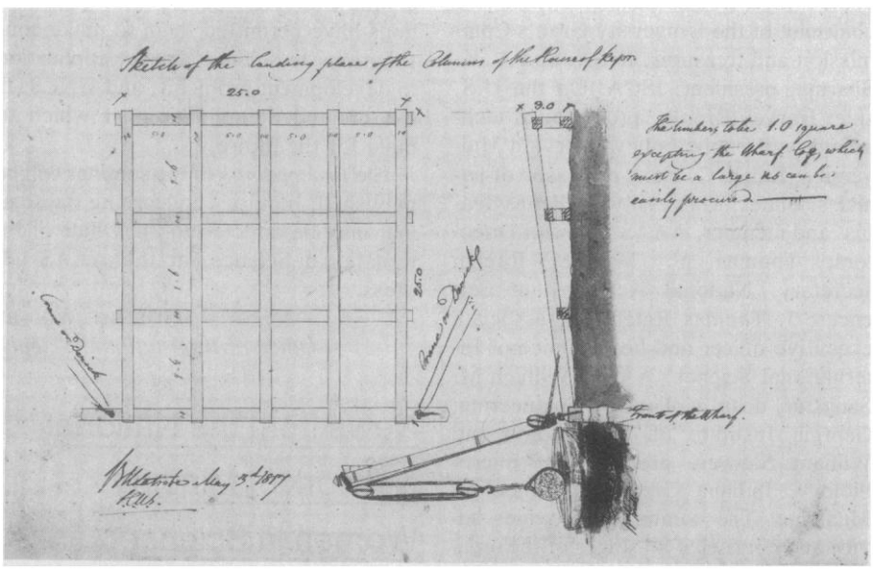
Documents of Technology

The Engineering Drawings of Benjamin Henry Latrobe. DARWIN H. STAPLETON, Ed. Published for the Maryland Historical Society by Yale University Press, New Haven, Conn., 1980. xx, 256 pp. $62.50. The Papers of Benjamin Henry Latrobe, series II.

In the development of American architecture and technology Benjamin Latrobe (1764–1820) was the leading pioneer figure, and the publication within the year of both his journals and his engineering drawings now provides abundant documentation of his position. His architectural achievement has been recognized since the appearance of Talbot Hamlin's biography (1955), but until the Maryland Historical Society and Darwin Stapleton collaborated in preparing the volume of his technical drawings we possessed a very defective idea of his contribution to the engineering arts. He was America's first professional engineer, and if many of his projects proved abortive the reasons lay in the primitive state of the native economy and technology rather than in any failure of his own. Since canal-building had become a mature technique by the end of the 18th century, Latrobe's plans for diversionary and navigational canals were perfectly feasible, and two designed by him eventually reached the stage of regular operation. His projects for large-scale waterway control and applications of steam power, on the other hand, taxed the financial and technical resources of the young Republic beyond their capacity, with the consequence that only the comparatively modest water supply system of Philadelphia reached the working stage. His solutions to problems of flood control and maintenance of navigation channels, however, were later adopted by the Corps of Engineers and employed down through the years where similar conditions existed.

The collection of Latrobe's engineering drawings is divided into two major parts. The shorter introductory section by Stapleton provides an overview of the engineer's career, presented chronologically and organized according to the projects with which he was associated. The longer portion consists of black-and-white and color reproductions of many of the drawings, accompanied by the editor's detailed analyses of the individual works, which supplement the introductory account. The drawings cover an astonishing range of graphic representation—waterway and geological maps, including topographic features, vegetation, and man-made elements of the landscape; site plans; paintings of natural scenes and structures; plans, elevations, sections, and details of civil engineering works, steam engines, and associated machinery. Latrobe was as much at home in mechanical as in structural and waterway technology, and the drawings offer voluminous evidence of his widely diversified graphic talents. The fundamental geometric and representational characteristics of modern engineering drawing are either present or clearly foreshadowed in Latrobe's work; the main features that distinguish his practice from the contemporary variants are the elaborate shading techniques designed to give the impression of three-dimensionality, the paucity of linear dimensions, and the virtual absence of notes. With respect to the last, one who has had practical experience in any of the engineering professions knows that designers now regard workers as dunces and hence bury their strictly graphic material in a forest of descriptive and explanatory notes. Perhaps the chief respect in which Latrobe was prophetic is the carefully laid scientific basis of his waterway projects, a characteristic that is most prominent in his master work, the 17-foot physiographic map of the lower Susquehanna River and its marginal lands. The attempt to represent geological features best displays the thoroughness of his preliminary scientific investigations, but at the same time it reveals the primitive state of the science in his failure to recognize the existence and understand the nature of metamorphic rock. Schist, gneiss, and quartzite, for example, are classified as granite, though Latrobe does distinguish marble and slate.



"Sketch of the landing place of the Columns of the House of Repr." As architect of the Capitol Latrobe was faced with the task of replacing the colonnade destroyed in the fire started by the British in 1814. "This drawing shows Latrobe's plan for receiving the columns from the boats at a wharf on the Washington Canal. On the left side is the plan of the deck of the wharf: an open lattice of heavy timbers making a square 25 feet on a side. At the lower left and lower right corners of the deck are the bases of the cranes for lifting the columns. On the right side of the drawing is an elevation of the platform, showing its upward slope to the land side of the wharf. There is also an apparently incomplete drawing of a crane lifting a column from a boat." [From *The Engineering Drawings of Benjamin Henry Latrobe*; delineators, William Small and Benjamin Henry Latrobe, 3 May 1817; original (32.4 by 50.2 cm) in the Library of Congress]

The most valuable feature of the book for the historian is Stapleton's close union of illustration and exposition. The primacy of graphic depiction for the creation, advancement, and successful working of a technology is so obvious as to require no further argument; yet even when the drawings serve a strictly utilitarian end, they must be supplemented by notes, reports, and specifications. The historian, however, needs more than these: if he or she is to comprehend and set forth the underlying need, the problems, the solutions offered, and their success or failure, verbal and mathemati-

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-