But the swarm-founding polistines are more advanced in certain respects. Though they have multiple egg-layers and often lack morphological castes, they are the most obligately social wasps (lacking a solitary colony-founding stage) and have the most sophisticated division of labor. Additional systematic and behavioral studies should help reveal where and perhaps why these kinds of socially advanced traits have evolved.

Readers of *The Social Biology of Wasps* should be warned of the considerable overlap in coverage, particularly between early chapters organized by taxa and later ones organized by theme. Also, there is no overview chapter that collects the main themes and places wasps in a larger context. Those desiring such a chapter should turn to the recent review of eusociality by Alexander, Noonan, and Crespi in *The Biology of the Naked Mole Rat*, (P. W. Sherman, J. U. M. Jarvis, and R. D. Alexander, Eds., Princeton University Press, 1991). While we are only beginning to understand the complexity of sociality in wasps, *The Social Biology of Wasps* provides a thorough and up-to-date account. It is fertile ground for graduate students seeking thesis topics and a great resource for anyone attuned to the tension between conflict and cooperation that makes social animals so interesting.

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Engineer in the Making

The Idea Factory. Learning To Think at MIT. PEPPER WHITE. Dutton (Penguin), New York, 1991. xviii, 313 pp., illus. $21.95.

The premise of this unabashedly autobiographical book is simple: a young man with a bachelor's degree in environmental engineering from Johns Hopkins and a year and a half of experience in Europe (including one year working at the von Kármán Institute in Belgium) goes to graduate school at MIT. Although admitted into the school's Technology and Policy Program, White transfers to "Course 2," which is mechanical engineering at MIT, even before classes begin. The bulk of the book is descriptive of various of the courses White takes (with varying degrees of success) and of graduate and undergraduate student life in Cambridge.

After his first semester White secures a research "assistanceship" on a project involv-
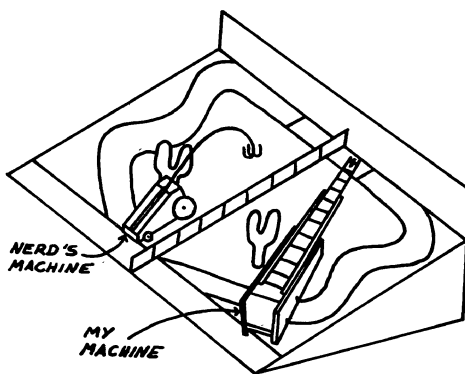
Entries in a contest where "some weight had to go to the top of a ramp in twenty seconds, and with just a little tiny electric motor and two little tiny springs . . .". [From *The Idea Factory*]

ing a rapid-compression machine, for which it is his task to raise the compression ratio. Since his master's thesis work revolves about this project, it understandably plays a significant role in the story's development. In his second year, White moves into Senior House as a tutor, or resident assistant, and this position provides much of the focus for the book's descriptions of undergraduate life at MIT.

White's self-consciousness about what it means to be a student trying to distinguish himself, and an MIT student in particular, pervades *The Idea Factory*. This self-consciousness is especially explicit in an account of a televised contest in which a team of three MIT students is pitted against a team of three Berkeley students in attempting to explain the workings of an alleged perpetual motion machine. Tensions between concern for form and substance manifest themselves in how the students choose to dress and how they behave before the camera, but in the end it is the technical aspects of the competition that clearly determine the outcome.

Although *The Idea Factory* appears to be targeted toward a general readership, the technical detail White gets into in describing homework assignments in such courses as advanced fluid mechanics would seem to appeal to and be most accessible to a technically initiated readership of engineers and scientists. Indeed, this book provides a rare and welcome opportunity for more mature academic engineers and scientists to see materials and methods that have long become second nature to them from the point of view of a student. White's struggle with the concept of "model," for example, reveals how difficult it can be for some students to pick up even what might appear to be among the most fundamental aspects of the engineering and scientific method.

Many well-known personages are encountered in the pages of *The Idea Factory*, and the reader is given glimpses of the classroom

style of several MIT professors. We spend an extended time in the labs of the legendary Doc Edgerton, to whom White goes for advice on the use of high-speed photography to capture the diesel fuel spray in the ignition chamber of the rapid compression machine. There is also much name-dropping in the book, and some of the names get damaged. Thus Vannevar Bush's name becomes "Vannebar" (on p. 7 and in the index, but not elsewhere), and Newton's Second Law is misnumbered the First (on p. 177). It is hard to know what to make of such lapses in technical detail in a book about technical detail, but they do give a touch of humanness to an account that at times borders on being overly mechanical.

The human side of the story of being a student in *The Idea Factory* is full of pathos, and White seems less sure of himself in trying to explain it. An awkward juxtaposition of personal tragedy and engineering calculation, for example, may leave the reader wondering if there really is something dehumanizing about technical education. But because White has, even with its flaws, told such a human and gripping story, it would be a disservice to potential readers of this book to reveal too much of the plot. Suffice it to say that in the end this is one articulate student's attempt to communicate across gaps in experience that have remained generally unbridged. White is to be applauded for his candid and hard-nosed account of his years at MIT, and his book is sure to reach a wide readership among those who have been through, at whatever level, the rigors of engineering and science education. Many will find this book hard to put down and will find much in it with which their own experiences can resonate.

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Children's Theories

Understanding the Representational Mind. JOSEF PERNER. MIT Press, Cambridge, MA, 1991. xiv, 348 pp., illus. $35. A Bradford Book. Learning, Development, and Conceptual Change.

Most people, even most scientists, spend much of their time figuring out what other people think: "Why did the lecturer explode about that trivial question?" "What does the peculiar behavior of the grants officer mean?" "Does he really love me?" In asking and answering these questions we rely on an enormous store of ordinary, common-sense psychological knowledge. Where does this

"folk psychology" come from? How do we know about our own minds and the minds of others?

Philosophers have been concerned with questions like these for centuries, and more recently they have been investigated by psychologists. The past five years have seen a growth of interest in them within the field of developmental psychology—with when and how children begin to understand such concepts as belief, desire, imagination, and emotion. The study of "children's theories of mind" has become a hot topic and was the subject of innumerable graduate student presentations at the 1991 Society for Research in Child Development convention—one of the indicators, or possibly one of the perils, of success.

Much of the appeal of the recent work in "theories of mind" is exemplified in Josef Perner's new book. It is a fine instance of Piaget's original project—the attempt to use developmental evidence to illuminate epistemological questions—even while it rejects the great majority of Piaget's empirical and theoretical claims. The book is also an example of cognitive science at its best. Philosophical ideas and ideas from artificial intelligence blend seamlessly with Perner's ideas about developmental psychology. At the same time Perner is an extremely careful and sometimes dazzlingly ingenious experimenter.

In fact, one important factor in the recent ascendency of the "theory of mind" was an experiment conducted by Perner with his colleague Heinz Wimmer. The experiment was actually inspired by a problem in comparative psychology (as well as by the German children's book *Max and Moritz*). How would you know if a creature really understood belief? The answer is to see if it could appreciate that beliefs may differ from reality. For example, suppose we show a child a candy box, and when she opens it she finds, to her surprise, pencils inside. We close the box, and Max enters the room. Then we ask the child, "What does Max think is inside the box?." Three-year-olds consistently say that Max thinks there are pencils in the box; they don't understand that his belief may be false. Perner and others have subsequently conducted many additional experiments demonstrating that this result taps a genuine conceptual difference between adults and children and is not simply the result of superficial performance limitations.

Understanding the Representational Mind takes off from this experimental finding. The book has a clear and focused thesis. Perner is concerned with how we come to understand the representational character of the mind: the fact that beliefs, and other mental states, refer to a world outside the mind. In many philosophical views, the representational

character of the mind is one of its most central and distinctive traits. If children do not understand that mental states are representational, then their "folk psychology" is deeply, radically different from that of adults. Perner argues that this understanding does not emerge until about age four and that it is indexed by the child's performance in the false-belief tasks.

One problem for this view is the fact that children as young as 18 months old appear to be capable of understanding that we can pretend or imagine or hypothesize things that aren't actually true. When a child says "I'm pretending that this is an apple, but really it isn't" or "I think this could be an apple, but maybe it isn't" she seems to be demonstrating a capacity to think about representations. Perner's solution to this problem is derived from philosophical work on "situation semantics." From 18 months to four years, in his view, the child sees herself and others as psychological beings related to situations, some of which are real, some imaginary, some hypothetical. Of course, from the psychologist's point of view, the imaginary and hypothetical situations are, in fact, only representations. But this is not the three-year-old child's view. The three-year-old, we might say, represents the world, both the real world and possible or imaginary worlds, but doesn't know that this is what she is doing.

Much of the book plays out the contrast between the three-year-old "situation theorist" and the four-year-old "representation theorist" in a wide range of areas. Though those outside the field have focused on the false-belief task, Perner recognizes that this task is only interesting insofar as it indicates a more general conceptual change. He uses this framework, for example, to explain John Flavell's pioneering work on the development of perspective-taking and the appearance-reality distinction. He also applies it to the developing ability to understand symbolic systems such as drawing and to changes in children's social behavior and memory. The general picture that emerges from Perner's work is that children construct the idea of representation as a way of explaining certain features of action and experience. They do this in much the same way a scientist might construct a new theory. Developing this new theory, moreover, makes an important difference in the way the child acts in the world.

Generally, Perner's extensions of his ideas to other areas of development are ingenious, and usually they are convincing, particularly when they concern the experiments in Perner's own research program. Occasionally, however, they seem forced. Perner sometimes seems to skimp on the psychological

abilities of three-year-olds in an attempt to make the achievements of the four-year-old seem all the more impressive.

The book is admirably written, which is rare in psychology, and also admirably argued, which is even rarer. Still, the central idea of the child as "situation theorist" is a slippery one and seems to turn slipperier at crucial junctures of the argument. Largely, this reflects the philosophical complexity of the problem of representation and the difficulty of characterizing minds that are so different from our own. Though Perner doesn't completely solve these problems (what mortal could?), his important achievement is to show how they can be mutually illuminating. Trying to understand the child's ideas about belief can clarify the nature of belief itself. If this field continues to produce work of this caliber, it stands a fair chance of surviving its success.

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Some Other Books of Interest

Human Paleopathology. Current Syntheses and Future Options. DONALD J. ORTNER and ARTHUR C. AUFDERHEIDE, Eds. Smithsonian Institution Press, Washington, DC, 1991. vii, 311 pp., illus. $70. From a symposium, Zagreb, Yugoslavia, July 1988.

As outlined by Ortner and Aufderheide the field of human paleopathology (the interpretation of indicators of health and disease in ancient peoples) has four main strands—research on soft tissue, research on skeletal tissue, analysis of historical and archeological materials, and biochemical research—and has been characterized by a "commensal" relationship between anthropologically and medically trained researchers. In organizing the symposium on the subject that was part of the 1988 International Congress of Anthropological and Ethnological Sciences, Ortner and Aufderheide report that they were motivated in part by a sense that the field had reached a plateau and was in need of assessment and perhaps redirection. To that end they brought together some 70 scholars from Europe, the Americas, and Australia.

The resulting proceedings open with a group of six papers headed Theory. Among the issues raised here and in the editors' concluding synthesis are the need for more universal descriptive methods and better classificatory systems, problems with overreliance on clinical diagnostic criteria, the relevance of paleopathology to contemporary