Quest for a Particle

The Higgs Hunter's Guide. JOHN F. GUNION, HOWARD E. HABER, GORDON KANE, and SALLY DAWSON. Addison-Wesley, Redwood City, CA, 1990. xvi, 425 pp., illus. $49.50.

Through the pioneering work of Glashow, Salam, and Weinberg, we now understand that electricity and magnetism and weak radioactive decays are different aspects of the same deep theory. The long-range nature of electromagnetic forces and the pointlike interactions responsible for nuclear beta decay—discordant physical phenomena—emerge physically from the same theory as a result of the spontaneous breakdown of a local underlying symmetry. This excellent monograph by Gunion, Haber, Kane, and Dawson explores the consequences of this symmetry breakdown's being triggered by elementary scalar excitations. Even though this is the simplest possibility, it remains in many ways the most compelling. Furthermore, as this book attests, it leads to a very rich phenomenology.

When spontaneous breakdown occurs through the self-interactions of some fundamental scalar field, at least one massive, spin-zero excitation appears in the spectrum of the theory. This particle is the famous Higgs boson, whose traces Gunion and friends search for in their book. Finding this excitation experimentally would provide unrefutable evidence for the mechanism responsible for the symmetry breakdown, with deep implications for our understanding of the fundamental interactions.

The main focus of this monograph is on the expected signals and detection techniques for Higgs bosons. The authors explain with care what the main properties of the "standard" Higgs boson are and how such a particle can be seen in both electron-positron and hadronic collisions. Equally praiseworthy is their general discussion of the two-doublet Higgs model, which, although necessarily rather detailed, manages to convey in a crisp way the new features expected when one enlarges the Higgs sector. For my taste, however, their treatment of the minimal supersymmetric extension of the standard model is a bit too exhaustive. I suspect that all but the most faithful reader will get lost in the maze of details.

Although it is understandable given the thrust of the book, I was also a bit disappointed that the authors spent so little time discussing possible alternatives to symmetry breakdown by scalar fields. However, this omission is compensated for by a lovely discussion of the general theoretical bounds, and some particular experimental bounds, that exist for Higgs bosons. I found the treatment of this topic really quite good, putting into perspective and correlating a large amount of otherwise rather disjoint material that appears in the primary literature.

On balance, I believe that *The Higgs Hunter's Guide* is a very timely and useful addition to the growing literature on the standard electroweak theory. It is a well-written book that covers in a comprehensive manner one of the few remaining areas that remain open in the theory of electroweak interactions. As such it belongs on the bookshelves of all active researchers in the field. Its pedagogical approach should also make it quite a useful book for students who are trying to enter into the field.

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Embryogenesis

This Side Up. Spatial Determination in the Early Development of Animals. ROBERT WALL. Cambridge University Press, New York, 1990. xii, 436 pp., illus. $110. Developmental and Cell Biology Series, 24.

During the last decade, largely owing to the combined use of genetic or molecular analysis and experimental embryology in studies of development in *Drosophila melanogaster, Caenorhabitis elegans,* and *Xenopus laevis*, solutions to such long-standing problems as the molecular basis of spatial determination seem finally within reach. Emphasis on fewer species, however, has considerably narrowed the perspective of embryological research. A glance at leading journals might suggest that the only animals worthy of embryological interest are worms, fruit flies, frogs, and, for anthropomorphic reasons, the mouse. Robert Wall expounds the opposite philosophy in this book, which examines the processes and mechanisms of spatial determination throughout the animal kingdom. The hope is that by understanding information obtained from different animals, embryologists will be inspired to mount a more rational attack on the most general features of development.

This book focuses on the question of whether spatial determination is controlled "mosaically" by tissue-specific determinants sequestered in the egg or epigenetically by inductive cell interactions that arise during the formation of the embryo. It begins with a consideration of how much pattern is already laid down in the egg during oogenesis, then proceeds through the generation of new spatial patterns during ooplasmic segregation, cleavage, and gastrulation, and ends with a summary in which the processes and mechanisms of spatial determination are compared in different species. The theme is developed cleverly, first by considering data obtained with a particularly relevant species, such as ascidians for tissue-specific determinants and sea urchins for cell interactions, and then by surveying different animals groups. The nematode worms, fruit flies, frogs, and mammals are not forgotten in this book but are given the same emphasis as hydrozoans, ctenophores, mollusks, other arthropods, echinoderms, ascidians, birds, and so forth. Obviously, there are dangers to this approach. Wall has to deal with a voluminous and sometimes contradictory literature (about a fourth of the pages are devoted to bibliography) and must try to explain and integrate species and data that are out of line with the general trends. Wall has handled these pitfalls quite well; the book is superbly organized and readable, and the examples are critically selected and integrated into a comprehensive theory of spatial determination in the final chapter.

Although the primary focus of the book is on experimental embryology, existing molecular data are also evaluated for each animal group. Through this exercise it becomes clear that a large portion of the molecular research that was done before the recent focus on just a few species is irrelevant to the fundamental questions that need to be addressed by modern embryologists. Perhaps most of these molecular details could have been left out, but in considering them the author drives home his lesson that molecular embryologists should pay attention to the rules that govern development as well as those that govern the behavior of molecules.

The author's general conclusion is that cell interactions, rather than tissue-specific determinants, are responsible for spatial determination in most species. The title, *This Side Up*, is meant to convey the idea that the animal egg contains little developmental information other than instructions needed to specify the poles of the embryo. One of the crucial facts used to negate the existence of tissue-specific determinants is that maternal effect mutations that affect a somatic cell fate directly have yet to be found. The author's bias is transparent here; he fails to point out as strongly and frequently that this negative evidence has been obtained only in those few species in which sophisticated genetic analysis is possible. Otherwise, however, the subject matter is treated fairly. For example, Wall admits that determinants, rather than cell interactions, may function in determining the germ line and some somatic cell fates in rapidly developing organisms, such as ctenophores and ascidians. Whether or not they all agree with Wall's approach and