Encyclopedia of Ancient Natural Scientists: The Greek Tradition and Its Many Heirs edited by Paul T. Keyser and Georgia Irby-Massie

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What are the boundaries of ancient science? What subjects were pursued as part of the study of nature? Who should be counted among ancient scientists? How did they conceive of themselves and their activities? Where were they from, especially those who inherited traditions long after ancient Greece lost its independence?

Historians of ancient science have increasingly recognized the importance of such questions, even as they have learned how difficult they are to answer. Research in recent decades has paid extensive attention to areas once excluded from studies of science—everything from applied technologies to magic, alchemy, and astrology—even as fuller and more honest accounts of central fields have acknowledged that individuals long celebrated as heroes of rational inquiry regularly delved into formerly suspect areas and often failed to live up to their carefully crafted self-presentations as fully rational inquirers.

In the face of the vastly increased complexity of the study of ancient science, Paul T. Keyser and Georgia Irby-Massie have done a superlative job in putting together the *Encyclopedia of Ancient Natural Scientists: The Greek Tradition and Its Many Heirs* (hereafter *EANS*). Shepherding a team of over 100 scholars of ancient science and writing half of the entries themselves, the editors have produced a resource of remarkable breadth and value, reflecting the best current thinking in the history of ancient Greek science in all its inclusive diversity. In a single volume of just over 2000 entries filling 1000 pages, they have provided a comprehensive guide to a range of materials far beyond what previous editors have attempted or would have thought necessary—a point over which they show justifiable pride [5]. There are, of course, concise and informative entries covering every

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major figure in ancient science. More remarkably, they have included hundreds of names that appear in no other reference work—names mentioned sometimes only once in sources combed and sifted from more than a millennium of surviving literary remains. Joined to this exhaustive list of named figures, the editors also include 200 pages devoted to place names, timelines, topics, a glossary, and indices (including women scientists, rulers, and the ancient names of plants). *EANS* will certainly become the standard starting point and often the only readily accessible source for research in ancient science.

Despite its remarkable breadth, *EANS* is highly focused. This is indicated by the volume's subtitle. The editors concentrate on Greek and Greek-based natural science. By Greek, they mean works written in Greek (even if known only by reference in later writers) or works clearly indebted to Greek writers produced up until *ca* AD 650. These inheritors are found mainly in Latin sources; though again as a sign of their inclusiveness and completeness, reference is made to works in Armenian, Celtic, Gothic, Egyptian, Persian, Sanskrit, and a host of Semitic languages. By natural science, they mean abstracted descriptions of nature that attempt to explain it rationally, without recourse to divine personages or an uncritical reliance on tradition. One might worry that such a definition begs many questions. But the editors recognize the arbitrariness of disciplinary boundaries and have tried to be inclusive of figures and works on the margins. They have excluded areas of philosophy not bearing directly on a science of nature, most theology (including divine cosmogonies), and mere records of technological wonders. But one finds references not just to physics, cosmology, biology, and mathematics, but also to geography, pharmacy, the study of stones, astrology, alchemy, cosmetology, and many other formerly non-standard disciplines and activities.

Given the breadth of the coverage and the clarity of their goals, I offer the following observations not in criticism of the editors' policies but as an indication of the precision of their focus.

The oldest named figures are Homer (as the starting point of geography) and Hesiod (primarily for his moralistic tone and agricultural calendar, not for his cosmogony and possible Babylonian influences). Plato and Aristotle are covered in entries clocking in at the 2000-word maximum length, both of which focus on their scientific ideas. There is a brief entry on Socrates the younger, but there

is no entry for 'the' Socrates. The historians Herodotus and Thucydides are included, the former for the sake of a fuller understanding of *historia*, the latter for his account of the Athenian plague of 430, and both for their contributions to geography. Xenophon of Athens also merits an entry, apparently because of his writings on applied military arts. Twelve pages are devoted to various Greek papyri dealing with mathematical problems, alchemical recipes, and medical issues. But there is no entry for the ancient Egyptian Edwin Smith medical papyrus or on Egyptian medicine generally. There is, however, an entry on the infamous Egyptian Queen Cleopatra that focuses on a work *On Cosmetics* attributed to her. Babylonian astronomy is discussed; but the emphasis of the very interesting article is on the assimilation of its later, exact phases into Greco-Roman astronomy of the Hellenistic period.

While the Greek tradition serves as a strong organizing principle, it functions less clearly as a theme of individual entries. The editors have developed a system for cross-references which is easily learned and can be useful. But articles often do not place their subjects in the larger tradition, so that the relative importance and influence of various figures is hard to assess. This may be an unfair criticism. *EANS* is, after all, an encyclopedia, not a history. And while the sense of promise of an overview of a long tradition conveyed by the editors' introduction seems unfulfilled, *EANS* provides countless discoveries and delights for the curious browser. This should not be surprising given the volume's unprecedented coverage.

There are two more serious criticisms. The first is the general failure of contributors to distinguish between works that are extant and those that are not. The editors remark in the introduction that more works of Greek science survive than any other genre. But they also note how arbitrary was the survival of particular works and how much has been lost. It is regrettable that so many entries provide little if any indication as to whether the works mentioned in connection with an author are extant and, if not (which I sense is often the case), what is the provenance of our knowledge of the work in question. Second, entries can be uneven in emphasis and in level of detail. By this I mean that some entries may devote up to half their length to biographical information, while others of equal length overall say little or nothing of a figure's life (including whether anything is known at all). This corresponds to varying levels of detail

in the entries, with some entries attempting to give fairly detailed summaries of important ideas and arguments, while others offer only very general summary statements of content. In general, I would prefer being given fuller descriptions of a figure's contribution to science where it is possible to do so.

Each entry concludes with a very brief list of sources, including critical editions where available, with which the reader may begin further research. These are necessarily highly selective regarding major figures and so quibbling about what is included or left out is beside the point. I would say that the sources listed for Hesiod seemed especially well judged, making me wish that they had served as a model for other entries. In the citations, frequent use is made of abbreviations of the sort classicists like. While these are no doubt important space-savers in a book that is already long and expensive, I would have preferred to see the keys to this scholarly shorthand listed in the contents under a separate heading, rather than being contained without separate notice in the concluding 14 pages of the introduction [13–26].

Following the entries devoted to scientists are 200 pages of supplementary material. The gazetteer [855–909] lists all 290 sites and 35 regions mentioned previously in the text. Each entry contains a brief historical sketch highlighting important events such as a city's founding and conquest by non-Greeks (especially the Romans), followed by a list of scientists born there, plus further references. There follows a 25-page glossary of ambiguous terms used at least three times in the encyclopedia. Entries cover many ancient scientific and technical terms, but also the names of institutions (Academy, Garden) and scientific movements (Atomism, Methodists, Epicurean), plus a list of scientists associated with the terms. The entries are often very basic. Thus, a key term such as *phusis* can be given a much shorter treatment than many less important terms (*hudrophobia*, *ikhthuokolla* or 'fish-glue'). There is a separate index of plants at the end of the volume [1039–1062] listing the Greek or Latin popular name along with those scientists who mentioned them, and a separate listing of modern binomial names where identification is possible.

Fifty pages of timelines cover nearly all of the figures included in encyclopedia entries, divided into two columns. The left-hand column groups figures in 35-year spans (a notional generation) where

more precise dating of a figure is possible, while the right-hand column uses a span of 105 years to list those names for whom greater precision is not possible. Moving between the two columns in search of a particular name takes some getting used to, but the columns allow the editors to avoid the ancient convention of a figure's acme.

Very interesting and useful is a topics index, which classifies every figure in the encyclopedia under modern categories such as agriculture, alchemy, biology, doxography, encyclopedia, *lithika*, pharmacy, and so on. The editors allow multiple listings for figures with wide-ranging activities. There is also an index that lists figures under headings such as female scientists, rulers, and non-scientists who are nevertheless frequently mentioned. Though one might wonder at why some of the headings were chosen, one can imagine that they would be useful starting points for various research projects.

Despite the enormous labor that *EANS* must have cost them, the editors speak of their hope of someday producing an improved edition. No doubt specialists in many sub-specialties will feel that this or that entry could be strengthened, just as I have noted points which I think could be improved. But this should not obscure the outstanding achievement that *EANS* represents. In its unrivaled scope and the quality evident on every page, Keyser and Irby-Massie have given us an essential reference work.