evergrowing research on Hellenistic and Roman philosophy continues to percolate into the classroom.

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## BURNING MIRRORS

R. RASHED: *Les catoptriciens grecs. I: Les miroirs ardents. Textes établis, traduits, et commentés* (Collection des Universités de France publiée sous la patronage de l'Association Guillaume Budé). Pp. xxv + 450, ills. Paris: Les Belles Lettres, 2000. Cased. ISBN: 2-251-00481-5.

An unusual Budé: most of the texts are Arabic versions of otherwise lost Greek treatises. R.'s French is mostly clear and direct, and his mathematical expositions competent and relevant. Our map of cultural history in late antiquity and beyond is extended, the synthesis is useful, and readers of *CR* will want to know the gist from a classicist's point of view. We are concerned with a particular branch of optics and the Hellenistic geometry which goes with it. A parabolic mirror reflects rays in parallel from a light-source at its focus, as in a car's headlamps. Conversely, a sunbeam normal to the rim of such a mirror is concentrated in reflection at a focus. Some knowledge of conic sections is required to draw the cross-section for a desired focal length. This lore can be traced beyond Apollonius (second century B.C.) to Menaechmus (mid-fourth century B.C.).

R. of course rejects the story that Archimedes fired the Roman fleet in 211 B.C. with burning mirrors (pp. 317–9; it can at best be traced only back to the second century A.D. Besides, there is the problem of directing a focused sunbeam, which Anthemius (sixth century A.D.) tries to address. Princes, caliphs, and shahs were later asking 'Is there a good book about these burning mirrors?' The usual answer was 'Anthemius', but there were other specialist sources, among whom Diocles (early second century B.C.) is much the earliest and, for the student of the history of Greek mathematics, the most important. Until quite recently his work was only known at all from some citations in Eutocius. However, it survives more or less complete in an Arabic version first edited with a translation and commentary by G. J. Toomer (*Diocles on Burning Mirrors* [Berlin and New York, 1976]). Diocles' own introduction (*c*. 15% of the book) is interesting and historically important but problematic, owing to abbreviation, paraphrase, and misunderstanding on the part of the medieval Arabic translator; the rest is more coherent (R., pp. xiv–xvi; cf. Toomer, op. cit. pp. 20–23), consisting of sixteen propositions, only six of which were previously known from Eutocius; the lost diagrams can be confidently restored from the text.

Apart from Diocles (34% of the volume), R. presents previously unpublished Arabic versions of an unknown 'Dtrūms' (14%), Anthemius (24%), and a Didymus (4%), each with an introduction, text, and *apparatus criticus*, a briefly annotated French translation, and, for Diocles and Anthemius, some *notes complémentaires*. The rest is taken up by a general *glossaire arabe–français* and a *lexique arabe–grec* for Anthemius (15%), indexes of names, topics, source-references, and MSS (4%), a bibliography (3%), and contents (2%). The book is generally carefully produced, though on p. 235 the labels [Gr] and [Ar] are confused. The diagrams are clear, but it should be explained that R.'s figures in perspective are themselves modern 'translations'. The extensive

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indexes are integral to the overall organization; by taking thought for this, R. has generally succeeded well in imposing unity, clarity, and economy on the many parts.

'Dtrūms' is preserved in a MS in the British Library (R., p. 160). He is independent of Diocles, and much later; he deals with parabolic and spherical mirrors in interesting ways (pp. 161–77) not attested elsewhere. Features of the Arabic style are said to betray a Greek origin, so (says R.) it is not an original Islamic work. The argument is not conclusive. R. interprets the name as 'Didymus', inviting identification with the Didymus of the fourth piece, which has survived in the same MSS as Diocles. This is doubtful. The fourth piece is pitched at a less sophisticated level than 'Dtrūms' or Diocles, and is probably a pseudepigraphical Islamic work (cf. Toomer, op. cit. p. 28); no Greek can have made Archimedes 'an inhabitant of Cos in the Roman sea assailed by the Persian host coming from Thasos'. The Arabic Anthemius and Didymus, long known by report, are published here for the first time. R. adds a fragment of a translation of Anthemius now in Teheran (reproduced pp. 280–3) and uses two versions of a paraphrase, both in Istanbul. R.'s attempt to unravel the textual history of these Arabic versions of Anthemius, at the same time as expounding the content (pp. 217–79), was an ambitious mistake: crabbed and ill-digested, it is the least successful of his narratives.

R.'s work as a whole is instructive. However, there are two aspects of his modus operandi as a commentator in which he gets the balance wrong, and a third which is very regrettable.

(i) The Arabic tends to crowd out the Greek. Eutocius' citations of Diocles and the *fragmentum Bobiense* are discussed, but clearly ought to have been edited too; so should Tzetzes *Chil*. 2.35.119–30 (alluded to on p. 344 as a testimonium to Anthemius' text). A truncated Greek text of Anthemius has been known since the eighteenth century, but priority is given here to the Arabic translation, which overlaps but is even more truncated, and to two versions of a tenth-century paraphrase. See Toomer, op. cit. p. 20. R., following T., but without acknowledgement, argues that the Arabic paraphrast preserves the gist of Anthemius' entire work. The primary Greek text (*Vat. gr.* 218, of the tenth century) is relegated to an *appendice* with no French translation or *notes complémentaires*. The Greek is competently edited with an *apparatus criticus* by one Marwan Rashed (only named on p. 343); the text differs from J. L. Heiberg's in *Mathematici graeci minores* (Copenhagen, 1927) in ten places, where the Teheran version and examination of the Greek MS under ultraviolet light are said to have helped. This wanted much more elucidation than has been supplied in Marwan Rashed's otherwise commendably succinct introduction (pp. 343–7), or in the *apparatus criticus* and the incidental notes on pp. 234–5, and the whole should of course have pride of place.

(ii) R.'s use of the Arabic language and alphabet in exegesis is Procrustean. The *glossaire* would be more useful the other way around, French to Arabic, in transliteration, and with Latin alphabetization; as it is, it can only assist those who least need it; similarly with the *lexique* for Anthemius.

(iii) As Toomer explained (T. pp. 26–31), a copy of the Diocles-translation was made in A.H. 867 = A.D. 1462/3, along with other Arabic texts, including Didymus. The examplar of the Diocles stood at more than one remove from its Arabic original, of unknown date. The resulting volume was in India in the seventeenth–eighteenth centuries, and has been at Meshed in Iran since the mid-nineteenth century. The only other MSS of Diocles and Didymus (both now in Dublin) can be eliminated as direct copies.

R. summarizes this (pp. 22–3) without acknowledgement, and states: 'De ce texte de

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Dioclès il a été donne une édition et une traduction anglaise dont nous aliens discuter'. This may or may not be ambiguous in French, but since there is only one work of Diocles, and since R. has just mentioned the Dublin *deterior*, the anglophone reader may easily misinterpret 'texte' as meaning that T. only used the *deterior*, and suppose that R. is the first to have used the Meshed MS. It is far from clear in R.'s account that the Anglo-American scholar did indeed use the Meshed MS, and used it exclusively, having obtained photographs in the time of the late Shah; he further provided excellent reproductions (T. pp. 114–37), which R. has used in turn, again without explicit acknowledgement. R. then (pp. 24–31) lists more than 200 places at which his Arabic text differs from T.'s, but without cross-references back to his own, or distinguishing the trivial from the substantive. R.'s statement that 'J'ai tenu . . . à inscrire toute conjecture faite par G. J. Toomer dans l'apparat critique' gives a new meaning to the term 'apparatus criticus'. R. alludes polemically (pp. viii–ix) to T.'s text as 'établi et traduit en anglais de façon déconcertante et étonnament fautive'; he adds (p. 23) 'Quant aux erreurs et contre-sens qui affectent la traduction, non moins nombreux que les fautes de l'édition du texte arabe, je ne les évoquerai point ici, non plus d'ailleurs que ceux commis dans le commentaire historique et mathématique. Au lecteur de comparer les deux traductions, s'il le souhaite, ainsi que les analyses et les commentaires.'

R. reviewed T's edition in *Archives internationales d'histoire des sciences* 28 (1978), 329–33, concluding that 'Il serait trop long de faire un bilan exhaustif de toutes les autres imprécisions et inexactitudes historiques . . . dans l'introduction, les notes et les commentaires. Nous ne pouvons donc que suggérer au lecteur de consulter directement les photocopies du manuscrit, reproduites dans le livre de M. Toomer, en attendant que lui soit proposée une édition scientifique qui serve vraiment le texte au lieu de le corrompre.' One wonders why there is no reference to this piece in the bibliography or notes in the present edition: it could hardly be more relevant.

Anyway, the reviewer has done this extensive homework, though detailed cross-referencing between the two editions is rendered maximally difficult because R. perversely omits T.'s straightforward numeration of the sentences. The lesson is that T.'s work is far from the incompetent tosh that R. implies, in every respect overtaken by the present edition, which depends so heavily on T. anyway. T.'s work on Diocles remains fundamental. The reader should be aware that at many points R. is either tacitly making T.'s view his own or tacitly contradicting him. The misleading caricature, the extensive borrowing, the refusal to acknowledge any merit in T.'s work or to focus on substantive points of difference in the mathematical interpretation, all indicate a sad case of *odium theologicum*.

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## GREEK MUSICAL TEXTS

E. Pöhlmann, M. L. West (edd.): *Documents of Ancient Greek Music. The Extant Melodies and Fragments Edited and Transcribed with Commentary*. Pp. 222, ills, pls. Oxford: Clarendon Press, 2001. Cased, £40. ISBN: 0-19-815223-X.

Since the publication of Egert Pöhlmann's *Denkmäler altgriechischer Musik* in 1970, which for the last thirty years has been the standard work on the surviving musical

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