J. Fluid Mech. (2004), *vol.* 516, *p.* 378. © 2004 Cambridge University Press
Printed in the United Kingdom

BOOK REVIEW

Renormalization Methods – A Guide for Beginners. By W. D. McComb. Oxford University Press, 2003. 330 pp. ISBN 019 856094 5. £39.95 (hardback).

J. Fluid Mech. (2004), *vol.* 516, DOI: 10.1017/S0022112004000631

This book has been developed from Professor McComb's lectures to MPhys/post graduates at Edinburgh. It spans a great deal of modern theoretical physics, linked by the word 'Renormalization'.

I first met this word when attending Nick Kemmer's lectures in the late 1940s, when news was filtering through from the US that quantum fluctuations, hitherto mysterious and ill-behaved, now mattered with the arrival of the (measurable) Lamb Shift, and could be handled by starting with a 'bare' electron and 'bare' change and, defining the real mass of the election as that bare value plus the contribution of the fluctuations, all calculations only involved this real mass. The bare mass and the fluctuation were infinite, but since only the real mass appeared in the final calculation one had finite values for experimental quantities. This had been proved by Dyson, and a large number of effects could be, and were, calculated, and experiments can check the theory to an astonishing extent.

Why was this called 'renormalization'? Back to normality? I don't know, but the word has spread over many areas of physics. The key point is that all real physical phenomena are nonlinear, and so to get an experimental prediction a naïve calculation may result in a divergent result, and one needs a way to find a finite answer in terms of the measurable physical constraints of the problem. The quantum field divergence comes from high momentum/short distance problems, and is simple, but there are problems where the bad behaviour comes from long distances/small velocities, and these really are difficult and are the principal problems addressed by the book. Sometimes it is easy, e.g. the screening of electrolytes resolved by Delye and Huckel, sometimes difficult but nevertheless possible as in the critical behaviour of phase changes, and sometimes difficult and still lacking comprehensive experimental data as in turbulence and therefore still contentious.

McComb tackles all of these problems, which is a courageous approach in a book of 330 pages, given that massive books are devoted alone to each of the areas above. I therefore must regard the book as one to whet the appetite of the graduate, to then go on to the monographs on special areas, for example McComb's own book (*The Physics of Fluid Turbulence*, Clarendon, 1990) and articles on turbulence.

Individual chapters are devoted to simple RG problems, mean fields, perturbation theories, noise-driven systems, turbulence theory, critical phenomena, the renormalization group in real space and momentum space, field theory, RG and classical nonlinearity. Exercises are given and the modern touch is that solutions are on the web!

The student will find some chapters tough going, particularly those on turbulence which remains to me the most interesting area of statistical physics, for it is still full of problems, whereas other areas of the book report on really successful completions. One can hope that this book will stimulate interest in bringing the theories of nonlinear dissipative systems up to the level of understanding of the familiar and largely solved problems of conservative statistical physics.

S. F. Edwards