

picture of Carnot, an engineer deeply involved in the political events of his time, who nevertheless retained a constant and productive interest in mechanics and mathematics. The book is handsomely printed, and Gillispie closes it with a very useful bibliographical essay.

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## Harvey as Inductivist

**William Harvey and the Circulation of the Blood.** GWENETH WHITTERIDGE. Macdonald, London, and Elsevier, New York, 1971. xvi, 270 pp. + plates. \$12.75.

Historians of modern science have offered few instances of radically conflicting interpretation firmly based on sound research and developed through cogent argument. The case of Harvey now becomes a notable exception. In question is Harvey the discoverer and at issue, to state it bluntly, are facts versus ideas. Gweneth Whitteridge favors facts and discounts ideas. Her study presents a forceful, ample, and often persuasive portrayal of the English physiologist as a "rational, unemotional" Aristotelian and the quintessential empiricist. By means of meticulous exposition and occasional general discussion, she seeks principally to create a chronology of Harvey's physiological studies. Her purpose and achievement are, however, anything but a mere precise dating of research and discovery. She stalks bigger game, and thus nicely transforms an extremely valuable assessment of Harvey's debt to his predecessors (notably Realdus Columbus) and a record of his own masterly anatomical investigations into a stern but fascinating polemic against the philosophical school of Harvey interpretation.

Whitteridge denies the famous doctrine of circles or its advocates any innovative influence on Harvey's consideration of the circulation of the blood. That discovery in her account is rendered the product of indefatigable and imaginative observation and experiment. Harvey loses all semblance of speculative philosopher and, above all, Neoplatonic metaphysician and becomes physiology's preeminent inductivist, moving from more or less randomly accumulated evidence and preliminary hypothesis to later testing and confirmation, or rejection, of that hypoth-

esis. Unfortunately, this hackneyed methodological sequence is of uncertain validity. It is also of dubious value in interpreting Harvey and raises some question, because of unsure terminology, regarding the true objective of Whitteridge's analysis.

The reader of *William Harvey and the Circulation of the Blood* will be uncertain whether its author really intends to relate the "history of a discovery" or whether she hopes, following Harvey's own words, "to confirm it by sense and experience" (p. xi). At issue is the ambiguous delimitation of "discovery" and "confirmation," the treasured innovation being, of course, Harvey's total view of the motion of the heart and circulation of the blood. Whitteridge's great knowledge of the available evidence lends credence to her claim that, for the present, the precise date of Harvey's discovery is unattainable. She also asserts (p. 111) that Harvey's vigorous collection of data by means of comparative anatomy, vivisection, and astute observation indeed bore fruit: "At some stage these observations ceased to be random." Yet this is not to resolve but to restate crucial questions. Why did his observations cease to be random? Had Harvey found his hypothesis? How had he done so? Or, as is not unlikely, had his investigations never really been "random"? Had he, even before his Lulleian lectures of 1616, a hypothesis by which to work? In either case, what are the terms of the hypothesis or hypotheses which entered Harvey's mind?

It is at this point that the philosophical and certainly more audacious interpreters of Harvey, preeminent among them being Walter Pagel (*William Harvey's Biological Ideas*, 1967), make their contribution. Acknowledging the paramount role of vivisection and comparison in the confirmation of Harvey's discovery, they focus on the act of discovery or, at the very least, the conceptual preoccupations informing it. Here are emphasized Harvey's various allusions to heart and hearth, solar influences and meteorological cycles, allusions which Whitteridge is willing to dismiss as after-the-fact appeals to authority. (In this alone, she believes, Harvey acted as a traditionalist.) Whitteridge implicitly accepts Harvey's presentation throughout *De motu cordis* as not only the obvious logical exposition of a new doctrine but a virtual record of a great discovery. This is a perilous assumption and one which

probably necessitates an inductivist interpretation of Harvey's achievement.

Elsewhere Whitteridge offers an uncommonly useful chapter on Harvey's views on the physiological primacy of heart or blood (the former holding sway over the mature body but the latter, because of its qualities and action in embryological development, being the truest basis of life in general). In appendix 1 appears, for the first time since the 17th century and in both Latin and in English translation, the most complete extant version of Caspar Hofmann's letter to Harvey of 19 May 1636 setting forth a Galenist's objections to the new doctrine of the circulation of the blood.

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## Boron Compounds

**Carboranes.** RUSSELL N. GRIMES. Academic Press, New York, 1970. xiv, 272 pp., illus. \$14. Organometallic Chemistry series.

The term "carborane" refers to a relatively new family of organoboron compounds which may be thought of as boron hydrides or polyhedral borane anions in which one or more boron atoms have been replaced by carbon atoms. We therefore find very stable carboranes which have closed polyhedral structures and some degree of electron-delocalization stabilization and relatively reactive open-framework carboranes containing more hydrogen atoms than carbon and boron atoms. Those of the former series (termed *closo*) are amenable to electrophilic substitution reactions and derivative formation with a vast variety of organic functional groups. Those of the latter, generally more unstable, series (termed *nido*) are less amenable to derivative formation and sometimes serve as precursors to *closo*-carboranes. Finally, recent work has provided a third general class of carboranes in which the basic framework structure contains atoms other than carbon and boron. Examples of this type of structural modification are known in which elements of groups II, III, IV, V and the transition metals are incorporated as framework members. Thus, the car-