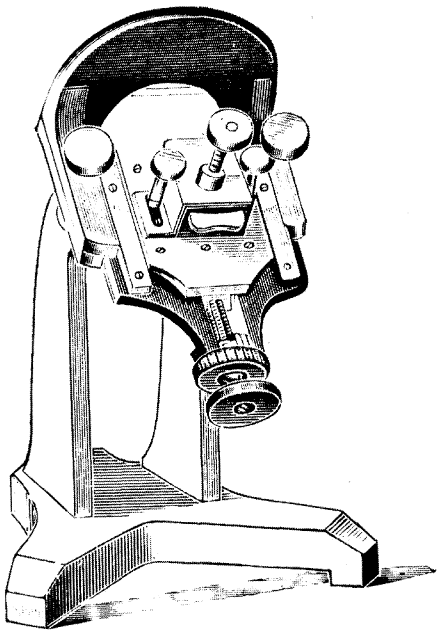
Bracegirdle's well-written and beautifully illustrated book summarizes the results of this extensive and well-placed labor.

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.



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*]

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.

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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*]

B.C.) or just a simple hand ax, worked more from rules of thumb in choosing ore sources and alloying recipes than through compliance with any formal priestly edict or indeed any folklore "handbook" of their ancestors. Otherwise it is difficult to understand why any stylistic, let alone technological, evolution was ever possible. I also have an uncomfortable feeling that many elements of fickleness pervaded the decision-making processes of ancient artisans: Brief intertribal disagreements and events like river flooding would have a far sharper effect on trading of raw materials than we currently predict, and the division of time between the development of new ideas and the completion of daily chores that kept mouths fed was probably finely balanced.

Factors such as these make the topic of archeological chemistry as much an excursion into past socioeconomy as a laboratory exercise, as much a psychological analysis of why an ancient artisan saw fit to perturb his or her own notions of how to handle materials routinely as a playground for statisticians who seek to define what "routine" meant, generation after generation.

Necessarily, then, *Archaeological Chemistry—II* is an admixture of ideas failed (or, in the case of amino acid racemization dating, of potential far from fulfilled) and elegant little studies that really do give us an empathy with our distant ancestors. Blurred pictures emerge about just how reliable collagen is in radiocarbon dating of bone and about aging mechanisms in Near Eastern ivories. In contrast, three-dimensional plotting of the cerium, lanthanum, and thorium concentrations for Spanish Colonial majolica pottery reveals a dramatic difference in source clays used, one group from Spain itself, the other from Mexico. I would expect this study, when extended, to provide a fascinating insight into how swiftly the culture carried by the Spanish conquest actually infiltrated and overprinted local traditions in its early phases. Separately I was intrigued by the marked success of x-radiography in study of bronzes in the Metropolitan Museum, particularly in analysis of the construction technique of an arsenical bronze *Ibex* (Sumerian, around 2500 B.C.), the head and neck of which are joined by an ingenious tongue-in-groove method.

Perhaps it is a consequence of my personal interest in how bitumen came to gain popularity as a medicament in the Middle Ages that the contribution on asphalts from Middle Eastern sites attracted my attention. Use of asphalt in Zagros settlements dates at least as far back as 7000 B.C., four millennia before it became an essential building material in Mesopotamian cities. By 5000 B.C., seepage bitumen was being converted to asphalt with considerable sophistication, the only subsequent innovation being the addition of vegetal matter together with reduction of the bitumen content. The surprises for me were to learn how many specimens of this organic adhesive-cum-sealant have survived the ravages of time at sites such as Tepe Farukhabad (southwestern Iran) and then of the future possibility of provenancing them to source by the ratio of vanadium and nickel contents. Our comprehension of the complexities of trade and intercity conflict along the length of the twin rivers, Tigris and Euphrates, is dawning but slowly, so each new fragment of fact provides desperately needed clues, however small.

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Classical Problems in Physics

The Physics of Vibration. Vol. 1, containing Part 1, The Simple Classical Vibrator. A. B. PIPPARD. Cambridge University Press, New York, 1978. x, 432 pp., illus. $54.

At a time when 90 percent of the new-books shelf in the library is devoted to such specialized titles as *A Renormalization Group Analysis of the Hierarchical Model in Statistical Mechanics* and 10 percent to unsuccessful attempts to write a better textbook, this volume is a most refreshing diversion. Pippard presents here a potpourri of musings about a wide variety of problems related, often somewhat tenuously, by virtue of some connection to the simple harmonic oscillator.

If your students have wondered, as I did as a freshman, why so many weeks of valuable class time are devoted to that apparently innocuous problem of a mass dangling from a spring, they will find ample answer in a perusal of this book. Pippard finds the opportunity to touch on topics as varied as noise theory, parametric amplification, stability of nonlinear systems, finger holes in woodwind instruments, relaxation times in nuclear magnetic resonance, mode locking, atmospheric whistlers, cyclotron resonance, and the pendulum clock. He treats none of them in technical depth, as he reminds us rather tediously at the end of many sections with such remarks as "These are advanced matters which would be inappropriate here." He treats them all with a physical insight that is consistently sound and is often missing from conventional textbooks, which are of necessity more involved with technical details.

I find in this unconventional book insight concerning a number of questions of the sort one is reluctant to raise as a student for fear of displaying one's ignorance. How can a signal that is zero for all time before a particular time, t_0, possibly be represented by the sum of infinite wave trains that were nonzero when the signal was still zero? Why does $e^{\alpha t}$, with suitably chosen α, always satisfy a homogeneous linear differential equation with constant coefficients? I never found "because it works" a very satisfactory response. Pippard encourages and helps the reader to ponder such questions.

This is not a textbook in any conventional sense. It is rather a book that brings new physical perspective to familiar problems, introduces the reader to some of the important physical ideas and relevant mathematical approaches to unfamiliar problems, and, perhaps most important, illustrates something of the style with which an eminently successful experimentalist approaches the understanding of physical problems. The book will provide many provocative ideas to anyone teaching a course in undergraduate or graduate mechanics, though it could not serve as a textbook for such a course. The graduate student studying for comprehensive exams would find serious study of this volume a stimulating and refreshing contrast with review of the standard textbooks. Because of its wide range and its continuing invitation to explore simple problems in depth (physical, not mathematical), the book would serve well as the basis of a small senior-level seminar. Such a seminar would help consolidate many aspects of the undergraduate curriculum, give exposure to a number of new ideas, and provide an important introduction to the "back of the envelope" argument.

This volume, which is restricted to classical problems, is to be followed by a second one, treating quantum systems. I am looking forward to some fresh insight into such matters as the significance of simple harmonic oscillator level widths and the appropriate time scale for discussion of the γ-ray emission in the Mössbauer experiment.

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