cal communication is equally essential. Stapleton has for the most part performed his editorial and expository role very well, and I have only two criticisms of his handiwork. First, as all engineers know, working drawings for a given project must be presented in a logical and clearly recognizable order if they are to be fully meaningful. In the Latrobe volume the order is sometimes incomplete, obscure, or puzzling, with the consequence that we are not sure how the craftsmen were expected to read the drawings in question. Second, Stapleton appears not be fully at home with the vocabulary of civil and mechanical technology, so that his definitions, though not incorrect, are often oversimplified to the point of being ambiguous or misleading. These are details, however; the book as it stands is a rich mine for the historian of technology or American culture, or for anyone interested in these disciplines.

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Cytoskeletal Components

Microtubules. K. ROBERTS and J. S. HYAMS, Eds. Academic Press, New York, 1979. xvi, 596 pp., illus. $78.50.

It has become evident during the past several years that the cytoplasm of eukaryotic cells is not a structureless "soup" but is highly organized and contains an elaborate and dynamic three-dimensional network of fibrous skeletal components. The major components include, at a minimum, microtubules, microfilaments, intermediate filaments, and their associated structural and regulatory components.

Probably the most thoroughly studied of the fibrous skeletal components are the microtubules. These tubelike protein polymers approximately 25 nanometers in diameter are present in all eukaryotic cells, often in impressive numbers. They provide the cell with a skeletal support system and also function in many different kinds of cellular movement, including chromosome movement during mitosis and various intracellular translocations. Much has been learned about the occurrence, organization, and functions of microtubules in cells, and impressive progress has been made, especially during the past ten years, in our understanding of their biochemical and assembly-disassembly properties in vitro. Yet our knowledge of their functions in cells on a biochemical and mechanistic level is still almost nonexistent.

Roberts and Hyams say in the preface of the book that "the first age of microtubule research is more or less at an end, and . . . the next phase is just beginning to piece itself slowly together." They reason that "now seems the time to sort out what is known and to speculate on the future," and I heartily agree. In the book they have included comprehensive reviews of fundamental aspects of tubulin chemistry, microtubule structure, and microtubule assembly in vitro and of the organization, distribution, and functions of microtubules in cells. They have attempted throughout the book to emphasize areas of microtubule research that hold great promise for unraveling the mysteries of microtubule chemistry and function within cells.

The book consists of 11 chapters, all written by individuals who have made substantial contributions to our understanding of microtubule chemistry and function during the past decade. There are a group of what could be called "core" chapters, which deal with the known structure of microtubules, their biochemical properties (R. F. Ludueña), their in vitro assembly and disassembly characteristics (R. B. Scheele and G. G. Borisy; M. Jacobs), their synthesis and utilization (C. Fulton and P. A. Simpson), and their cellular organization and distribution (J. B. Tucker; K. Weber and M. Osborn). The core is beautifully augmented by more functionally oriented and speculative chapters on the roles of microtubules within cells (R. D. Berlin, J. M. Caron, and J. M. Oliver; Hyams and H. Stebbings; F. D. Warner). The book is impressive in that virtually all of the chapters are high in quality, and each offers the reader something unique and provocative. Especially noteworthy are chapters on the structure of microtubules, by L. A. Amos, and on cell division, by J. R. McIntosh. In her lucid chapter Amos provides a thorough view of the current state of our knowledge concerning the arrangements of the tubulin lattice within the microtubule walls. McIntosh's discussion of mitosis and the involvement of microtubules in the process of chromosome movement is masterly and delightfully imaginative. He provides a thoughtful, thorough, and exciting analysis of mitosis, and the chapter is one of the more useful descriptions of mitosis and possible mitotic mechanisms of the many that have been written recently.

The image of the book as a collection of review chapters is weakened somewhat in that a few of the chapters devote excessive space to contributions from the authors' own laboratories. However, overall the book is superb. It should serve as an important and useful resource for future studies of the cellular roles of microtubules.

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Cells in Development

The Cell Surface. Mediator of Developmental Processes. Papers from a symposium, Vancouver, B.C., June 1979. STEPHEN SUBTELNY and NORMAN K. WESSELLS, Eds. Academic Press, New York, 1980. xvi, 374 pp., illus. $26.50.

The Cell Surface is a very good symposium volume. Its three sections—The Cell Surface: Background and Perspectives, The Cell Surface and Early Development, and The Cell Surface in Normal and Abnormal Development—each summarize important topics, and each section connects well with the others. The individual papers are usually a good mixture of the authors' experimental results and the literature. By choosing their contributors well, the editors have ensured that the papers will have good scope even when they concentrate on data from one laboratory.

The book begins with a paper by Branton, who discusses specific interactions between cytoplasmic fibers and filaments and elements of the cell surface proper, concentrating on his own work on interactions between spectrin and other proteins of the erythrocyte cytoplasm. Although the results given are for particular erythrocyte proteins, the approaches may well be useful in more complicated eukaryotic cells. Similarly, the second paper, by Stossel and coworkers, uses the mammalian leukocyte to consider cell motility in general. Those wanting to read further are directed to papers dealing with cells other than leukocytes; the theme of all the work cited is that calcium-mediated actin contractions are the main motive power of cells. The other three papers of the introductory section follow similar plans, though all three review the literature extensively. In particular, Yamada and coworkers have written a paper on fibronectin that ranges from cellular to molecular and that both reviews the subject and recounts recent experimental re-

sults. This paper also complements one in section 3 by Wartiovaara and coworkers on "matrix" glycoproteins in early development, which covers expression in early mammalian development of collagens and other glycoproteins as well as fibronectin.

About half the book is taken up by papers on cell surfaces in early development. Three important sets of data, from the laboratories of Vacquier, Shapiro, and Epel, cover fertilization from the first encounter and specific association of gametes to membrane changes in the zygote. Specific molecules for the association of sperm and egg (Vacquier), the persistence of the sperm surface in the developing embryo (Shapiro *et al.*), and the role of calcium in fertilization (Epel) are among the topics covered, but the authors have much to say about events in fertilization and discuss a wide range of subjects concerning membrane changes at fertilization.

Gamete interactions in *Chlamydomonas* and in higher plants are discussed by Goodenough and Adair and by Linskens. Plant development has generally been slighted by experimental embryologists. Contacts between workers on animal development and workers on plant development have been few, and it is good to find the paper by Linskens indicating that some selectivity mechanisms in higher plant fertilization probably involve adhesive specificities familiar to those working in animal cell adhesion. Although its language is somewhat unfamiliar, the paper is worth a careful reading. The paper by Linskens, one in section 3 on lectins and their receptors as determinants of *Rhizobium*-legume associations, and two on lectins of animal cells, those of teratocarcinomas (Martin and co-workers) and those of chick embryos (Barondes), suggest some features of cell adhesive specificity common to many organisms. Though Glaser in his paper suggests that cell adhesion in different systems will proceed via different mechanisms, a theme emerging from the symposium is that lectins and receptors provide specificity of initial recognition.

In conclusion I might mention a paper on the role of the cell cortex in development. Kirschner and co-workers describe experiments on several aspects of early development in *Xenopus*, initiation of the cell cycle and establishment of dorsal-ventral asymmetry in the fertilized egg. The section on the cell cycle documents the waves of surface contraction that sweep over the fertilized egg in a period with a clearly defined relationship to cell cleavage. The authors develop a model in which a master clock controls both division time and frequency of surface waves. Drug treatments, for example with colchicine, can uncouple division and surface waves, allowing study of a simple oscillating system with the goal of understanding the cell cycle oscillator as well. The second portion of the chapter deals with experiments on twinning and the organizing role of the gray crescent in determining embryonic axes of symmetry. Twinning due to rotation of eggs is demonstrated, and it is suggested that the classic experiments of Curtis, in which transplantation of cortex from the gray crescent to the central region of another fertilized egg induced twinning, in fact were demonstrations of the effect of handling the eggs. This paper was for me the most interesting in the book. It approaches old problems and accepted views with both reasoned skepticism and fresh experiments.

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Stone Tools Analyzed

Experimental Determination of Stone Tool Uses. A Microwear Analysis. LAWRENCE H. KEELEY. University of Chicago Press, Chicago, 1980. xiv, 212 pp., illus. + plates. Cloth, $15; paper, $7. Prehistoric Archaeology and Ecology.

Because stone artifacts constitute a high proportion of the material archeologists have to work with, it is not surprising that one of the important frontiers in archeology is the attempt to develop ways in which to increase the information that can be derived from them. Along with ethnographic investigation of the few surviving stone-tool-using peoples, the study of the wear (known as use-wear or microwear) that stone tools sustain in the course of utilization has recently undergone an explosion of interest.

Use-wear comprises various kinds of damage and surface modification including scratches, fracturing, abrasion, and a kind that is loosely termed "polish." Studies of use-wear permit the identification of tool-use activities that were carried on within prehistoric sites and the differentiation of activities carried on at different sites, knowledge that can then be used to reconstruct more general aspects of subsistence behavior. They provide an avenue for seeking information about technological change, and more specifically about manufacturing procedures and techniques.

Lawrence Keeley currently leads the publications stakes in use-wear studies in terms not only of volume of output but of apparent potential of reported findings. This book provides a comprehensive presentation of his Ph.D. work on experimentally produced use-wear, and it incorporates the data on which his previously published summaries are based. With a new wave of graduates (mostly North Americans) entering the field it is timely that these basic data be made available.

Although Keeley points out that the work is a report on a particular research project—the interpretation of use-wear on specific collections of British Lower Paleolithic stone tools—and is therefore neither a textbook nor a general reference book, the results and the methods he employs are of general interest and there is scope for extrapolation to other prehistoric lithic industries. In fact, Keeley's work has already influenced the direction use-wear studies are taking.

The broader concern of this book is not British Lower Paleolithic tools as such (although certainly some very interesting conclusions are reached in that regard) but the identification at magnifications of about 200 of forms of use-polish that resulted from the experimental working of materials known to have been utilized by early humans, such as wood, antler, animal hide, meat, and fresh bone. The degree of success reported by Keeley in matching particular types of use-polish to type of material worked has not been approached by any other use-wear researcher.

Until about the time Keeley completed the research embodied in this book the major—and largely unrecognized—problem besetting use-wear studies was the isolation in which most of the researchers worked. With the convening in Vancouver of the first international conference on lithic use-wear in early 1977 channels of communication and interaction were opened. Despite the series editor's claim in the foreword that Keeley has "revised and updated his methodologically rigorous studies," there is no detectable cognizance taken of the papers or the discussions from that conference (whose proceedings were published as *Lithic Use-Wear Analysis*, B. Hayden, Ed., Academic Press, 1979). Keeley's book is essentially the same as his Ph.D. thesis, even retaining the more unorthodox terminology. For instance, how many of the uninitiated will know that Keeley's term "1/2 Moon breakage" refers to that well-known fracture me-