and meteorological issues. Although that early form of "large-scale, organized scientific research" in Russia led to the determination of deviations in gas behavior from Robert Boyle's, Edmé Mariotte's, and Joseph Gay-Lussac's laws, it failed at its most ambitious goal—the experimental identification of celestial ether.

Under the successors of Alexander II, Mendeleev rose through the imperial hierarchy to become a major consultant. Gordin carefully follows Mendeleev's many political and scientific engagements from the 1880s until his death in 1907. He proposed educational reforms and participated in a mission to Siberia (his childhood home) to survey iron production and forests.

Gordin also covers the scientist's protectionist economic thought, his political theory, his participation in a balloon ascent for scientific observation in 1887, and the substantial revisions of his chemical textbook, *Principles of Chemistry*, in 1889. Gordin's book concludes with scientific and political events that would put Mendeleev's achievements into question: the discoveries of the noble gases, radioactivity, and the electron, as well as Russia's political revolution in 1905.

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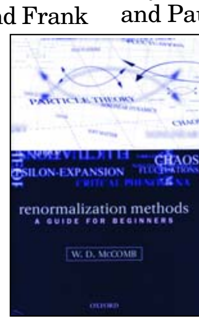
Renormalization Methods: A Guide for Beginners

W. D. McComb
Oxford U. Press, New York, 2004. $89.50 (330 pp.).
ISBN 0-19-850694-5

Renormalization originated in quantum field theory as a method of removing UV divergences in perturbation expansions. The subsequent development in the 1960s of the renormalization group introduced the novel concept of running couplings, which depend on the energy scale at which they are measured, and led to such groundbreaking discoveries as asymptotic freedom in quantum chromodynamics, for which David Gross, David Politzer, and Frank Wilczek received the Nobel Prize in Physics last year. Yet renormalization methods and the renormalization group probably have had an even more profound impact on condensed matter theory and statistical mechanics than on quantum field theory.



Aside from providing a mathematical framework from which to derive scaling laws and obtain nonclassical critical exponents near continuous phase transitions, in the past three decades, the renormalization group approach has provided a solid conceptual foundation for exploring such paradigmatic notions as universality, relevant degrees of freedom, and fixed points in parameter space. In fact, one may argue that any reduction of a complex interacting system to an effective model described by only a few variables and governed by a small set of control parameters tacitly relies on renormalization ideas. In any such model, "irrelevant" degrees of freedom are somehow integrated out to arrive at a fixed-point theory that then contains "dressed" particles and effective couplings between the remaining degrees of freedom.

W. David McComb, an expert in the field of fluid turbulence, is an avid supporter of the above overarching and almost philosophical view of renormalization. He set for himself the ambitious goal of rendering renormalization techniques and the ideas of the renormalization group accessible to advanced undergraduates and beginning graduate students in physics and neighboring sciences. I admire his courage in attempting to teach, essentially from scratch and in a mere 300 pages, technically demanding topics that encompass field-theoretic formulations based on path integrals and stochastic nonlinear hydrodynamics.

A text is certainly needed to bridge the gap between basic undergraduate course material in statistical mechanics and modern research topics. Excellent classic texts in the field, including H. Eugene Stanley's *Introduction to Phase Transitions and Critical Phenomena* (Clarendon Press, 1971) and Shang-keng Ma's *Modern Theory of Critical Phenomena* (W. A. Benjamin, 1976), miss the wide applications that the renormalization group has enjoyed more recently. Although those applications are aptly reflected in Nigel Goldenfeld's *Lectures on Phase Transitions and the Renormalization Group* (Addison-Wesley, 1992), John Cardy's *Scaling and Renormalization in Statistical Physics* (Cambridge U. Press, 1996), and Paul Chaikin and Tom Lubensky's *Principles of Condensed Matter Physics* (Cambridge U. Press, 1995), most undergraduates and beginning graduate students will find the level of those texts quite demanding. Moreover, the field theory classics such as Daniel Amit's *Field Theory, the Renormalization Group, and Critical Phenomena* (McGraw-Hill International Books, 1978) and Jean Zinn-Justin's *Quantum Field Theory and Critical Phenomena* (Clarendon Books/Oxford U. Press, 1989) most likely will be even more out of their reach.

In part 1 of *Renormalization Methods*, McComb introduces the basic ideas of renormalization. He begins on a very elementary level, which implies that he needs to explain fundamental mathematical tools such as Gaussian integrations, Green's functions, perturbation theory, and high-temperature expansions. His tour de force works quite well. He manages to cover a wide range of topics, which include anharmonic oscillators, Debye–Hückel screening, fractals, percolation, mean-field theory, dynamical systems, and diagrammatic representations and renormalization in quantum field theory. However, I find it unfortunate that Lev Landau's Fermi-liquid theory for interacting electron systems is not mentioned at all, because it so beautifully illustrates the renormalization paradigm. In addition, I noticed that quantum mechanics receives a somewhat rough treatment in chapter 1: Erwin Schrödinger's surname is misspelled, the equation named in his honor is stated incorrectly, and observables are not properly represented by operators.

Parts 2 and 3 of McComb's book describe, on a generally accessible level, the technical framework and ideas of the renormalization group for applications in statistical mechanics—from the standard topic of equilibrium critical phenomena to nonlinear stochastic dynamics. The concise treatment manages to cover the essentials appropriately, although certainly a more careful proofreading could have eliminated a few lapses. For example, I find it important to state that the renormalization procedure constitutes a semi-group and that the Ising model does display "net magnetism," namely, paramagnetism, at high temperatures. I also certainly do not understand what the author is trying to convey in chapter 7 with the misleading statement that "the Ising model is equivalent to an assumption that there are no correlations."

But more important, in the chapter on the field-theory approach, McComb fails to explain the connection between UV divergences and the infrared singularities that are physically relevant for critical phenomena. I warmly welcome the inclusion of noisy hydrodynamics and stochastic differential equations of the Langevin type. However, McComb discusses neither the Einstein relation, which in thermal equilibrium connects the white-noise correlation strength with the relaxation rate, nor the crucial impact the functional form of the stochastic force correlator may have on the scaling properties of nonequilibrium systems. Given that McComb does introduce many of the required tools in field theory, I would have found it beneficial had he included an exposition of the path-integral representation of stochastic processes and developed from there the dynamic perturbation expansion, rather than using the somewhat cumbersome iteration of the equations of motion.

My feeling is that the author's own research expertise has influenced his choice of topics, perhaps too much. Stochastically driven Navier–Stokes equations and turbulence cascades do not represent the simplest, most accessible examples of dynamic scaling. I would have first discussed the noisy Burgers equation, which McComb does mention, and simple relaxational kinetics, and then ventured into, for example, the critical dynamics of isotropic ferromagnets.

In summary, McComb manages to convey the essence of the renormalization group philosophy to uninitiated readers. The scope of his text is admirable; however, I see his book as only partially successful in explaining the required formalism in a way that would allow careful students to proceed with their own detailed calculations. In that respect, I would probably still recommend to true beginners *The Theory of Critical Phenomena* (Oxford U. Press, 1993) by James J. Binney and coauthors, which should be supplemented with the more advanced texts mentioned earlier. Nevertheless, *Renormalization Methods* should be an excellent source of material for anyone who plans to lead advanced undergraduates and first-year graduate students beyond the standard course material toward current research topics. I shall certainly keep the book in close reach when preparing my classes.

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Energy Landscapes: With Applications to Clusters, Biomolecules and Glasses

David J. Wales
Cambridge U. Press, New York, 2004. $90.00 (681 pp.). ISBN 0-521-81415-4

The quest for new lands and landscapes has always been a pursuit of inquiry born out of curiosity and adventure, but also out of anticipated gains. Mapping out landscapes—recently, even beyond the planet Earth—and putting them on the map, literally and figuratively, is an essential element of that pursuit. David J. Wales's *Energy Landscapes: With Applications to Clusters, Biomolecules and Glasses* takes us on a journey of discovery and exploration of a different type of terrain—energy landscapes of systems larger than just a few atoms. It is the first textbook on this subject.

Although more nebulous, at least in the eyes of nonspecialists, energy landscapes present an expert explorer—physicist, chemist, or biologist—with the same type of features (valleys, ridges, peaks, and passages) as their planetary cousins. Why would one want to know the peculiarities of the energy landscapes of different physical, chemical, and biological systems? Because in an analysis performed at the atomic or molecular level, the energy landscapes are the ultimate reason for the structural forms these systems can assume and the complex transformations, including chemical reactions, they can undergo. Another central role of energy landscapes is to furnish a common language for describing a broad variety of seemingly disparate systems and phenomena and for identifying common, even universal, elements in them.

In most cases, the topographies of energy landscapes are much more complex than the ones we experience in our hiking and climbing expeditions. The reason is that the potential energy surface of an N-atom system is embedded in a space whose dimensionality scales as $3N$. Devising tools, which are appropriate and efficient for the exploration and mapping of these multidimensional surfaces, is a challenge that demands ingenuity and is the focus of ongoing efforts by many experts. Wales's book gives an account of the state of the art in this area. It describes, even if only tersely, the various techniques used to locate minima and saddle points and presents a fairly detailed discussion of how the knowledge of these can be synthesized into a distilled but representative and informative picture of a complex energy landscape (for example, in the form of disconnectivity graphs).