Review
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Die Astronomie der Griechen: Eine Einführung
by B. L. van der Waerden
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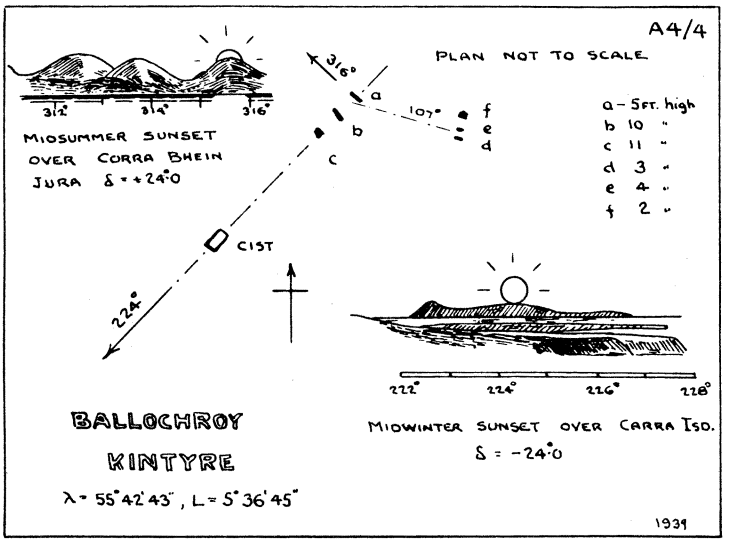

Plan of standing stones at Ballochroy, Argyll, drawn by Alexander Thom

priests and wise men." His thesis seems somewhat overdrawn, since in the southwest United States we find distant alignments with part-time astronomer priests whose calendars display no mathematical subtleties.

As the authors move from the astronomy to the geometry and metrology of megalithic sites, Thom's thesis of ancient wise men employing exact measurement and geometrical learning in the construction of stone rings comes under further revision.

Thaddeus Cowan proposes a new model for megalithic rings that accounts for their unusual shapes less through knowledge of geometry than through ignorance of it. The rings, he suggests, were intended to be circular, but were constructed by laying out a constant diameter, a technique that, lacking a fixed center, does not always yield a true circle. In contrast, Ronald Curtis's reanalysis of some rings previously studied by Thom finds a geometry based on Pythagorean triangles in integral megalithic yards. To me this scheme seems somewhat contrived.

Where, then, is Thom's paradigm; where is megalithic science? Thom saw "megalithic men" as disinterested seekers after precise, positive knowledge. His successors use very different models of the historical uses and contexts of science, yet they follow his example of precise measurements of large numbers of sites and careful interpretation of data. This volume is a fitting monument to Thom's inspiration.

STEPHEN MCCLUSKEY

B. L. van der Waerden. *Die Astronomie der Griechen: Eine Einführung.* (Die Altertumswissenschaft.) x + 315 pp., illus., figs., index. Darmstadt: Wissenschaftliche Buchgesellschaft, 1988. (Paper.)

This book appears in a series of introductions, addressed to general readers, to the subject matter, methods, and results of various branches of the study of antiquity. The scope of B. L. van der Waerden's book is Greek astronomy from its beginnings (nominally Hesiod) to Ptolemy—a period of enormous historical significance that saw the evolution of the quantitative, fully geometrical methodology that dominated astronomy from Ptolemy's *Almagest* to the time of Kepler. A book covering this ground in slightly less detail than Otto Neugebauer's *History of Ancient Mathematical Astronomy* has long been wanted, and van der Waerden's account has much to recommend it. The exposition is technically competent, concise, and intelligible to the nonexpert.

During the past century our knowledge of pre-Ptolemaic astronomy has immensely improved through study of the Babylonian astronomical texts, papyri, and astrological authors, and Indian astronomy. This progress is amply reflected in van der Waerden's book. Nevertheless there remain so many huge gaps in the evidence that any connected history of early Greek astronomy will inevitably contain a strong dose of speculation and conjecture. Some aspects of van der Waerden's reconstruction, in

particular the great importance he gives to heliocentric models, would by no means be universally admitted by other specialists. On the thorny topic of whether Ptolemy fabricated or "cooked" his observational data, van der Waerden accepts some of Robert R. Newton's primary results without following him to the historically preposterous conclusion that the *Almagest* was a wholesale fraud.

Some conjectures of considerable moment are founded on inadequate evidence. Thus, on page 186 van der Waerden revives the old bogey of a Babylonian discovery of precession, because of the discrepancy between the "sidereal" year underlying the system A and B lunar theories and the "tropical" year derivable from the Uruk solstice scheme. But this tropical year is merely a consequence of the nineteen-year calendric cycle, which is both older and of a lower order of accuracy than the lunar theories; the tropical year implicit in system A is identical with the sidereal year, while in system B there is only a small discrepancy that results from the arithmetical constraints of the zigzag functions.

Again, on page 180 van der Waerden (following Paul Tannery) declares that Hipparchus was a poor mathematician because Theon of Smyrna reports him as having written that it would be "interesting for the mathematicians" to establish the equivalence of the eccentric and epicyclic models, a notoriously easy theorem. If Theon had really said this, there would have been reason not to believe him, because he probably knew Hipparchus's work only at second hand and, above all, because otherwise we would have to suppose not just that Hipparchus was unable to prove the equivalence himself, but also that he did not know—or did not understand!—proofs that had circulated at least since the time of Apollonius a half century before. But in fact Theon's words should be translated as "it is deserving of mathematical understanding . . . ," a phrase that could have introduced a proof by Hipparchus himself.

Having "proved" Hipparchus's mathematical incompetence, van der Waerden is compelled to deny him the credit for both the invention of trigonometry (p. 181) and the three-eclipse method of measuring the lunar epicycle (p. 172). Instead he ascribes both discoveries, rather arbitrarily, to Apollonius. Hipparchus's own attempts to measure the lunar anomaly receive no discussion; yet on page 269 van der Waerden suggests, without giving reasons, that Hipparchus assumed the same maximum lunar equation as Ptolemy, a hypothesis that the available evidence flatly contradicts.

Although in these and other details van der Waerden's conception of how Greek astronomy evolved may be open to question, his book gives a full and faithful representation of the kind of work that historians of the subject have been carrying out in recent decades. The bibliographic references are sometimes too selective and tied to the immediate subject matter to provide a beginner with the best possible guide to further reading, and the index is very slight. Nevertheless, this is a book that deserves to be read critically by anyone interested in ancient astronomy.

ALEXANDER JONES

Robert Halleux; Jacques Schamp (Editors). *Les lapidaires grecs: Lapidaire Orphique; Kérygmes lapidaires d'Orphée; Socrate et Denys; Lapidaire nautique; Damigéron-Evax.* (Collection des Universités de France.) xxxiv + 347 pp., index. Paris: Société d'Edition Les Belles Lettres, 1985. Fr 299.

Among the several aspects of natural history taken up by Theophrastus of Eresus (ca. 370–288/5 B.C.) was mineralogy; his remarkable little handbook *Peri lithōn* (On stones) has survived as one of the few ancient or medieval works on such matters not linked securely to common assumptions of astrology, alchemy, and magic. In fact, Theophrastus's tract is in a separate tradition of stone-lore in antiquity and the Middle Ages, a tradition explaining mineral formation by the premises of philosophy. Far more common, however, were treatises on "medical" stones, gems, and minerals that possessed curative powers according to their associations with signs of the zodiac or even more deeply venerated magical data. Following the pattern set by N. F. Moore in *Ancient Mineralogy* (New York: Carvill, 1834), modern students of ancient science have tended to ignore this far larger literature on stones from antiquity and Byzantine times and thus have missed how the ancients most often perceived the "powers" of such minerals in their varied states—from the famous "earths" commonly used in medicines to the bonds of precious jewels with plants and animals so ordinary in astrological and Hermetic manuals.