

BOOK REVIEW

A review of *Phase Transitions for Beginners*

By Sergei M. Stishov

World Scientific, 2019, 152 pp., £40

ISBN 978-981-3274-17-4

Scope: Textbook

Level: Postgraduate/Researcher

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When ice melts, or water boils, or a magnet is heated above its Curie point, you have a phase transition, a sudden discontinuity at which one phase of matter turns into another completely different one, with new properties and features appearing, seemingly from nowhere. The physics of phase transitions is particularly rich and has a long history. The ideal gas law is all very well for describing gases, but it was realised early on that it must have limits; if the temperature is reduced the gas is expected to liquefy, but this is behaviour that will never emerge from the ideal gas law. It took Johannes Diderik van der Waals to add some corrections to the basic physical description, introducing intermolecular interactions and taking account of the finite size of the molecules, and thereby producing a model in which liquefaction could occur.

This was just the start. Generations of statistical physicists have given their lives to developing new techniques for understanding phase transitions, developing new models and introducing concepts such as tricritical points, scaling and the renormalization group, and exploring phase transitions that are driven by quantum rather than classical fluctuations. Progress in theory has gone hand in hand with progress in experiment, for which numerous compounds have been studied in various limits, stretching the models and illuminating new effects.

Stishov's book covers many of these aspects with an admirable brevity and lightness of touch, focussing particularly on melting. Such a short volume (the main part of the book is under a hundred pages in large, well-spaced type) could hardly be comprehensive, but as an introduction to the basic physics it serves its purpose quite well, though sometimes the explanations are perhaps too succinct. Where the book really wins is with the figures; points of principle are illustrated by numerous experimental examples, and the carefully chosen plots of data are a real treasure trove. As a bonus, the book contains an appendix with a few reprints of the author's papers (one covering quantum phase transitions and a couple on the properties of MnSi), documents which are just as well illustrated, though printed in a tiny font. Stishov is an expert on the subject, having made important contributions over many decades, and this wealth of experience and intuitive grasp of the key features of the subject comes through very strongly. In summary, this is a nicely written account which provides a refreshingly different take on the physics of phase transitions than is found in many other books on the subject.