index. The claim on the dust jacket that this book fills the need for a "comprehensive" approach is perhaps misleading. While each of the individual chapters considers man's influence on air chemistry to some extent, it is abundantly clear that the overall effect of past, present, and future human activity is poorly understood and that even the basic chemical processes need further elucidation. Workers in air chemistry will no doubt find extensive use for this book while we await other papers on more topics in the chemistry of the atmosphere, including, it is to be hoped, studies of what man's activities imply for our future atmospheric environment.

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Behavior of Matter

Phase Transitions and Critical Phenomena. C. DOMB and M. S. GREEN, Eds. Vol. 1, Exact Results. xvi, 506 pp., illus. $31. Vol. 2. xviii, 518 pp., illus. $31. Academic Press, New York, 1972.

The understanding of phase transitions and, particularly, the full elucidation of behavior in the vicinity of critical points, where two phases, for example gas and liquid, become indistinguishable, is still a major challenge for the theory of condensed matter. The subject, which cuts across the traditional boundaries of physics, chemistry, and engineering, goes back to the basic thermodynamic analyses of Gibbs and to the approximate and semiphenomenological discussion of the gas-liquid critical point by van der Waals. The first half of this century saw mainly a gradual extension and wider application of these "classical" approaches. It was not until Onsager's dramatic, exact solution of the two-dimensional Ising model in the middle '40's, and the growing awareness of its implications in the subsequent decade, that the serious deficiencies and inadequacies of the older ideas were fully appreciated. The Ising model—which may be interpreted as a model of the gas-liquid transition, of a ferromagnet or antiferromagnet, of a binary alloy, and so on—was found to have a specific heat which diverges to infinity at the critical temperature. Increasingly careful and precise experiments on many systems soon revealed that such "critical singularities" also characterize the real world, even though they are effectively excluded by the classical theories. The dominant roles played by dimensionality and symmetry were also quite unforeseen by the old masters.

The two volumes under review initiate a series which recognizes the recent crystallization of the modern theory of phase transitions and critical phenomena. Four principal threads may be distinguished in the picture which has emerged in the last ten years. The first is formed by rigorous general results based on fundamental statistical mechanics. An excellent review of this area is given by R. B. Griffiths in volume 1: in many instances the rigorous theorems provide only existence proofs, but sometimes they yield sharp and valuable inequalities. Complementary articles by J. Ginibre and by G. G. Emch (on the C*-algebraic approach) describe other strands of this thread. The second main thread follows the spirit of Onsager's work by seeking exact analytical solutions for particular, idealized models. Such models, even when caricaturing physical reality quite severely, have often proved surprisingly instructive and revealing. The remaining chapters in volume 1 are devoted to this quest. The long article by E. H. Lieb and F. Y. Wu on "ice rule" and related ferroelectric models will be especially appreciated by students and specialists since it is the first review of a subject otherwise accessible only through the mathematically forbidding original papers. The chapter by H. N. V. Temperley provides a nice overview of the extensive literature on two-dimensional Ising models, but (apart from the article by B. M. McCoy in volume 2, on randomly layered Ising models) the student will miss, in these volumes, those full explanations that would enable him to understand in detail and to calculate for himself. Knowledgeable readers will also enjoy the articles in volume 2 on finite size and surface effects by P. G. Watson and on the spherical model by G. S. Joyce; both of these contain results not otherwise published. The interesting article by K. Kawasaki on kinetic Ising models is the only chapter in these (and the announced further) volumes which discusses time-dependent phenomena.

The third thread of our current understanding is spun from numerical analyses, especially those based on the extrapolation of the leading coefficients of exact series expansions, by Padé approximant and ratio techniques. This approach, pioneered by the first editor (C. Domb) and his colleagues, is now accepted as yielding the most reliable estimates of the critical behavior of three-dimensional models (which have otherwise proved quite intractable). Aspects of these developments are found in volume 2 in J. W. Essam's article on percolation and cluster size problems and in L. K. Runnels's survey of lattice gas theories of melting. For extensive and authoritative reviews, however, the serious student must wait for volume 3 (now in press), which is devoted to this scientific art.

The final thread is formed of the new phenomenological and approximate analytical theories which supersede the van der Waals and subsequent "mean field" approaches. (Aspects of the latter are reviewed by D. M. Burley in volume 2.) Here we find the concepts of critical exponents and the strikingly successful "scaling" hypotheses for describing the behavior of the thermodynamic and correlation functions close to criticality. These ideas have very recently been given a deeper foundation by K. G. Wilson's powerful renormalization group approach. Apart from a lucid discussion of the interface between coexisting phases by B. Widom and a review of critical equation of state data for fluids and ferromagnets by M. Vicentini-Missoni (in volume 2), the general reader will have to await further volumes in the series for a systematic exposition of these central developments. In the meantime the student may still turn to the standard reviews (L. P. Kadanoff *et al., Rev. Mod. Phys.* **39**, 395 [1967] and M. E. Fisher, *Rep. Progr. Phys.* **30**, 615 [1967]) or, especially for time-dependent phenomena, to the introductory text by H. E. Stanley (*Phase Transitions and Critical Phenomena*, Oxford University Press, 1971) recently reviewed in these pages.

Overall, the editors and contributors have attained a high standard of scholarship and clarity (which is matched by the pleasing appearance of the volumes). This series makes a welcome coming-of-age present to a subject which promises to intrigue and tantalize researchers for some time still.

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