Book Reviews

A Concept of Many Uses

Conceptions of Ether. Studies in the History of Ether Theories, 1740–1900. G. N. CANTOR and M. J. S. HODGE, Eds. Cambridge University Press, New York, 1981. x, 352 pp. $55.

This volume collects ten independent studies of diverse themes from the rich history of ether theories. The editors have provided a valuable introduction integrating much of the recent secondary literature and at least attempting to place the individual essays within a common framework. Nevertheless, although the book does hang together thematically, it is scarcely a more coherent whole than most such collections.

Ironically, perhaps, one of the chief functions of ether has historically been to integrate disparate classes of phenomena. In the 18th century in particular ether was frequently a key concept in natural philosophies of broad scope, views of the world that embraced not only natural phenomena but also the mind and God. Again and again ethers have been invoked as mediators between different species of matter or between matter and spirit. Heimann shows nicely how ether theories could have fostered themes of the unity of nature and the duality of forces during the early 19th century, themes concern with which some have been inclined to take as prima facie evidence of *Naturphilosophie*. In contrast with this earlier period of wide-ranging speculation, most of the 19th century (as Cantor observes and others illustrate) was marked by the more limited concern with the invention of mathematizable mechanical models capable of accounting for the phenomena of optics and (later) of electromagnetism. Cantor further notes that the "theological" use of ether—common during the 18th century but not prominent during the middle quarters of the 19th—revived in Britain in the decades around 1900 in the hands of Oliver Lodge and others. What we are not told is how properly "scientific" these thinkers or their contemporaries considered these musings. It is surely significant that the work of 1875 in which Balfour Stewart and P. G. Tait invoked a hierarchy of ethers to mediate between the realms of science and religion was published anonymously. Such examples suggest that changing attitudes toward ether might provide a way of estimating what was regarded as "scientific" at different times.

As the editors remark, "Ether concepts introduce us to the broadest themes in the scientific thought of the eighteenth and nineteenth centuries" (p. ix). Among the historiographically important themes featured in one or more essays are the metaphysical and theological aspects of science, the nature of scientific explanation, methodology (for example, whether inductive or hypothetico-deductive), and the role of models and analogies. Siegel's paper, in particular, illustrates the complex changes in the "reality" status of ether: William Thomson transformed Faraday's lines of force into an electromagnetic ether via a suggestive mathematical analogy between heat flow and Faraday's calculus of electrical lines of force; Thomson's dynamical models afterwards *became* reality for him. In contrast, Maxwell's conviction of the early 1860's that he had succeeded in discovering (in Siegel's words) "an explanatory mechanical theory rather than an illustrative analogy" (p. 247) gave way to increasing dissatisfaction with detailed mechanical models of the structure of the ether; the formalism based on Lagrangian mechanics then became the centerpiece. One paper (Christie's) attempts to explain Hume's, Adam Smith's, and William Cullen's use of ether in terms of "the larger economic and ideological forces that moved and shaped the culture" (p. 86). Unfortunately, the argument is weak and the evidence thin. Several papers provide raw material for a consideration of national differences in the conception of ether, but none elaborates these differences with an explicit comparison.

It is hardly surprising that the contributors do not all pay equal attention to the gamut of themes dealt with in the book. It is somewhat more surprising, given the book's pretensions to unity, that they contradict or talk past each other as often as they do. For Heimann (who cites relevant evidence), James Hutton and Peter Dugud Leslie both believed in an active ether that provided a unified account of light, heat, electricity, and chemical activity, whereas Laudan (who cites none) places them among those who rejected imperceptible fluid hypotheses. According to Christie, "Hume's methodology and epistemology by no means ruled out etherial speculation" (p. 87); according to Laudan, "classical empiricism (by which I mean the empiricism of Berkeley, Condillac, Hume, and Reid) left no scope for entities like ether" (p. 159). The problem, it seems to me, is that each author has accommodated the sometimes ambiguous evidence rather too unambiguously to his own ends. In the same fashion, Laudan seriously overstates the extent to which the work of late-18th-century natural philosophers embodied a "trenchant inductivism" (p. 170). His strongest evidence is from the commonsense philosopher Thomas Reid, who Laudan neglects to tell us was not also a *natural* philosopher. Even at that, his account of Reid's criticism of David Hartley is one-dimensional in its limitation to epistemological issues: elsewhere in the volume Christie, French, and Cantor all point to the moral and theological aspects of Reid's hostility to Hartley. Laudan treats scientists' methodological pronouncements as if they determined their commitments to particular theories, and he consistently misses the polemical character of what purport to be philosophical strictures. He writes: "Roger Boscovich called Le-Sage's system a 'purely arbitrary hypothesis,' for which there is no direct proof" (p. 165). Boscovich here stands for the putative antispeculative consensus of late-18th-century natural philosophers, hence it would be awkward for Laudan to recognize the absence of any "direct proof" of Boscovich's point atoms, either.

With few exceptions, however, the caliber of writing as history of science is high, and the essays by and large give a fair representation of the scientific context. Buchwald's précis of 17th- and 18th-century developments in optics and his examination of technical issues in the molecular theory of ether during the 19th century deserve special praise for the clarity with which difficult material is distilled and explained. Buchwald pays particularly careful attention to the kinds of problems that usually appeal to those working in a mature science: Which phenomena can a theory explain, and in particular which can it explain quantitatively? On the other hand, he ignores all other kinds of issues (personal, philosophical, or whatever) that typically influence a scientist's judgment. Not that the story he is concerned with would ever be as richly ramified as one of 18th-century figures, but given, for example, what we know of Fresnel's philosophical

interests, one wonders whether we may be getting too "objective" an account. There remains an imbalance among the essays with respect to the adequacy with which different factors are considered. A balanced account does not result from the mere juxtaposition of partial viewpoints.

This volume provides a striking number of examples of theories that have successfully accounted for a significant fraction of the known phenomena, only to have to be abandoned. Darwin wrote, in defense of his own theory, that one would not expect a false theory to explain so much. Alas for the defenders of many a good-looking theory, neither history nor philosophy sanctions such an intuitive conviction.

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Invertebrate Paleobiology

The Ammonites. Their Life and Their World. ULRICH LEHMANN. Translated from the German edition (Stuttgart, 1976) by Janine Lettau. Cambridge University Press, New York, 1981. xiv, 246 pp., illus. $19.95.

In this book, somewhat updated in the translation, Lehmann draws extensively from European examples to illustrate major aspects of ammonite paleobiology. His intention is to take ammonities, superb biostratigraphic markers that they are, and view them as living creatures. The strongest portions of the book develop this theme, dealing with paleobiological topics that Lehmann personally has researched: sexual dimorphism and ammonite jaws and radulae. Lehmann expands his earlier articles into a coherent chapter on ammonite jaw shapes and the relationships between aptychi and possible modes of feeding. Aptychi are clearly shown to be part of the jaw apparatus, rather than opercula as previously thought.

The book is aimed at nonspecialists. As a researcher interested in ammonites, I felt a slight unease, stemming not from the contents but from the topics that are not covered. Ammonites are fascinating because of their peculiar evolutionary history of high speciation rates followed by spectacular extinctions and because of the extraordinary complexity of their chambered shells. Lehmann addresses both of these topics in only cursory fashion. Jurassic and Cretaceous ammonites showed some of the most spectacular expansions and declines in the fossil record. The ammonites of the Jurassic served as the basis for the pioneering efforts in biostratigraphy of the last century, by such forefathers as d'Orbigny, Quenstedt, and Oppel. The strength of Lehmann's work has been in looking at ammonites as once-living organisms. Such an approach could have been enlightening if used in an evolutionary context. Second, the great debate about the ammonite suture, whether it served as a strengthening device or an aid to buoyancy control, is not discussed. It is perhaps no accident that the increase in sutural complexity in the Ammonoidea is matched by an increase in diversity. More insights into the use of the complex septa in the living ammonite, including a discussion of the Westermann-Bayer debate, would have been welcome.

The book will be welcome to anyone wishing easier access to this baffling but fascinating group. It is easily the best summary to date in a rapidly expanding field.

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A cast of one of the largest ammonites ever found, *Parapuzosia seppenradensis* (H. Landois), Upper Cretaceous, Seppenrade near Münster in Westphalia (West Germany). Diameter 1.7 meters. [From *The Ammonites*]

Archeological Strategies

Foundations of Northeast Archaeology. Papers from a conference, Albany, N.Y., Feb. 1980. DEAN R. SNOW, Ed. Academic Press, New York, 1981. xiv, 270 pp., illus. $19.50. Studies in Archaeology.

According to editor Snow, the purpose of this volume is to explore the "range of problems, possible research strategies and possible solutions" appropriate to the archeology of northeastern North America. Though a collection of seven individually authored conference papers is probably not the ideal instrument for this purpose, the book does include some valuable and stimulating discussions of topics important to northeastern archeology.

Bruce Trigger's lead-off paper, "Prehistoric social and political organization: an Iroquoian case study," presents an extensive critical review of research concerning these topics and other aspects of Iroquoian culture and environment that bear upon them. Trigger advocates a strategy for future research that includes the refinement of chronologies, extensive (even total) excavation of sites, and more careful study of artifact distributions. This strategy will be criticized by deductivists and particularly by advocates of the "conservation ethic," but the problems he addresses are complex and his aggressive stance therefore is probably justified.

Dena Dincauze's "Paleoenvironmental reconstruction in the Northeast: the art of multidisciplinary science" is, in her words, "a multifaceted review" of an approach that has figured prominently in her teaching and research. That approach rests upon "collegiality" among