. But, overall, the book is a fine collection of images of fluids in motion.

In choosing the word 'Gallery' in the title of the book, the editors implicitly acknowledge the visualizations and images of fluid motion presented in their collection as an art form. Flow visualization goes back a long way. Newton knew that the orbits of particles under surface waves in deep water are circles (presumably through watching the motion of small particles, but exactly how appears not to be known). Leonardo de Vinci's wonderful sketches provide an obvious early link between fluid dynamics and art. Although Lev Landau once said, "The world of science and the world of art are not in any way connected for me", I cannot believe that anyone can refute the claim that some of the images obtained in the course of scientific investigations are truly artistic, if not deliberately created within the (vague) boundaries of a 'true art form', and may, in the future, stand as an art form in their own right. Already they may serve to inspire artistic forms in other media.

This raises an important issue. In 1982, Van Dyke described his difficulty in obtaining original prints of some photographs; several classics, including Prandtl's, had been lost. The state of 'conservation' or safe custody seems to be no better now. The authors of the *Gallery* were surprised to find that only since 2000 have the publishers of *Physics of Fluids* maintained an archive (which is now electronic) and, in common with other journal publishers including the publishers of JFM, Cambridge University Press, they have no original copies of earlier photographs other than those in the published journals. In some cases the original photographs entered for the APS competition are no longer available, having been lost or destroyed. Now that negatives are becoming obsolete and electronic files most commonly provide the prime image source, perhaps the future archiving and care of photographs can be left to the publishers (a doubtful premise, given the insecure state of the industry). The older photographs raise issues that are in many respects similar to those relating to other works of art, paintings and sculpture, and identical to those of photographs, including both conservation and provenance, the latter becoming the more serious now that exact reproductions (even of paintings) can be made. Of course in principle, excluding cost and inconvenience, it should always be possible to reproduce a laboratory experiment described in a scientific paper – and descriptions should always have sufficient detail to verify and repeat laboratory experiments exactly – and so new photographs of flow phenomena could be obtained just as in an original study.

But then the photographs wouldn't be those taken by the original scientific investigator.

Is it not time to ensure that the best photographs of fluid-related phenomena and of fluid motion are preserved?

S. A. Thorpe