

## History of Science

**Robert Boyle on Natural Philosophy: An Essay with Selections from His Writings.** Marie Boas Hall. Indiana University Press, Bloomington, 1965. x + 406 pp. Illus. \$6.75.

"Boyle died just as Newtonian physics was beginning its ascendancy, and the success of the Newtonian synthesis somewhat obscured Boyle's influence upon science and thought. How many readers of Locke's *Essay on Human Understanding*, published 3 years after Newton's *Principia* and directly associated with Newtonian philosophy, have realized that the 'Newtonian' echoes were, in fact, derived from Boyle?" (p. 110).

Thus, in the conclusion of part 1 of this book, Marie Boas Hall states her case for a continued interest in the work of Robert Boyle. Her justification is valid, and in this book she has excellently summarized Boyle's achievements (in part 1) and illustrated them (in part 2) with extensive and appropriate excerpts from Boyle's writings. This book is thus both a summary and a source.

Although, as Hall freely acknowledges, Newton was the better scientist of the two, his work did not supersede or displace Boyle's, and the latter's scientific work continued to be read and admired by scientists throughout the 18th century. Boyle was more of an experimentalist and less of a synthesizer than Newton, and it was to his detailed accounts of experimental investigations that later scientists turned for information and example. Boyle's standards of investigatory procedure had not become habitual even by the end of the 18th century.

The book is divided into two parts. Part 1 includes a 30-page "Life," a "Conclusion," and four chapters efficiently describing Boyle's contributions to "The New Learning" (the experimental investigation of nature), "The Mechanical Philosophy," "Chemistry," and that field uniquely Boyle's, "Pneumatics." For those already familiar with recent writings on this period, these 110 pages constitute an excellent summary. At the same time, part 1 is sufficiently extensive to be useful to any one making his first attempt to study Boyle's life and science.

In part 2, which constitutes about two-thirds of the book, the four in-

terpretive chapters of part 1 are paralleled by four identically titled sections devoted to illustrative quotations from Boyle's writings. The order is significant, for Boyle was first of all an experimentalist, and what he saw was a mechanical world. Hall's inclusion of Boyle's familiar definition of the chemical element in the section devoted to mechanical philosophy illustrates this interpretation. Hall has done us all a great service in making these selections topically available, for as she knows, probably better than any one else, Boyle's writing style is terribly prolix and for the modern reader a major work appears almost impenetrable.

The quotations are drawn largely from Thomas Birch's *The Works of the Honourable Robert Boyle*, although

it is not clear whether from the edition of 1744 as stated on page 118, or from the edition of 1772 as stated in the prefatory note on page vi. In either case, references to place and date of original publication are given only in the introductory note to each group of selections, and page references are given only to the *Works*. This may constitute a minor frustration to readers who wish to pursue more of Boyle's thought in the original context.

In summary, the book is a valuable source for those who require a brief but reliable interpretative account of Robert Boyle, and a correlated supply of supporting quotations.

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## Koshtoyants Commemorative Volume

**Essays on Physiological Evolution.** J. W. S. Pringle, Ed. Pergamon, London; Macmillan, New York, 1965. xxii + 364 pp. Illus. \$12.

This is a collection of papers published in Moscow in 1961 in memory of Professor Kh. S. Koshtoyants, the leading comparative physiologist of Russia. A biographical sketch shows how Russian scientists are active in public affairs; Koshtoyants was elected from Armenia to be a Deputy of the Supreme Soviet of the U.S.S.R. His bibliography contains some 120 papers written between 1928 and 1961 and covering a variety of topics but emphasizing comparative physiology of nervous systems and muscle.

The essays are a miscellaneous lot, very few of them related to the title of the volume, *Physiological Evolution*. Some are in the style of reviews, a few resemble after-dinner talks, and others present original research. Some of the Russian papers use vague concepts that have little meaning to Western physiologists—for example, "an-electrotonic and catelectrotonic syndrome" (Arshavskii), "cathodal parabiosis" (Zhukov), "pessimum" (used on p. 1 and defined on p. 341), and the use of mineral water to block acetylcholine receptors (Mirzoyan). It is also difficult to accept without more critical proof that the fact that the temperature of fish is below water temperature on

warming and above it on cooling is not more than a lag due to thermal conductance (Pegel' and Remorov). It is also difficult to understand the reported significance of increased production of ammonia by brain and muscle in epileptic seizures (Budanova), the release of acetylcholine and changes in Ach metabolism not only in acute radiation sickness but several years after severe irradiation (Demin), and the recommended use of honeybee venom for treatment of hypertensive diseases (Artemov).

Many of the Russian papers present aspects of physiological evolution in clear and original ways. A paper on the phylogeny of chemo- and baroreceptors in vascular reflexes includes much new information (Chernigovskii). Interesting changes in succinic dehydrogenase, also in transport properties of the gills and kidneys of fish according to whether they are in fresh water or seawater, are presented (Ginetsinski, Vasil'yeva, and Natochin). Karamyan traces the evolution of central responses to visual stimulation from midbrain to specific regions of the forebrain. Evidence that the acetylcholine receptor of frog ventricle is a sulfhydryl-protein is given by Turpayev. Zhukov reports on the tonic (slow fiber) muscle in reptiles and suggests that such fibers (also found in cyclostomes but not fishes) were used in amphibians and reptiles in static antigravity responses whereas in mam-

mals, with higher centers of gravity, the antigravity control is more dynamic, hence postural muscles are all of the fast type.

Among the papers from outside the U.S.S.R., several are of particular interest. Burřs, Bureřov, and Křivnek, from Prague, describe the release of potassium from cortical cells as the basis for spreading depression. Grundfest discusses the evolution of sense cells as a transition from transducing mechanisms to electrogenic neurones. Pantin clearly separates the fast and slow systems of contractile response in sea anemones. A brief but scholarly historical essay on concepts concerning the evolution of the brain is given by Magoun.

This volume makes available to Western physiologists some important work previously published only in Russian. Many of the chapters are provocative and informative. The quality is extremely uneven, and the title of the volume is not appropriate.

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## Transistor Devices

**Principles of Electron Tubes: Including Grid-Controlled Tubes, Microwave Tubes, and Gas Tubes.** J. W. Gewartowski and H. A. Watson. Van Nostrand, Princeton, N.J., 1965. xvi + 655 pp. Illus. \$18.50.

The decade of the 1960's may go down in the history of science and technology as the one in which training in transistor devices *completely* displaced that on the use of electron tubes. The collection of tales is growing about the young engineers who design intricate control equipment, up to the point where an electron tube becomes necessary, and then bog down completely. Gewartowski and Watson's book may well turn this tide. Here is a book that presents, between its covers, the fundamental principles of electron tubes with the technological developments, covering the full range from diodes and triodes, through picture tubes, klystrons, magnetrons, traveling wave tubes, and gas discharge devices, to an ultimate chapter on gaseous lasers. Not infrequently in universities the inside of the electron tube is described

in one course and circuits and the uses of the tubes in another course; the courses may even be taught in different departments. Occasionally, students have time for only one of the courses, a situation that leaves them in an oddly incomplete position professionally. Gewartowski and Watson acknowledge this to be the rule rather than the exception. The book is written for the use of engineers and physicists at approximately the first-year graduate level.

The problem of rigor and completeness within the bound of 600 pages is squarely faced and met. Electron sources and electron optics are first treated. The reader is left satisfied with his comprehension of the subject—that is, he knows that the treatment is usable and that greater complexities lurk very near. The subject of "radio tubes" is handled by treating the fundamentals and illustrating them with one example each of a triode, a tetrode, and a pentode. The ground is laid immediately for klystrons and other microwave tubes by raising the question at the outset of the electron transit time compared with the signal period. The famous teaser that has been stumbled over by generations of students—"what is the current induced in an external metallic circuit while an electron is traversing a diode space?"—is clearly formulated and solved, and its importance in practice is subsequently emphasized. The use of equivalent circuits is presented and extensively used. A smooth transition from lumped circuit constants to microwave procedures is made, and a quite thorough treatment of elements of microwave equipment and analysis is presented.

Approximately one-third of the book (the middle section) deals with klystrons, traveling wave tubes, and magnetrons. The treatment, as is customary in this book, covers the principles and designs of tubes *and* a discussion of uses of the tubes. The final chapters deal with gas discharges and devices.

In general, the problems presented are exercises in application of principles, with only a few purely numerical ones.

Regardless of whether authors, editors, or publishers deserve the credit, it should be noted that the style, format, and language are remarkably good.

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## Boring's Selected Papers

**History, Psychology, and Science.** Selected papers of Edwin G. Boring. Robert I. Watson and Donald T. Campbell, Eds. Wiley, New York, 1963. xii + 372 pp. \$8.95.

The pen of E. G. Boring has been one of the truly phenomenal instruments of our time. Skillfully directed toward all manner of public psychological questions and problems—the psychology of science, systematics, psychological history and historiography, critique of the communication process, psychophysics and psychophysiology, persistent vexations of epistemological roots (not to mention a solid set of laboratory investigations and even ventures into psychopathology)—it has been of enormous influence in shaping the psychological thought of this generation and will be in shaping that of the next. The *omnium gatherum* by 1961 was reckoned as 505 publications!

If the present book were being put together in the early days of the republic, it would have carried some such title as "The Science of Science; being a selection of some of the essays of Edwin Garrigues Boring on scientific topics not hitherto assembled in one place, though for the most part already published in scholarly journals, and eschewing all writings dealing with such matters already contained in Professor Boring's justly popular *History of Experimental Psychology, Sensation and Perception in the History of Experimental Psychology, The Physical Dimensions of Consciousness*, and, with one notable exception, his recently expanded autobiography, *Psychologist at Large*."

The one exception is "Human nature *versus* sensation: William James and the psychology of the present," a paper originally printed in 1942 in *American Journal of Psychology* at a time when preoccupation was less with "microscopic psychology," as James derisively called it, than with new aptitude tests and formulae for correction of restricted range. The James paper is a great paper, a masterful effort to point up the differences between the Jimmian psychology and the modern positivistic approach, and fully merits the reiteration provided by *Psychologist at Large* and the present volume.

The contribution selected for keynote position and one eminently deserving