where v, w, x, y, z, b and so on are vectors in V and $\wedge$ denotes an antisymmetric multiplication. One then takes linear combinations

$$a_0 + a_1 v + a_2 w \wedge x + a_3 y \wedge z \wedge b \ldots$$

where a_0, a_1, a_2, a_3 and so on are real or complex depending on whether V is a real or complex vector space. These sums are the elements of the Grassmann algebra; Dewitt calls them "supernumbers." The multiplication law under the operation $\wedge$ makes them into an algebra. Ever since Herman Grassmann, the resulting algebraic calculus has been used to treat questions involving relations between subspaces of V. More than 30 years ago Felix Berezin developed a systematic theory of functions whose independent variables are supernumbers, and this theory has been used effectively in the quantum mechanical discussion of fermions ever since.

The next step in the theory is to define vector spaces in which the coordinates are supernumbers, the supernumbers themselves forming the one dimensional vector space. Using the Berezin calculus, one can then imitate the usual construction of manifolds (coordinate patches, consistency of coordinates in the overlap of patches, atlases and so on) to define the notion of a supermanifold. All this is done in chapters 1 and 2.

Chapter 3 deals with super Lie groups. They differ from Lie groups in having the group manifold generalized to be a supermanifold. Chapter 4 discusses examples of super Lie groups. Chapter 5 contains applications of supermanifold theory to the quantization of dynamical systems in which the configuration space is based on euclidean space. The new Chapter 6 concentrates on the additional wrinkles that arise when the configuration space has a non-trivial topological structure.

I recommend the book to those hardy souls who wish to venture out into the stormy waters of current particle theory.

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Statistical Mechanics of Phase Transitions

J. M. Yeomans
Oxford U. P., New York, 1992. 153 pp. $24.95 pb
ISBN 0-19-851730-0

This book provides a brief, accessible introduction to phase transitions, critical phenomena and the renormalization group. Proficiency in the study of phase transitions is not a prerequisite for writing a book such as this one, given the large number of review articles, monographs and texts at various levels of sophistication that are now in the literature. However, an intimate acquaintance with frontline research enables one to distinguish what is essential from what is dispensable in preparing an introduction to the field. The author, Julia Yeomans of Oxford University, has the competence and accomplishments that prepare one to exercise this kind of judgment. She has, for example, performed some of the best and most influential research on the antiferromagnetic next-nearest neighbor interaction model, which describes a magnetic system that, because of competition between ferromagnetic and antiferromagnetic order, can exhibit an extraordinary diversity of magnetic phases.

Yeomans starts, appropriately enough, with a definition of phase transition and follows with a description of some of the systems exhibiting the thermodynamic singularities that betoken phase transitions. Then, after a compressed discussion of relevant notions in statistical mechanics, she embarks upon a review of models, concepts and theoretical techniques that have been applied to the study of critical phenomena. The reader will find mention of almost every theoretical approach to phase transitions that has influenced the evolution of our understanding of this remarkable set of phenomena over the past three decades.

I am not a neophyte in the field, so finishing the book in two sittings as I did is not a particularly noteworthy feat, especially given the fact that I attempted none of the problems at the end of each chapter. However, I did keep an eye open for the kind of writing that leads the reader into logical dead-ends simply because he or she hasn't managed to extract the author's meaning from a jumble of ambiguously worded sentences. I was well pleased with the clarity and coherence of the exposition. I did, however, find much to criticize in the quality of the prose. About three-quarters of the sentences in *Statistical Mechanics of Phase Transitions* use passive, rather than active sentence construction. The best technical books breathe life into a topic by conveying the author's enthusiasm for and delight in the subject; this book fails in that regard. Fortunately, there is enough mystery and elegance to be found in the subject of critical phenomena to seduce the reader, even in the absence of a compelling prose style.

On the whole, this book will prove useful to the beginning graduate or advanced undergraduate student who wants to start learning about phase transitions and critical phenomena, and to the instructor who would like to teach the subject to such a student.

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Exotic Properties of Superfluid ^{3}He

G. E. Volovik
Series in Modern Condensed Matter Physics, Vol. 1.
World Scientific, River Edge, N. J., 1992. 215 pp. $48.00 hc
ISBN 981-02-0705-0

The "exotic properties" in the book's title are essentially the phenomena arising when the internal order parameter of one or the other of the superfluid phases of ^{3}He—which reflects the orientation of the "diatomic molecules" (Cooper pairs)—varies in space and/or time. Grigor E. Volovik of the Landau Institute in Moscow has been a leading theoretical player in this area, and this book is in large part a compendium of his contributions and related work. Apart from some review material that introduces the language of broken symmetry and a fairly brief final chapter on quasi-two-dimensional films, one can pick out three main themes: the bulk orbital statics and dynamics, analogies with phenomena in particle physics and the properties of various topological singularities, particularly vortices in ^{3}He-B. The last topic is likely to be of somewhat limited interest to those not actively engaged in the relevant theory and experiment, and it is at times presented in an unnecessarily mystifying way. (For example, the author makes much of an A-phase singularity, which is described as "a combination of the half-wounded disgyration with the half-quantum vortex" and illustrated in fairly abstract terminology in a figure. I wonder how many readers will grasp that this superficially exotic beast is nothing but a simple (^{4}He-type) vortex of the up-spin Cooper pairs, with the down-spin order parameter remaining constant.)

As to the correspondences with particle physics, being the kind of philistine who does not feel that, for example, his understanding of the Bloch equations of nmr is particularly improved by being told that they are a consequence of Berry's phase, I have to confess to greeting the news that the "spin-orbit waves" of ^{3}He-A are the analog of the W boson and the "clapping" modes the analog of the graviton with less than overwhelming excitement. These analogies no doubt display a certain virtuosity, but it is not clear that they actually help our concrete understanding of either the condensed-matter or the particle-physics problems very much, especially when they have to be qualified as heavily as is done here.

To me the most interesting part of the book was that on the bulk orbital statics and, more particularly, dynamics (chapter 6)—an area where the author has certainly injected a number of novel and important ideas and where, if anywhere, the experience he draws from particle physics pays off. Even here, however, the scant and unsystematic attempt made to relate the often abstract theoretical concepts to experiment is frustrating. For example, the "density of the orbital [angular] momentum L of the Cooper pair rotation," an idea that is apparently fundamental to much of the work of chapter 6, is introduced just like that, in words, with no attempt made then or later to relate it directly to microscopic concepts or, as far as I can see, to anything that might be experimentally measurable. (It would have been easier to check this kind of statement if the book had an index!)

Despite the above reservations, there are many good things in this book, and the author is to be commended for not swamping his arguments with any heavier formalism than they need. However, the prospective reader should realize that to appreciate its virtues, he or she will need to come armed not only with a modicum of group theory and, ideally, phenomenological particle physics but, more importantly, with a working knowledge of the principal experimental properties of superfluid ^{3}He and their explanation in terms of BCS-type theory. Despite the implication to the contrary in the foreword to the series, this is not a book for the novice.

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