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Book Review: *Scaling and Renormalization in Statistical Physics*

Scaling and Renormalization in Statistical Physics. John Cardy, Cambridge University Press, Cambridge, 1996.

In the past 25 years scaling concepts and renormalization group analysis have been applied to a remarkably wide range of topics in physics and chemistry. Many of these topics, such as percolation and turbulence, have no obvious connection to either quantum field theory or equilibrium critical phenomena. Unfortunately this wide field of application rarely finds its ways into courses and introductory texts on renormalization group methods. The reasons for the relative narrowness of these courses and texts are easy to understand. A course on the renormaliztion group and critical phenomena typically covers (at least in my experience) the thermodynamic limit, models and phenomenology of phase transitions, Landau theory, basic renormalization group concepts, real space renormalization groups (to insure a reasonable intuitive feel for the meaning of renormalization group transformations), and then finally the course gets to the systematic momentum space renormalization group methods. This last topic involves lengthy formalism, so that no time is left for applications of these systematic methods. Introductory texts usually suffer similar problems.

This book represents a serious effort to address the problems of narrow focus in an introductory text on the renormalization group and critical phenomena. Although I do not think that this effort is wholly successful, I do think that the statistical physics community owes the author, John Cardy, a debt of gratitude for writing this book. As well as providing a broader view of applications of the renormalization group, this book has several excellent qualities. The first half of the book covers the usual course material in chapters on phases transition basics, on mean field theory, on renormalization group concepts, on flows and fixed points, and on the epsilon expansion. The epsilon expansion is derived in an unusual way: by means of the operator product expansion. This method allows the author to derive the first order results (which is the highest order that the book

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uses) while using very little formalism. The operator product expansion is not derived, but plausibility arguments for its correctness are given. The second half of the book covers applications of the scaling and renormalization group ideas presented in the first half. The selection of applications is excellent. It includes low-dimensional systems, surface critical phenomena, random systems, polymers, critical dynamics, and conformal symmetry.

The reader of this review may be wondering if this book is enormously long. In fact, it has fewer that 250 pages and these pages are small. Partly the book is so short because of the remarkably elegant and concise presentation of many topics. Partly the book is so short because the writing is uncomfortably dense. This density is the book's major flaw. The presentation is well organized, often beautifully organized, but there are often "gaps" in the arguments where the reader must supply some non-trivial inference in order to get from one point to the next. Although each of these "gaps" can be filled by a reasonable graduate student, the presence of "gaps" on almost every page means that reading this book requires great effort, even for someone who knows the subject. I think that the required effort would ultimately frustrate most people who tried to use this book as their sole source of information on the renormalization group. In contrast, this book would be a superb choice to supplement a text that gave an explicit, detailed treatment of renormalization group fundamentals, such as Nigel Goldenfeld's *Lectures of Phase Transition and the Renormalization Group* (Addison-Wesley, 1992).

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