

Book Review

Turbulence in Fluids—Third Revised and Enlarged Edition

Marcel Lesieur, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1997, 515 pp., \$225.00

Turbulence continues to be probably the most important phenomenon in fluid mechanics and the least understood. The most important because it has a profound influence on the global distribution of heat, oxygen, carbon dioxide, and other substances and hence on life itself, as well as on the expenditure of energy by man and on most of his industrial processes. The least understood because, although we have a rough idea what is happening physically, we are usually (except in rare, artificial circumstances) at a loss to calculate with greater accuracy than, say, $\pm 50\%$.

The third edition of this interesting book has been considerably expanded (approximately 100 more pages than the second edition), and an effort has been made to make the book suitable as a text for graduate courses (which the author felt the second edition was not). There is a great deal of new material in this edition, too much to give more than a sampling here: transition, turbulent shear flows (coherent structures), rapid distortion theory, two-dimensional turbulence (baroclinic instability and cyclogenesis), backscatter, large eddy simulations (LES), and the effects of stratification, rotation, separation, and compressibility.

I complained mildly, in my review of the first edition, that this was clearly a European physicist's book, maybe even a French physicist's book. Not that that was necessarily a bad thing. I said this because of the emphasis in that edition on "spectral methods and homogeneous flows, both isotropic and two-dimensional/quasi-geostrophic, and from the coverage of three- and two-dimensional EDQNM (Eddy Damped Quasi-Normal Markovian), DIA (Direct Interaction Approximation), the Test Field Model and other stochastic models, and such subjects as predictability theory and internal intermittency, and the Craya decomposition." I pointed out that people who thought these were useless for the most part did not understand how difficult the turbulence problem really is and did not appreciate the necessity for deep study of really simplified situations. To a certain extent, the author has responded to this criticism in this edition because he does address shear flows, coherent structures, and the effects of stratification, rotation, separation, and compressibility.

I must say, however, that the book continues to have a deeply felt affection for the idea and the utility of

mathematical constructs. Of course, this is the pot calling the kettle black—I have been responsible myself (and in collaboration) for the publication of some of the most impenetrable mathematical thickets in print. Lesieur's mathematical constructs do contain a lot of physics, and their study can be rewarding for the insight they give into some of the mechanisms of turbulence. These approaches are certainly beloved of physicists, even American physicists, who feel that they are nearly the only quasirational approaches to turbulence that exist. They have the disadvantage, however, that they are sometimes more complicated than turbulence itself, that is, it is sometimes cheaper to do a direct numerical simulation (DNS) than it is to do a direct interaction approximation. In addition, these approaches are very complicated and put off all but the most determined students. Finally, they can deal with only a small range of situations and few of those of great practical importance. However, if I wanted my students to learn about these approaches, this is certainly where I would send them.

The book is leavened by lots of good physics and illustrated by figures from DNS and LES (generated by the author and by others). Lesieur is one of the world's best-known specialists in LES. The book also covers all of the usual relatively simple physical arguments that explain the behavior of various turbulence measurements.

In my review of the first edition, I complained that the price was about US\$0.24/page, whereas *Annual Review of Fluid Mechanics*, with a similar press run, is sold for US\$0.06/page. Now Lesieur's book has risen to US\$0.44/page (and *Annual Review* remains about the same), which I find even harder to understand. The manuscript is still delivered by the author in camera-ready form. This is certainly not the fault of the author, who has no control over this sort of thing. A publisher's representative told me that we (the scientific community) are subsidizing the humanists, who do not deliver their manuscripts in camera-ready form but handwritten and filled with arcane symbols in Aramaic and do not have support from government agencies in addition. I have no idea whether this is true, but it would explain a great deal.

John L. Lumley
Cornell University