ploration of the technological component.

Now, more than 20 years after the publication of the last volume of this monumental work, one of Singer's associate editors, Trevor I. Williams, has undertaken the "completion" of the set with two volumes for the period 1900 to 1950. Williams believes that the passage of time has diffused the original objections to extending the series. With the intention of placing more emphasis on the economic, social, and political factors and adding chapters on management and unions, he has otherwise sought for these volumes to be "an extension of their predecessors."

Though the time that has elapsed since the publication of the volumes to 1900 has provided opportunity to make more judicious selection of topics and materials, the continuation in the basic format of the earlier volumes reminds us of how different a field the history of technology is today from that of the middle 1950's. Seven essays on the historical setting, the sources of innovation, and the economics of technological development have been added, but despite Williams's request that his contributors place their work in a historical setting most of the remaining 51 chapters, which cover subjects ranging from sources of power to food technology, simply chronicle technical developments. There are few analytical discussions of the role of technology in its social or cultural setting or of the shaping influence of society on technology. Where discussion of social context occurs, economic forces predominate.

In a certain sense these two volumes are an expanded equivalent of the second volume of the Kranzberg-Pursell textbook, *Technology in Western Civilization* (Oxford University Press, 1967). In this case the contributors are predominantly British rather than American. The result is an account that places undue emphasis on British developments—in some cases, such as atomic energy and weapons, requiring that the time frame be expanded well beyond 1950 in order to make the British case. Moreover, continental developments are slighted.

The organization by areas of technology has led to the usual redundancies, such as those between the treatments of atomic power and atomic weapons or of electricity and electric generation and distribution. The latter two chapters are separated by 30 chapters and are in different volumes. The chapter on communications ignores telephone technology after 1910; surprisingly little mention is made of the submarine, even in the chapter on ships; military technology in general is slighted; rubber technology is ignored; and styling and design in the automobile industry are underplayed. Much of the discussion of space technology is out of place in the designated time period. The chapters on management and architecture are among the more notable as good summaries.

As Williams notes, one of the basic problems for a work of this kind is obtaining qualified authors for 20th-century topics. It would have helped to draw upon a more international group of scholars. Yet the problem of true integration would have remained, given the Singer format. Such integration will not come through encyclopedic surveys but through scholarly monographs such as those of Bruce Sinclair, Merritt Roe Smith, Thomas Parke Hughes, Edwin T. Layton, and Hugh Aitken. The continuance of such analytic studies is required for any future survey of the history of technology that is to be truly historical and integrated.

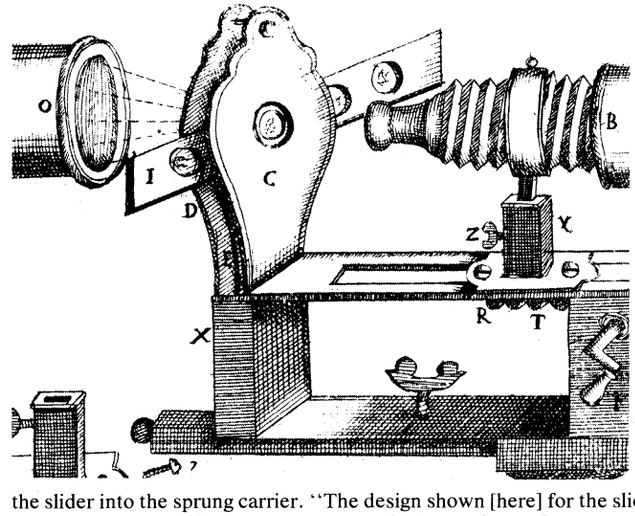
Williams, like Singer, has undertaken a Herculean task. The work provides a comprehensive survey of Anglo-American product and production technologies in the first half of the 20th century. I shall certainly make use of these volumes. The problems of sufficient space for meaningful discussions, appropriate contributors for the articles, integrated discussion of technologies that cut across industrial or disciplinary boundaries, and a true international perspective are most difficult to solve, especially in the Singer format. Williams has made a notable effort. And despite a misnumbering and incorrect ordering of pp. 1056–58, Oxford University Press has produced once again handsome, well-illustrated volumes with good indexes.

REESE V. JENKINS
Thomas A. Edison Papers,
Rutgers University,
New Brunswick, New Jersey 08903

Slides and Microtomes

A History of Microtechnique. BRIAN BRACEGIRDLE. Cornell University Press, Ithaca, N.Y., 1978. xvi, 360 pp., illus. $47.50.

The microscope has been the subject of some excellent publications by historians and practitioners, but the techniques associated with its use have had less attention. Brian Bracegirdle's account of the development of some of these techniques introduces a new high level of instrumentation scholarship by combining the historian's practice of interpreting published and ephemeral sources and the technician's facility in examining and using instruments to determine their functions and capabilities. Inspired by Edwin Clarke, who has demonstrated the value of recreating and duplicating classic experiments and observations for the study of the history of medicine and its technology, Bracegirdle set up a project in which he reviewed 40,000 microscope slides and scrutinized over 3500 of them in order to understand the development of microscopial preparations over a span of 150 years (1760–1910). He inspected original 18th- and 19th-century slides with the microscopes under which they were originally viewed.



The first illustration of a "slider," from F. Bonanni's *Observationes circa viventia, quae in rebus non viventibus reperiuntur* (Rome, 1691). The earliest sliders were made of ivory or hardwood and had several apertures. Each aperture contained a pair of mica disks, between which objects for viewing were placed. The disks were retained against a shoulder by a brass circlip. This illustration shows the chamfered end that facilitated insertion of the slider into the sprung carrier. "The design shown [here] for the slider was to be the norm for well over a century." [From *A History of Microtechnique*]

Bracegirdle's well-written and beautifully illustrated book summarizes the results of this extensive and well-placed labor.

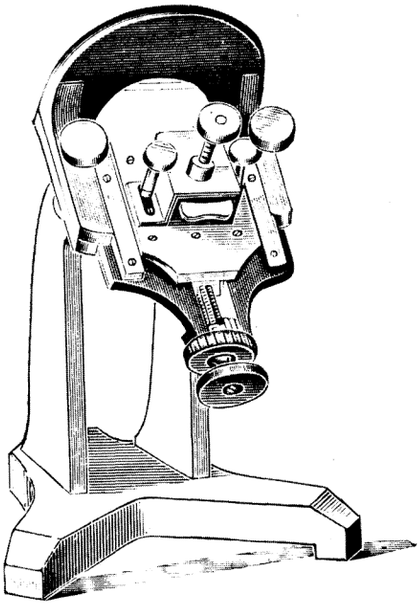
Microscope slides prepared in the 17th century have not survived, since they were created to be viewed only once, and most 18th-century "sliders" were made for amateurs, but a number of unstained 18th- and stained 19th-century preparations have been preserved in museums and private collections, including the author's. The methods and instruments employed in making these slides and some of the discoveries they led to are the topic of this volume.

The treatment of all aspects of the subject is excellent, but two information-packed chapters deserve special mention. One is the "select descriptive bibliography" of works on microtechnique published between 1830 and 1910. The other is the survey of instruments used in microtechnique in the same period. The latter chapter begins with a summary of how the size of the microscope slide came to be standardized in 1839 under the guidance of the Microscopial Society of London. Then all the major instruments and some of lesser importance employed in preparing specimens for mounting onto slides are traced. Among the most significant of these instruments is the microtome, the instrument for slicing thin transparent sections to be viewed under the microscope. Heretofore the microtome has scarcely been discussed, and it is not represented in many microscope collections. The instrument was named in 1839 by Chevalier, who had to be content with a Valentin knife for his own tissue preparations. Between 1840 and 1870 25 microtomes were designed and produced, and after 1870 many more appeared, often having undergone only trivial modifications. Embellishing the discussion of these instruments are intriguing bits of information such as Stilling's accidental rediscovery, when he noticed a frozen piece of spinal cord on the windowsill of his laboratory in 1842, of freezing as a method for preparing tissues for sectioning.

Another noteworthy chapter is "Notes on commercial mounters 1800–1910," in which is outlined the contribution of a number of slide manufacturers who sold their products primarily to amateur microscopists. The first commercial slide mounter to advertise his name on a glass slide appears to have been J. West of London around 1830. By the end of the century microscope specimens on slides for viewing through a projector were also being sold. Baker of London offered lantern slides for loan. Histological sections including preparations demonstrating plant and human physiology and pathology and bacteriology were lent to teachers and schools. A decade later Baker had lent out over 69,000 slides in addition to those he sold. Test plates made by F. A. Nobert of Barth in Pomerania and Grayson of Yorkshire and Melbourne, who could draw 120,000 lines to the inch, producing the finest test plate ever ruled, were among the other fascinating slides all microscopists could use to advantage. Slides containing intriguing and colorful designs composed, for example, of diatoms or the Lord's Prayer brought many amusing hours to amateurs, and their production was a major activity of slide manufacturers and retailers in the 19th century.

Bracegirdle concludes the book by discussing the impact of developments in microtechnique on the early growth of histology. Histology (the term was coined in 1819) commenced with Bichat's treatise of 1800, to be followed by years of stagnation. Between 1830 and 1840 microanatomy was extensively studied, and during the next 30 years the concepts of functional histology and pathology were expanded. There ensued an avalanche of fundamental research that made further demands for unique specimens and equipment to produce and study them. The technology that evolved to meet the demands is well described here. Biologists, historians, and many laymen ought to at least dip into the book, and many will find it stimulating enough to keep on reading.

AUDREY B. DAVIS
Division of Medical Sciences, National Museum of History and Technology, Washington, D.C. 20560



Microtome developed by Wilhelm His in 1866 and first described by him in 1870 (*Archiv für mikroskopische Anatomie*, vol. 6, p. 229). "Based on the use of a modified microscope stand, the specimen was held by the central screw directly below the stage aperture. Coarse adjustment was obtained by the screws either side, the whole carrier being clamped. Advance was by the large milled head, the knife being slid across the stage above." By 1870 His had made more than 5000 sections with his microtome. "It was a matter of pride to him to have been able to make so many sections in the time, but by 1885 it would be possible to make that number in one day!" [From *A History of Microtechnique*]

Probings of Artifacts

Archaeological Chemistry—II. Papers from a symposium, Chicago, Aug. 1977. GILES F. CARTER, Ed. American Chemical Society, Washington, D.C., 1978. x, 390 pp., illus. $46. Advances in Chemistry Series, 171.

The search for generalizations in ancient technology and for the moments of primacy in ancient innovation is always fraught with problems. Literacy in millennia long past was confined to mere pockets of civilization across the world, so our knowledge of practical details of early experimentation in, for example, metallurgy, glassmaking, and textile-dying, is truly narrow. I tend to believe that ancient artisans, when producing items such as a Shang Dynasty ceremonial bronze vessel (in China, around 1200

X-ray fluorescence analysis of Velasquez's portrait of Queen Mariana of Austria, painted around 1658. [Reprinted from R. Frankel, *Isot. Radiat. Technol.* **8**, No. 1 (1974), in S. V. Meschel's paper in *Archaeological Chemistry—II*]