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Book Review: *The Critical Point: A Historical Introduction to the Modern Theory of Critical Phenomena*

The Critical Point: A Historical Introduction to the Modern Theory of Critical Phenomena. C. Domb, Taylor and Francis, London, 1996.

No major branch of physics has a sharp beginning and a clean ending, but the fascinating behavior of materials at critical points comes close to following this pattern. It is, moreover, not straining the evidence too far to say that the period between its beginning and its end was just 100 years. The experiment that made clear the behavior of a fluid at the gas–liquid critical point was published by Thomas Andrews in 1869, and a simple explanation of it in terms of the forces between the molecules was put forward by J. D. van der Waals in 1873. The transition in solids from para- to ferromagnetism was shown in the 1890s to be another example of critical behavior. The classical theory of van der Waals (for fluids) and of Pierre Weiss (for magnets) was, however, found to be inadequate in a way that resisted the occasional attempts to patch it up that were made in the first half of this century. The problem is that the free energy is not an analytic function of its natural variables at a critical point, as was shown explicitly by Onsager in 1944 for a two-dimensional model of a ferromagnet. His methods have, however, been unsuccessful so far for three-dimensional systems and a quantitative route to the properties of more realistic models appeared only in 1971 when Kenneth Wilson imported the method of the renormalization group into the field.

Domb gives superb account of all three phases of his subject—the classical (90 pages), Onsager (130 pages), and the renormalization group (100 pages). He writes with the authority of one who has read widely in the early history, who contributed substantially, with his research group at King's College, London, to the working out of what he calls the 'Onsager revolution,' and of one who, in his 50s and 60s, has mastered the subtle methods of the renormalization group. He devotes most attention to lattice

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models, as is proper, since their theory has proved more tractable than that of the continuum models used to represent fluids. However, the strict transverse symmetry of most of these models means that they cannot be used for a discussion of such problems as the shape of the fluid rectilinear diameter, which are particularly acute in metallic and ionic systems. Tricritical points and the many transitions that occur in surface phases receive only passing mention. Such selectivity is inevitable and does not detract from the value of this clear account, which concentrates always on the physics rather than the mathematics, but which goes more deeply into the field than is implied by the modest word "introduction" in the subtitle.

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