Book Reviews

Matter at a Critical Point

Introduction to Phase Transitions and Critical Phenomena. H. EUGENE STANLEY. Oxford University Press, New York, 1971. xx, 308 pp., illus. $9.50. International Series of Monographs on Physics.

If heat is applied to a sealed vessel that contains a fixed quantity of water in the form of liquid water in equilibrium with water vapor, then if the quantity is small enough the meniscus that divides the liquid from the vapor will drop toward the bottom of the container (as liquid turns into vapor). If the quantity of water in the vessel is large enough the meniscus will rise toward the top (as vapor turns into liquid). But if the quantity of water is neither too large nor too small (about 0.32 gram of water per cubic centimeter of vessel) then the meniscus will neither rise nor fall, but, as a critical temperature (373°C) is reached, will broaden, fade, and disappear.

Matter at such a critical point is matter at its most perverse: specific heats are anomalously high and bulk moduli are anomalously low; otherwise clear substances become opalescent. For a time it was a matter of dispute whether the conventional fundamental theory of bulk matter was capable, even in principle, of describing matter at a critical point, but in 1944, in one of the great tours de force of mathematical physics, L. Onsager demonstrated that a conventional statistical mechanical analysis of a very special model could yield critical behavior every bit as complicated as that observed. Indeed, the Onsager solution of the Ising model indicated a state of affairs even more complex than many had suggested, and thereby launched a renewed attack on the critical point. Within the last decade the attack has become a massive assault, as a result of highly precise measurements and highly sophisticated numerical analysis of model systems together with (perhaps too occasional) striking theoretical advances and (perhaps too frequent) conjectures.

This volume is intended to help ease the beginner into the field, which until now has been accessible only through several excellent review articles and summer school proceedings on static critical phenomena and through the original articles on time-dependent critical phenomena. I have my doubts as to the wisdom of producing anything so permanent as a book while the battle is raging at its height. (There have already been two developments of major significance since the manuscript was finished: R. J. Baxter's solution of the eight-vertex model and K. G. Wilson's successful application of the renormalization group.) Still, an informal collection of lecture notes could be of considerable help at this stage, and, in spite of the imposing series in which it finds itself, that is what Stanley's volume is. As such, it performs the valuable service of assembling, in simplified form, a large body of disparate material of high current interest, which is presented in an enthusiastic, at times almost breathless, style.

The value of this service, however, is diminished by the uncritical way in which the material has been brought together, commonplaces, points of great subtlety, and, on occasion, common misconceptions all being presented in the same evenhanded cheerful manner. This can be trying in a book on the level of this one, for the reader is rarely furnished with enough analytical details to judge matters for himself and must often accept on faith what the author tells him. For example, L. P. Kadanoff's "derivation" of B. Widom's scaling hypothesis appears to be taken much more literally than Kadanoff intended it to be, and the reader is asked to swallow some of the more preposterous points with little more guidance than qualifying phrases such as "would seem to be valid."

In short, this is not a book from which one can acquire a secure foundation from which to pursue the subject further. Viewed as providing a guide to the existing literature, however, it is, at the moment, unique, and could still perform the useful role of easing the properly warned and closely watched beginner into this most fascinating subject.

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First-Person Physics

Adventures in Experimental Physics. A Selection of Papers and Personal Discovery Stories Dealing with Innovative, Unconventional and Adventurous Experimentation. Alpha 1972, Jan. 1972. Edited by BOGDAN MAGLICH (Rutgers University). World Science Communications, Princeton, N.J. Single issue: $6; to institutions, $12. Subscription (three issues): $12; to students, $10.80; to institutions, $24.

For at least a century and a half, physics textbooks generally have followed a pattern and have been written in a style intended to pave over all obstructions to a flow of distilled argument that seems to reach toward, perhaps, geometry as the ideal of expressiveness. J. R. Oppenheimer said that physicists are continually purifying their concepts; he might have extended this remark to their textbooks. H. R. Crane uses another metaphor: if a physicist were to write a detective story, it would begin with a chapter on the Origin of Law and proceed through Police Practice and the Administration of Justice; the corpse would be discovered in the final chapter.

This attitude toward instruction is especially visible in the curriculum and the textbooks for the physics major. It is quite inconsistent with imparting any of the enthusiasm a scientist brings to his work. The volume reviewed here is the first of a serial publication intended to supplement the lean fare of the major curriculum with tales of adventure in contemporary physics. Maglich has selected episodes, eight in this issue, which tell of the introduction of an inventive technique, the application of physics to an unusual problem, or an attempt at a far-out observation, or which stimulate the imagination for some other reason. Two issues a year are planned.

The chapters in the first issue are: