

# *AESTIMATIO*

Critical Reviews in the History of Science



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## Critical Reviews in the History of Science

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# *AESTIMATIO*

Critical Reviews in the History of Science

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Edited by  
Alan C. Bowen and Tracey E. Rihll

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## Preface

*Aestimatio* is founded on the premise that the finest reward for research and publication is constructive criticism from expert readers committed to the same enterprise. It therefore aims to provide timely assessments of books published in the history of what was called science from antiquity up to the early modern period in cultures ranging from Spain to India, and from Africa to northern Europe. By allowing reviewers the opportunity to address critically and fully both the results of recent research in the history of science and how these results are obtained, *Aestimatio* proposes to advance the study of pre-modern science and to support those who undertake this study.

When we first began publication in 2004, the plan was to make the individual reviews in *Aestimatio* available primarily online as typeset files that could be read on screen in a web browser or downloaded and printed. But recently, we have arranged with Gorgias Press to publish all our annual volumes in print. We are very grateful to George Kiraz of Gorgias Press for his interest in *Aestimatio* and hope that this new mode of publication will enhance the utility of *Aestimatio* to its readers.

Alan C. Bowen

Tracey E. Rihll



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*Myths of the Underworld Journey: Plato, Aristophanes, and the ‘Orphic’ Gold Tablets* by Radcliffe G. Edmonds III

Cambridge: Cambridge University Press, 2004. Pp. xii + 276. ISBN 0-521-83434-1. Cloth \$75.00

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*Reviewed by*  
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The book by Radcliffe Edmonds deals with texts that relate a very similar tale of the journey to the underworld:

- the Orphic gold tablets, which describe the journey of the deceased to the realm of the dead, providing instructions for handling the dangers of the other world,
- Aristophanes’ *Frogs*, which tells of the journey of Dionysos to the underworld with the purpose of bringing back a tragic poet to save Athens, and
- Plato’s myth in the *Phaedo*, which also describes the journey of the deceased after death.

These texts belong to very different literary genres and have very different purposes. The Orphic gold tablets are documents of a religious group (or groups), whose goal is that initiates (μύσται) achieve a privileged status in the other world. Aristophanes tries to make the audience laugh. Plato places the tale in the frame of a philosophical analysis of the immortality of the soul. The Orphic tablets are therefore religious texts, the Aristophanic interpretation is a parody and the Platonic one, a philosophical adaptation.

Edmonds tries to determine the particularities of each and the relationship between them. His book is organized in five chapters: ‘Introduction: The Start of the Journey’ [1–28], ‘Roadmaps of Déviance: The “Orphic” Gold Tablets’ [29–110], ‘Descent to the Depths of Comedy: The *Frogs* of Aristophanes’ [111–158], ‘The Upward Path of Philosophy: The Myth in Plato’s *Phaedo*’ [159–220], and ‘Conclusions: The End of the Road’ [221–239]. It also contains a very complete bibliography, an index locorum, and an index.

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In the introduction [1–28], Edmonds tries to define myth, starting from *Phaedo* 107e4–108a6 in which Plato (contradicting the statements made by Aeschylus in his *Telephus*) asserts that the path leading to Hades is ‘neither simple nor single’, speaking ‘from the evidence of the rites and observances followed here’. Edmonds wonders what rites and observances are meant, what stories were told in these rites, and what stories about life after death were told in Greece [2]. Edmonds tries also to explore the ways in which different authors make use of myth. He follows a metaphor by Levi-Strauss: ‘the authors of these texts are all doing *bricolage* with the same pieces of the tradition’ [4]. The story, variously told and retold in the tradition, is defined by Edmonds with the term ‘traditional tale’ [5]. The significant variations among myths arise from the intent of the teller with regard to his audience [7]. Although myths and rituals are different modes of communication, the spheres of myth and ritual can overlap; and the teller of a myth tries to shape the narrative to make it memorable and acceptable to the audience, since his version is always in competition with alternative versions [11].

Edmonds examines also the two approaches taken by previous scholars in interpreting these texts [13–20]: *Quellenforschung* and seeking the meaning of the text in the underlying pattern of action. Edmonds declares himself sceptical about Dieterich’s interpretation [1893], which postulates a canonical, but underground, Orphic descent (κατάβασις), because he considers that it is insufficiently supported [15f]. Edmonds prefers to reconstruct a ‘traditional mythic pattern’ [20–24], of which he correctly presents a sound structural analysis: there is a traveller and there is also an obstacle, and the traveller who applies the correct solution finds some reward [23]. Also he shows the different purposes of the three versions [25–27]. Thus, the

so-called Orphic gold tablets<sup>1</sup>...provide evidence of countercultural religious movements in which the individual deceased marks her separation from the mainstream of her society by means of her privileged status in the other world. [25]

In contrast, Aristophanes’ *Frogs* ‘uses his comic picture of the realm of the dead to provide a critique of Athenian society’ [26]; whereas

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<sup>1</sup> Edmonds fails to offer an alternative label.

‘Plato seeks to co-opt the traditionally authoritative mythic discourse in service of his own philosophic projects’ [27].

The analysis of the Orphic gold tablets [29–110] reveals the various ways in which ‘the tablets use the traditional pattern of the journey to the underworld to express a protest against the mainstream of polis society’ [30]. Edmonds makes a good review of both formal elements and religious concepts. He denies that the original source of the gold tablets is Orphic because

none of the fragments attributed to Orphic or pseudo-Orphic poems<sup>2</sup> provide any clear parallel to the texts of the gold tablets, and the attribution to one source or another seems largely dependent upon the preconceptions of the attributing scholar. [102]<sup>3</sup>

In the chapter about the *Frogs*, Edmonds considers that

Aristophanes reformulates the boundaries of the polis through his deployment of mythic elements and patterns in the comedy, redefining the true citizens of the polis and excluding those he sees as harmful to the city [112]

and offers many interesting details about this version of the journey. Edmonds concludes that

rather than the traditional pattern of the journey to the other world signaling an initiation of Dionysos into maturity, the pattern provides Aristophanes with a number of opportunities to renegotiate the boundaries of the categories that define Athenian society. [156]

The basic scheme is more difficult to apply to Plato’s *Phaedo* because the pattern is very different. The crux of the matter is the origin of the idea of the soul is somehow imprisoned in the body. This idea is attributed by Socrates in *Phaedo* 62b to ‘mysterics’ (ἀπόρορητα) and in *Cratylus* 400c to ‘those around Orpheus’ (οἱ ἄμφι Ὀρφέα) [177]. Edmonds’ interpretation is striking:

<sup>2</sup> I do not understand this distinction, unless Edmonds thinks that there are poems really written by Orpheus. In my opinion, all Orphic poems are pseudo-Orphic.

<sup>3</sup> This is a fault of which Edmonds can by no means claim to be free, as we shall see.

the mysteries (*ἀπορρήτοι* [*sic*]) to which Socrates refers *may allude* to secret doctrines of these people who make use of the poems of Orpheus *or they may refer to some other religious group with a similar idea* of the relation of the soul to the world.<sup>4</sup>

And he adds,

I follow Wilamowitz<sup>5</sup> and Linforth 1941 p. 148 in reading the passage as drawing a distinction between the etymology of οἱ ἄμφι Ὀρφέα and the unnamed τινες who provide the σῶμα/σῆμα derivation. [177n48]<sup>6</sup>

In this respect, I find specially interesting his statement that

it is likely... that Plato chose the word φρουρά precisely because of its ambiguity, because it enabled him to convey the image of imprisonment of the soul in the body while tempering it with the more positive connotation of garrison duty that is owed to the gods. [177]

The concluding chapter summarizes the previous statements and arguments.

This book is no doubt very interesting. The texts are carefully analyzed and there are many stimulating interpretations, especially in some details. Edmonds shows also a deep knowledge of the relevant bibliography, including (*rara avis!*) Spanish works.<sup>7</sup> The outstanding contribution of the book is its highlighting the political motivation of this narrative model following the path traced by Marcel Detienne [1975], who coined the concept of *chemins de déviance*. But the *interpretatio politica* does not exhaust the scope of these texts. Edmonds considers the texts of the gold tablets as ‘various modes of protest... against the world from which they came’ [109]. But it is a

<sup>4</sup> The italics are mine. Where are these other religious groups attested? Edmonds explains *obscura per obscuriora*. On the Platonic quotations of the Orphic literature, see Bernabé 1998.

<sup>5</sup> Edmonds refers to von Wilamowitz-Moellendorff 1931.

<sup>6</sup> Edmonds seems not to know Bernabé’s arguments [1995] favoring the identification of τινες and οἱ ἄμφι Ὀρφέα, and showing that the etymological relationship between σῶμα and σῶζω is proposed by Plato himself.

<sup>7</sup> There are, however, other papers that might be added, such as Suárez de la Torre 1997, a very interesting study of the religious aspects of the *Frogs*.

strange protest, a silent one, because it was destined to be buried. It is likely that political dissatisfaction is an aspect of the interpretation of the texts, but the limitation of the gold tablets to that is a quite reductionist view.

The most debatable proposal is that concerning the relationship between the three versions. The *opinio communis* considers that the Orphic tale (which is basically recorded in the gold tablets) is the original one (although of course it can contain some elements of other traditions) and Aristophanes makes a parody of it, whereas Plato elaborates an *interpretatio philosophica* of it. Edmonds [20–24] prefers to start from ‘traditional mythic pattern’ (impossible to situate in space or in time) and to speak about various ‘countercultural religious movements’ [25]. Each tablet is written by one evanescent countercultural movement which cannot be specified nor defined. These movements would proliferate like mushrooms in different places. The similarities among tablets would result from the fact that they turn to the same structural pattern.

The reason for that interpretation is that Edmonds maintains a ‘crusade’ against the idea of the existence in Antiquity of a religious movement that accepted Orpheus as spiritual leader, that is, of the Orphics. Edmonds deals with a question that is now the object of attention by scholars in philology, philosophy, and history of religions, after a long period of lack of interest: the definition and determination of Orphism. During the 19th century and the first third of the 20th, scholarship reconstructed a whole religious and philosophical pattern around a group of literary works that the ancients ascribed to Orpheus. In the reconstruction, many excesses undoubtedly took place and varied heterogeneous phenomena were attributed (often without good reason) to Orphic ‘church’, priests and religion.<sup>8</sup> A sceptical trend was begun by Wilamowitz and followed by other scholars.<sup>9</sup> According to them, Orphism was nothing, only a few poems ascribed to Orpheus which do not shape any system nor religion. After the publication of some fundamental texts like the Derveni papyrus [see Laks and Most 1997, Betegh 2004], the Olbian bone plates [see West 1982], and new gold leaves [see Bernabé

<sup>8</sup> Macchioro [1930] was a conspicuous proponent of ‘panorphism’.

<sup>9</sup> See, e.g., von Wilamowitz-Moellendorff 1931, Dodds 1951, Moulinier 1955, and Linforth 1941.

and Jiménez San Cristóbal 2001], most scholars have recognized the existence of a religious movement (although it has no clearly defined boundaries) that follows Orphic texts. But Edmonds still aligns himself with the sceptical trend.

I agree with Edmonds that Orphism is not ‘a sect with an exclusive set of eschatological ideas’ [221];<sup>10</sup> but between that extreme and the idea of many ‘countercultural Bacchic and Orphic movements’ [221], there are many intermediate possibilities. However, Edmonds, as crusaders do, prefers the extremes; he maintains that ‘the Orphic doctrine of Original Sin from the murder of Dionysos Zagreus and the creation of men from the ashes of his Titanic murderers’ is ‘a modern fabrication dating from 1879’ [64].<sup>11</sup>

Other examples of this hypercritical attitude can be found everywhere in the book. Edmonds interprets the statement we found in the Pelinna Tablet, which explicitly describes the deceased as having been born again the same day she died (and then adds: ‘tell to Persephone that Bacchios himself liberated you’), in the following way [227]: ‘even the Pelinna tablets... use the traditional pattern to position the deceased in a network of relations with Persephone and Dionysos that identifies her in ways beyond the normal polis system of identification’. Such reduction of the hope to be reborn after death to political dissatisfaction can only be judged as too narrow a view of religious beliefs.

Edmonds asserts [33] ‘the complete lack of evidence about such a community’ (that is, the group that puts the tablets in the graves of its members). I think that there is no lack of evidence, but lack of interpretation of a mass of facts.<sup>12</sup> I just point out some specially significant examples.

<sup>10</sup> Burkert [1982] has proved that Orphism is not a sect, but it exists. See Bernabé 2005.

<sup>11</sup> Cf. Edmonds 1999, which tries to deny the antiquity of the Orphic myth about Dionysos’ death at the hands of Titans and his relationship with the origin of men and metempsychosis. But see Bernabé 2002.

<sup>12</sup> The evidence is collected in Bernabé 2004–2005.

- There is no mention of the ‘great’ tablet from Thurii [C], which was found enveloping another gold leaf [A 4]. There are no references to the journey in it, but it comes from the same ‘cultural movement’. The analysis of its content is important for determining the religious ideas of the group.<sup>13</sup>
- The Cretan tablets with an abbreviated text [B 3–9] are also neglected. Edmonds only mentions one of them [B 6: page 65] because the possible reading of ΓΥΕΤΕΡ as *θυγάτηρ* fits very well with his proposal of ‘gender issues’ [65]. Edmonds’ method of analysis would lead us to suppose that the group of initiates from Crete does not know about the journey, but only about the question which they will be asked. The Cretan tablets show that these documents only refer to one part of the trip, it being possible that the journey referred to in all the gold leaves be one and the same, as Riedweg [2002] has pointed out.
- Despite the cover of the book, which shows an interesting Apulian vase,<sup>14</sup> Edmonds does not fully exploit the rich information given by Apulian pottery. The imagery of the netherworld depicted in these works is very similar to the one reflected in the gold tablets [see Bernabé 2006]; but Edmonds only mentions the scene depicted in the the aforementioned vase, with his characteristically hypercritical attitude [59n85]:

Johnston and McNiven 1996 have argued that this scene illustrates the power of Dionysos in the underworld, but their inference that the scene provides evidence for the filial relation of Dionysos and Persephone does not necessarily follow from their argument.

That is true, but it would be strange to find on the vase the inscription, ‘She is his mother!’

- The iconography of the *πίνακες* from Locri [see Giangiulio 1994, Bernabé 2006], which illustrates close relationships between Persephone and Dionysos, are also completely ignored.
- The same ‘reductionist’ view is shown on page 58:

<sup>13</sup> Cf. Bernabé and Jiménez San Cristóbal 2001, 183–200, with many Orphic parallels, and Betegh 2004, 332ff, which compares the C tablet with the Derveni papyrus.

<sup>14</sup> A vase now in Toledo, Ohio, whose Orphic character has been demonstrated by Johnston and McNiven [1996].

certainly Persephone seems to stand in some sort of close relation to Dionysos, particularly to Dionysos as Bacchios in the Pelinna tablets, but the relation is not necessarily that of mother to child.

Edmond also quotes another well known skeptic, Moulinier,<sup>15</sup> to conclude that ‘the first reference to Dionysos as the child of Persephone . . . comes in a fragment of Callimachus [Fr. 171]’ [59n84]. But Pindar fr. 133 [Maehler 1987–1989] is a clear and older reference than this.<sup>16</sup>

- o Both Aristophanes and Plato refer to their sources. The comedian mentions Orpheus by his name in *Frogs* 1030–1032:

Look at how, from the very beginning,  
the noblest of poets have conferred benefits on us.  
Orpheus revealed mystic rites (τελετὰς κατέδειξε) to us  
and taught us to refrain from killing.<sup>17</sup> [Sommerstein  
1996, 117–119]

Orpheus is mentioned as a real person, a prestigious and beneficial poet, because he revealed rites (τελεταί). The Orphic poems are, therefore, used as texts (λεγόμενα) in these rites, and these rites are in fact parodied in the *Frogs*.<sup>18</sup> Even the word τελετή is used twice again in the *Frogs*—by the chorus of initiates [342f] and by the chorus-leader (κορυφαῖος) [368].

Plato also alludes several times to the Orphic mysteries in the *Phaedo*:

There is of course the reason given in mystery doctrine (ἐν ἀπορορήτοις), that we men are in a sort of prison [62b: Hackforth 1955, 36]

<sup>15</sup> ‘Les documents que nous rappelons ici ne nous permettent pas d’admettre que le thème du Dionysos, fils de Perséphone, ait été orphique dès l’époque classique’ [Moulinier 1955, 64n5].

<sup>16</sup> Edmonds [1999] scorns this testimony: but cf. Nilsson 1935, 214; Rose 1936, 79–96; Lloyd-Jones 1985, 245–279 [= 1990, 80–105]; Cannata Fera 1990, 65 and 219ff; Bernabé, 1999 and 2002.

<sup>17</sup> On τελεταί, see Jiménez San Cristóbal 2005.

<sup>18</sup> Aristophanes parodies Orphism again and again: cf. Bernabé 2004.

and it may well be that those persons to whom we owe the institution of mystery-rites (οἱ τὰς τελετὰς ἡμῖν οὔτοι κατὰστήσαντες) are not to be despised, inasmuch as they have in fact long ago hinted at the truth by declaring that all such as arrive in Hades uninitiated into the rites shall lie in mud, while he that comes there purified and initiated shall dwell with the gods. For truly, as their authorities tell us, there are ‘many that carry the wand, but Bacchantes few are amongst them’. [69c: Hackforth 1955, 55. Cf. Bernabé 2004–2005, fr. 576]

we may put our question like this: do the souls of men that have departed this life exist in Hades or do they not? Now there is an ancient doctrine (παλαιὸς λόγος) that comes into my mind, that souls which have come from this world exist in the other, and conversely souls come and are born into this world from the world of the dead. [70c: Hackforth 1955, 59]

It is very difficult to separate the Platonic reference, ‘persons to whom we owe the institution of mystery-rites (τελετὰς)’, from the Aristophanic one, ‘Orpheus revealed mystic rites (τελετὰς)’. On the other hand, the verse quoted by Plato is attributed to Orpheus by Neoplatonic philosophers,<sup>19</sup> and the ‘ancient doctrine’ referred to by Plato is an ‘Orphic and Pythagorean one’ according to Olympiodorus and Damascius.<sup>20</sup>

There is no lack of evidence, but obstinacy in denying the evidence we have.

To sum up, there was at least one ancient text attributed to Orpheus and used in rites in which a descent (κατάβασις) of the soul was described. This descent of the soul has been composed for concrete religious (secondarily, political too) purposes: to enable initiates to save themselves. This is not an *interpretatio christiana* nor

<sup>19</sup> Olympiodorus, *In Plat. Phaedon* 7.10, 10.3, 8.7 [Westerink 1976, 115, 141, 123]; Hermias, *In Plat. Phaedr.* at Couvreur 1901, 249.

<sup>20</sup> Olympiodorus, *In Plat. Phaedon* 10.6 [Westerink 1976, 145]; Damascius, *In Plat. Phaedon* 1.203 [Westerink 1976, 123].

a fiction by modern scholars: the purpose of saving oneself is explicitly stated in the Gurob papyrus.<sup>21</sup> It is, therefore, a poem composed at a given moment and transmitted in a text, from which the leaves derive. Aristophanes had in mind this kind of poem for elaborating his parody. A parody presupposes a concrete type of religious poetry dealing with the descent of the initiate known by his audience. An evanescent ‘traditional tale’ cannot be parodied. Plato adapts the Orphic pattern converting the ritual and religious model into a philosophical and political proposal.<sup>22</sup>

Edmonds denies that the gold tablets are Orphic. But if they are not Orphic, what are they? If the Orphics are not religious groups, what are they? It is significant that Edmonds cannot give another name to the ‘Orphic’ gold tablets.

In spite of my disagreement on these points, I think that Edmonds has elaborated a very interesting study of the ‘path to underworld’ theme. The book contains many important statements about political aspects, gender issues, and pattern variations. The analysis of the *Frogs* and *Phaedo* is in my opinion more interesting than that of the gold leaves because they are not so conditioned by Edmonds’ *parti pris*.

Edmonds, who shapes his book as a journey which starts in the introduction and ends in the conclusion, persists in maintaining his particular *chemin de déviance* against the mainstream of scholarship. I am not sure that he will reach salvation.

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<sup>21</sup> We read in line 5 σωζόν με (‘Save me’). On the Gurob papyrus, see Hordern 2000.

<sup>22</sup> That is the procedure named *transposition* by Diès [1927, 2.432ff]: cf. Bernabé 1998.

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*In memoriam*  
Marshall Clagett  
(1916–2005)

When Marshall Clagett died on 21 October 2005, the scholarly world lost not only a distinguished medievalist, but the last member of a triumvirate who had after World War II established the history of science as a recognized discipline within American universities. For, together with Henry Guerlac and I. Bernard Cohen, Clagett during these years indulged in what the historian of medicine Richard Shryock called ‘spreading the gospel’.

Marshall Clagett was born on 23 January 1916 in Washington, DC. He began his university studies in 1933 at the California Institute of Technology, in two years transferring to George Washington University, where, in 1937, he received the A.B. and A.M. degrees. Clagett then entered Columbia University where his historical interests initially lay in Byzantium, specifically in the 15th-century scholar Georgios Scholarios. But, under the tutelage of Lynn Thorndike, he soon switched to 15th-century Latin science and published in 1941 his doctoral dissertation, *Giovanni Marliani and Late Medieval Physics*.

In the same year as his Ph.D., Clagett entered the U.S. Navy, rising from Ensign to Lieutenant Commander, and serving in the Pacific, especially on Okinawa. Following his discharge in 1946, he returned to Columbia as an Instructor in the History Department, lecturing and publishing in Columbia’s Program in Contemporary Civilization. Yet within a year, he joined the Department of the History of Science at the University of Wisconsin, where he remained from 1947 until 1964 and where he also served as Director of Wisconsin’s Institute for Research in the Humanities from 1959 to 1964. It was at Wisconsin that he did the major share of his ‘spreading the gospel’. This is testified by his editing in 1959 of a volume entitled *Critical Problems in the History of Science* containing papers by leading historians of science both in the United States and abroad, who had convened in Madison at the University in 1957. This ‘evangelization’ is also especially evident in his teaching in the Department, where he taught undergraduate courses covering the whole of the history of science, separate lecture courses on ancient and medieval science, and, of particular note, seminars on medieval Latin science. Members of these

seminars frequently went on to produce doctoral dissertations in the field, most of which, unfortunately, remain unpublished.

In 1959 Clagett published his introductory book *Greek Science in Antiquity*, a volume which he viewed ‘as an introduction to medieval and early modern science—that science being considered as a transformation of Greek science’. Indeed, he had already published in 1952 with Ernest Moody, *The Medieval Science of Weights (*Scientia de ponderibus*)*, which was to form the first volume of the University of Wisconsin’s Publications in Medieval Science (16 in all), edited by Clagett. The subject of this book with Moody provided some of the results that were incorporated in Clagett’s own *The Science of Mechanics in the Middle Ages* [1959], which has remained to this day the definitive treatment of its topic. It received the History of Science Society’s Pfizer Award in 1960. Clagett himself regarded his book as attempting

a documentary analysis of some of the crucial criticism and modification of Aristotelian mechanics that took place from the thirteenth through the fifteenth century. In the course of this analysis both the ancient antecedents and the early modern consequences of medieval mechanics will also be examined briefly

adding that

anyone who is honestly interested in the enormously complex *historical* process of the formation of modern science must examine in detail the terminal concepts of the preceding periods. [1959, xix]

It must be admitted that Clagett was completely successful in accomplishing these goals.

In 1964 Clagett became a permanent member to the faculty of the School of Historical Studies of the Institute for Advanced Study in Princeton, where he served until his retirement in 1986, thereafter assuming the title of Professor Emeritus, under which he continued his substantial research. During his years at the Institute, Clagett attracted a number of leading scholars in the history of science.

It was there that Clagett continued his investigation of medieval mechanics in his edition and English translation with analysis of *Nicole Oresme and the Medieval Geometry of Qualities and Motions*:

*A Treatise on the Uniformity and Difformity of Intensities, Known as 'Tractatus de configurationibus qualitatum et motuum'* [1968]. Here Oresme extended immeasurably the medieval doctrine of the intension and remission of forms, representing all sorts of qualities, including velocities, geometrically.

In point of fact, if one gives only a cursory glance to Marshall Clagett's books and numerous articles, it is evident that there is a remarkable preponderance of work on the application of mathematics in natural philosophy (as is clear in his three previously mentioned books) and on pure mathematics. This concentration on mathematics is already clear from an early, but seminal, article in *Isis* in 1953: 'Medieval Latin Translations from the Arabic of the *Elements* of Euclid'. Although Clagett initially intended to edit at least part of these translations, this task was left to others (chiefly H. L. L. Busard and Menso Folkerts). Instead, evidence of this emphasis on mathematics in the Middle Ages became the major project in Clagett's scholarly career and culminated with the five volumes in ten tomes of his *Archimedes in the Middle Ages*. Already in the first volume on the Arabo-Latin Tradition, the edition and translation of eight versions of Archimedes' *De mensura circuli* gives a very good picture of what the 'scholasticization' of mathematics in the Latin Middle Ages really was. As a whole these volumes contain not merely Latin translations of Archimedes' works, but Archimedean works in and beyond the medieval period and into the Renaissance with such figures as Nicholas of Cusa, Jacobus Cremonensis, Regiomontanus, Piero della Francesca, Leonardo da Vinci, Niccolò Tartaglia, Francesco Maurolico, Federigo Commandino, and others. John North in an essay-review of four of these five volumes claimed that

the overwhelming importance of Marshall Clagett's compendious works rests on his ability—through a judicious selection of texts or editing and translating—to reduce by a substantial factor the disorder of medieval studies, a disorder inevitable in a subject where sources are scattered, fragmentary, anonymous, unpublished, and quite out of proportion to the number of scholars capable of handling them. Not only are Clagett's texts well selected, well edited, and well translated; they are also provided with invaluable indexes of Latin terms.

For these volumes Clagett was awarded the Alexander Koyré Medal of the International Academy of the History of Science in 1981.

The next major project to which Marshall Clagett addressed himself is absolutely remarkable. About 1977 he began the study of Egyptian hieroglyphs and, after the completion of the Archimedes' project in 1984, Clagett turned to the study of ancient Egyptian science. The results of this study are magnificently evident in the three volumes in four tomes published between 1989 and 1999. Collectively entitled *Ancient Egyptian Science*, the first volume, in two tomes, was subtitled 'Knowledge and Order' and treated of scribal activity and the creation of the world (cosmogony and cosmology); the second, 'Calendars, Clocks, and Astronomy'; the third, 'Mathematics'. In each of these volumes, Clagett continued his usual procedure of providing English translations of the appropriate documents on which his analyses were based, as well as illustrations relating to these texts, and indices of proper names and Egyptian words. Clagett intended to publish a fourth volume on Egyptian medicine and biology, upon which he was working at the time of his death.

One might note that at the conclusion of his efforts dealing with Egyptian science, he had planned to come full circle, as it were, and to give us a critical edition and translation of Richard Swineshead's *Liber calculationum*, a part of which was the subject of an article much earlier in his career, 'Richard Swineshead and Late Medieval Physics' in *Osiris* [1950].

In recognition of his scholarly research, in addition to the Pfizer Award and the Koyré Medal already referred to, Clagett was the recipient of the Charles Homer Haskins Medal of the Medieval Academy of America (1969); the Sarton Medal of the History of Science Society (1980); the John Frederick Lewis Prize of the American Philosophical Society (twice), in 1981 for his *Archimedes in the Middle Ages* and in 1989 for the first volume of *Ancient Egyptian Science*; one of two Giovanni Dondi dall'Orologio European Prizes in the History of Science, Technology, and Industry in 1995; and in 1996 the International Galileo Galilei Prize for outstanding contributions by a foreign scholar. He was also awarded honorary degrees from George Washington University (1969) and the University of Wisconsin (1974).

A bibliography of Marshall Clagett's works will appear in the 2007 volume of *Historia Mathematica*.

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*Ancient Worlds, Modern Reflections: Philosophical Perspectives on Greek and Chinese Science and Culture* by G. E. R. Lloyd

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*In Ancient Worlds, Modern Reflections*, G. E. R. Lloyd makes an often persuasive case for the relevance and use of comparative studies of ancient cultures in relation to two areas of contemporary concern. This concern is of two sorts—there are philosophical questions bearing on science and its history, and questions about the relevance of reconstructions of ancient thought to such modern social and political issues as higher education, human ‘rights’, internationalism, and democracy. At 179 pages (excluding the bibliography), this is a large project for a comparatively small volume. However, it is also a work written from a vantage point attained through a career’s worth of inquiry into such problems in the context of antiquity, especially ancient Greece, and subsequently through comparative analysis of the history of science in ancient Greece and China. This has been the dominant project of the last two decades in Lloyd’s research and writings, through *Demystifying Mentalities* [1990], *Adversaries and Authorities* [1996], *The Ambitions of Curiosity* [2002], and *The Way and the Word* [2002] (written with the Sinologist and historian of science Nathan Sivin). Of these, *Adversaries and Authorities* and *The Way and the Word* are the most similar to Lloyd’s earlier and extremely influential works on ancient ‘scientific’ cultures and problems, notably *Magic, Reason and Experience* [1979], *Science, Folklore and Ideology* [1983], and *The Revolutions of Wisdom* [1987]. These were sustained pieces of often thematic analysis, characterized by being carefully contextualized and substantiated by a broad range

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<sup>1</sup> A paperback edition has now appeared.

<sup>2</sup> In the interest of full disclosure, I should say that G. E. R. Lloyd was the supervisor of my Ph.D. thesis.

of detailed empirical evidence—in *Revolutions of Wisdom* in particular, the footnotes are not infrequently the larger part of the page. Although concentrating primarily on the classical world, they often used comparative evidence from anthropology and located Greek inquiries more generally among other societies of antiquity, such as Egypt and Mesopotamia.

A concern with comparative evidence has moved increasingly to the foreground of Lloyd's work, and this in turn has highlighted certain philosophical questions and methodological problems. *Demystifying Mentalities* offered a sharp attack, using Greek and Chinese evidence, on the claim first given wide influence by Levy-Bruhl in 1922 that certain culturally distinctive beliefs are incomprehensible to outsiders because they were produced by different 'mentalities', a failure of explanation that Lloyd thoroughly demolished. That critique is briefly recapitulated here, along with a brief survey of alternative approaches as outlined by such figures as Kuhn, Feyerabend, Quine, and Davidson [2–4, 6–8]. Such compressed versions of arguments made elsewhere at greater length and with more grounding and context, and of summary versions of complicated questions, is a feature of this work. Lloyd touches on controversies in such diverse fields as anthropology, linguistics, pragmatics, semantics, neuroscience, and botany. The existence of cognitive modules and the validity of alternatives to formal logics flash by in a paragraph and a short list of major thinkers. Although this work is a development of long-standing themes from Lloyd's previous studies, it is also one that addresses the current state of play in an interrelated set of disciplines about no less a topic than the nature of the world and our understanding of it. It should probably be read in conjunction with its entire bibliography for a more thorough understanding of its own contents.

The weakness of such breadth is that it risks brevity and simplification. It is probably an inevitable weakness, given that Lloyd's purpose is to present a comprehensive and closely interrelated set of arguments. Most of the time he succeeds in presenting enough of the material to support his case, especially if the reader is familiar with the more detailed studies of earlier works. Of course, that in itself carries a risk in that the (brief) reuse of certain subjects means some seem very familiar: most people acquainted with Lloyd's work will recognize such themes as the link between the individualistic and competitive nature of intellectual Greek discourse and the legal and

democratic frameworks of Greek political discourse, or the comparison of these characteristics in Greek star-gazing with the focused and more conservative tendencies of state-run Chinese astronomy.

However, the book under review, if standing on the shoulders of prominent predecessors, is also explicitly different in that it tackles not only philosophical questions ‘in a more fundamental and head-on manner’ [vii] than previously, but also matters of contemporary politics and ethics. The former at least is foreshadowed by *Ambitions*, but that was still a matter of investigating the kinds of inquiry found in ancient China and Greece. Here, Lloyd brings the weight of his accumulated expertise and experience to bear on inquiry and understanding in general, with the ancient world as his evidential resource. In addition, he argues not only that the methodology of comparison, but also that the content of ancient thought, has much to offer in the modern world.

The first nine chapters, the greater part of the book, investigate the philosophical sort of concerns through the analysis of Greek and Chinese ‘science’, their differences, and their points of contact. Lloyd inquires, in the first chapter, whether any culture not our own can be understood at all, whether by contemporary anthropologists or historians of antiquity. In the second, he asks whether there is such a thing as ‘science’ in the ancient world; in the third, whether, and if so, how the terms of the historical investigation map onto those of ancient cultures; and in the fourth, whether logic is universally valid, a problem similar to that of chapter 7, which asks whether different cultures have a common ontology, and also to that of chapter 5, on whether different cultures have the same concept of truth. Chapters 6, 8, and 9 examine more closely such cultural patterns of reasoning as the questionability of belief, the classification of concepts, and the use of examples as evidence.

The chief and underlying problem throughout is the choice between two irreconcilable theoretical perspectives about the possibility of cross-cultural understanding. The correspondence theory of truth has as its outcome a common ontology and logic, and thus the potential for recognizably shared methods and classificatory systems. Alternatively, the many worlds that result from a coherence theory of truth, each self-sufficient to the culture thereof, lead to incommensurable relativism. As methodologies, both relativism and universalism are sometimes useful but neither is perfect: we should learn from

both of them that adopting one single rule for cross-cultural study is not sensible.

As so often, a dichotomous expression of theory in terms of exclusive extremes produces the argument that both are wrong, and that the proper approach is somewhere in between. Yet Lloyd makes a convincing case that there is more to his *via media* than the rhetorical attractiveness of compromise.

Lloyd's criticism of the first approach is a matter of showing how historical complexity defeats any single cross-cultural answer to questions of definition, whether of logic, proof, or of what constitutes astronomy. Such universals do not apply, either between different cultures or indeed within them. There is, for instance, no such thing as a single set of criteria for what constitutes astronomy. The assumption that Eudoxus' astronomy is Ptolemy's, or that either is directly equivalent to *tianwen*, the Chinese study of star patterns [27], simplifies each to the point of misunderstanding. Moreover, the fact that many such theories about the stars do not meet modern notions of astronomy, for instance in their inclusion of what we would call astrology or theology, does not mean that ancient societies had no such thing as astronomy. The reason why modern science draws a distinction here and many ancient inquiries did not is not some regrettable ancient failure to achieve a modern understanding, but stems from different aims and different social and intellectual expectations. More generally, no ancient culture practiced 'science' in the sense of the modern scientific ideal—not that Lloyd thinks this ideal is an actuality in the modern world either—nor does it set out to be any such thing. We should employ the kind of historical methodology outlined on page 22: a focus on specific inquiries, as much as possible in their own terms and contexts, which resist as far as possible the formulation of queries and answers in anachronistic terms. The historical focus helps us avoid problems introduced by the principle of charity of interpretation, that is, the assumption that any message is intelligible. Lloyd points out that some formulations, beliefs, or practices are instead set up to be obscure, or can be understood in more than one way, even though the reasons for such unintelligibility may themselves be understandable. For such elements of a particular culture to be understood, the historical framework must be part of the message [6–8]. This kind of nuanced analysis of specific texts and authors, read closely and placed in the context of social, economic,

and political structures and dynamics, has always been one of Lloyd's greatest strengths and provides here much of the continuity with his earlier works. Concentration on the specifics of what is under historical investigation foregrounds the diversity of thought in any culture or period, while the range of specifics studied and the deliberately comparative style of analysis of them reveals what the points of contact between individuals and inquiries are as well as, hopefully, why they are as they are. Used carefully—and this is a point I shall return to later on—this approach can enable the identification of broader tendencies and patterns within any one group, time period, or civilization, and perhaps even between cultures, though *provisos* are always necessary and over-simplification is a constant threat.

However, focusing on inquiries in their own terms evidently presupposes that those terms can be understood to a useful extent. Lloyd argues strongly that although there are no cross-cultural universals, there is also no case for strong incommensurability. He points out more than once [3, 40] that there are no empirical reasons to accept such a level of incomprehension. No case has ever been found where there were absolutely no points of contact between concepts or languages, however inexact and susceptible to misunderstanding such endeavors undoubtedly are. Here Lloyd is surely right that it has never been shown that failure to comprehend is inevitable and wholesale. The notion that language can radically constrain conceptual understanding put forward by Benjamin Whorf among others is now rather out of favor in contemporary linguistics, while Robert Wardy's *Aristotle in China* [2000] attacks its survival in relation to Western *vis-à-vis* Chinese thought. After all, it is often difficult to ensure in ordinary conversation between speakers of one's own language that exactly the same thing is meant [cf. Wardy 2000, 17], but this is not taken to make communication between individuals impossible. Most statements in any language do not meet the univocal, universal idea of formal logic [cf. Lloyd 2002, 117]. Lloyd uses the term 'semantic stretch', as he did in *Ambitions* [2002, 123], to express how the absence of completely commensurable terms and translations does not equate to incomprehension.

Instead, Lloyd argues that there is a continuum between categories and concepts of different cultures which renders comparison between them valid, as long as attention is paid to the individuality of each as well. To revisit astronomy from this perspective, we

can say that however the aims, methods, and sometimes results of studies involving the stars vary, as noted above, such studies do have phenomena in common, e.g., eclipses. This is part of the more general point that such phenomena are what different cultures have in common, so long as they are only ‘defined in general terms’ [37]. Lloyd also argues that cultures have certain aims in common, such as understanding or predicting, regardless of what phenomena or categories they apply these to. Such broad aims can also be identified in relation to specific disciplines, as when Lloyd remarks that the common aim of various forms of ‘medicine’ is ‘well-being’ [30], though elsewhere the ends of various studies are described as ‘analogous ambitions’ [23] rather than as broad or universal aims. Persuasiveness, I suspect, would also be a common aim of certain forms of discourse, though not always directed at the same audience or produced by the same methods.

One could complain that such aims are so general as not to be very useful, and indeed Lloyd’s own definition of ‘science’ appears narrower. His remarks on ‘the bland generalizations concerning necessary conditions [for science]’ [22] reveal that he thinks of ‘this type of inquiry’ as ‘sustained investigations’ susceptible to recording in literate form. Thus, for Lloyd, ‘science’ even in the ancient world necessarily involves such things as economic surplus and consequent social specialization [33]. By the way, this might supply an argument for why the analysis of long-ago cultures is as valuable as modern-day anthropological studies, even with the immense difficulties of accessing the past through its fragmentary remains. Societies like ancient Greece and China were in size, organization, and materials more like our own than many contemporary societies, making it easier for us to narrow down crucial differences.

Lloyd’s critique of relativism *vs* universalism in cross-cultural analysis as an overdrawn dichotomy is matched by his insistent rejection of absolutes more generally. Definitive answers and simple, single truths, he says (rather definitively) do not occur in the history and philosophy of science any more than they do in science itself, not least because no practitioner of these disciplines can achieve some uninformed state of observation or description entirely free of theory. Yet if all observations are theory-laden, some are more theory-laden than others. ‘The claim that all observations are theory-laden admits of degrees, but of no exceptions’ [189: cf. 62, 82 ff.]. And although

truth is not a simple or single thing, various kinds of truth provide viable criteria for the validation of a claim, although what that validation consists in is more relativistically defined. Recognizing the incomplete universality of any one definition of truth allows us to comprehend how appeals to 'truth' work in different contexts and different cultures, and to avoid limiting truth to the special cases of syllogistic logic and its use everywhere else to error and incomprehension. As Lloyd has often pointed out, authors and practitioners in any culture in which some kind of appeal to validating notions are implicitly or explicitly expressed can be evaluated in these terms without anachronism, and indeed as part of analyzing their impact and strategy in the general cultural context. Kinds of truth, he argues, allow the relativists to be partly right: reality, as perceived by different 'styles of enquiry' [e.g., 77] constrained by 'different leading preoccupations' [87] is multidimensional. The difference between Lloyd and the relativists is that for him those are not separate realities which never touch, but depend upon perspective in a shared world. There are 'points of contact between what there is for the perspectives to be perspectives of' [91]. The elimination of perspective, or theory-ladenness, is not possible, but different approaches can affect and perhaps improve each other. This is, I think, Lloyd's central argument: comparative analysis is a way of shifting perspective to gain perspective. The relevance of other ways of doing things, whether historical or contemporary, is not to measure them against us or us against them, but as other attempts to find out what can be found out, and thus to clarify and nuance our own endeavors and values.

This suggestion takes us to Lloyd's second major theme, the relevance of studies of ancient cultures not just to the history and philosophy of science but to crucial social, political, and ethical problems in the modern world. In the last three essays, he considers higher education, human 'rights' and 'nature', and democratic institutions and internationalism from the perspectives offered by the past. Each discussion follows a similar pattern of argument. Relevant thought and institutions in ancient China and Greece are briefly described. Lloyd then offers a critique of the state of play today, and finally he argues that the first are relevant to the second.

Although the problems we face today seem, at first sight, so different from those of the ancient world, we can use our historical analysis to gain a useful perspective on them. [164]

Moreover, not just perspective but sometimes actual content and values from antiquity can be usefully employed in contemporary society.

Thus, in chapter 10, he describes intellectual discourse in Greece and China and the subsequent history of Chinese and western medieval education. He argues that there are advantages and disadvantages to both the individualistic and changeable free-for-all of Greek culture and the more persistent but less independent tendencies of Chinese education. For Lloyd, these past approaches offer both warnings and suggestions for modern universities; and, perhaps more importantly, the study of different approaches is itself a model for what he thinks education should do. The key to this is to learn about both the natural world and the human world in a way that enables the student to make connections and draw comparisons between different subjects, cultures, and languages, and how each contributes to ‘universal knowledge’ [152]. (This should not be mistaken for current US-style undergraduate education, which Lloyd regards, with some justification, as often fragmented and superficial.)

In the place of either academic or vocational specialization with a view to producing professionals, Lloyd’s program is generalist, multidisciplinary, and intended to encourage innovation, rather than the production of students in the mould of the previous generation’s experts [148]. (Of course, the education Lloyd advocates would tend to produce people very like Geoffrey Lloyd, in approach if not necessarily in content.) In the ideal system, learning is valued for its own sake, as it was in Greek antiquity; and it produces innovative generalists with both the knowledge and, implicitly, the value system to act as informed and innovative critics of themselves, their subjects, and society more generally. It is a fiercely felt and rather inspiring program, but short on details on the practical side, not least because Lloyd views this level of education as something that should be accessible to all as a ‘basic human value’ [152]. ‘This will no doubt be criticized as excessively idealistic’ [153: cf. 191], he remarks accurately. In addition to funding problems, the mere thought of the curriculum committees involved is enough to turn one pale, and the amount of language acquisition or of translated materials required would be a major problem. Specialization would have to be postponed to further degrees or qualifications. Nonetheless, whatever the practicalities of application—and such an approach could perhaps be applied to a smaller extent, without any politically unlikely

radical restructuring—this is an important contribution to the debate on what a university education is meant to do and how it can best do it.

After the relatively narrow focus on higher education, the last two chapters have an increasingly broad remit. Lloyd turns first to a discussion of Chinese and Greek—the latter mainly Aristotelian—concepts of what it is to be human, what this means for ethics, and how to organize society. The morals drawn from the past are the Greek principle of equality and the importance attached by the Chinese to mutual obligations. Lloyd prefers a combination of these to the notion of human rights, which he sees as a modern Western cultural bias, since universal and inalienable human rights is not a concept that can be found in either of the ancient societies. Problems that we might formulate in such terms were instead conceived of as questions about law and justice: ‘much modern talk of rights might have seemed to the ancients to be aggressive individualism.’ Instead, ‘focusing on fairness, equity, responsibility provides a wider basis for approaching the problems than does the discourse of rights’ [165]. In the absence of inalienable rights, Lloyd also finds in antiquity useful responses to moral relativism, citing Aristotle’s contention that a denial of absolute moral principles does not amount to a denial that principles may be applied as general rules, that action is always particular, and that character and reasoning are interdependent. This last argument gains cross-cultural support from Chinese philosophers such as Mencius and Xunci.

Lloyd’s use of the past to inform the present works in three ways. Firstly, it gives us perspective and encourages self-criticism. For example, comparing our views on what constitutes a human and how humans should live with the views of ancient China and Greece reveals that ‘what was presented as an ideal for human kind often reflect just the interests of the group advocating it. . . [or] mirror political experience more generally’ [164]. Our discourse of human rights is no exception. Secondly, any attempt to work out universal human values should be as broadly based as possible, either grounded in cross-cultural concepts identifiable in history or combining different ones. Hence Lloyd’s appeal to fairness. Thirdly, there are concepts and values which we can specifically select as useful from the ancient world.

Finally, Lloyd's last critique and call to arms addresses Greek and Chinese political institutions and activity, characterizing the former as a unstable, varied, subject to questioning, and noting again their explicit articulation of the equality of citizens, albeit a rather narrowly defined equality. Greek politics is contrasted with the Chinese ideal of a benevolent ruler with loyal ministers and watchful intellectuals, who had a duty to curb authority's excesses if necessary, even at risk to themselves. These are relevant to modern political difficulties identified by Lloyd, difficulties which include the relationship between science and government, the excessive power of commercial interests, the responsibility of the public to understand science and of scientists to explain themselves to the public, the apparently irreconcilable ethical stands taken on issues like abortion, a lack of effective international decision making, the social breakdown in the western world as a result of wealth inequality, voter apathy and other inadequacies of representative democracy, worldwide economic inequality, and reckless environmental degradation. This is also his gloomiest chapter. Although Lloyd thinks solutions or at least improvements are possible, he suspects—no doubt rightly—that they stand little chance of being put into practice. We will probably rush to catastrophe, but 'even catastrophe does not necessarily teach good sense' [186].

The ancient world, Lloyd again argues, offers us alternatives good and bad. Classical Greek democracy, for example, should be studied as both a positive and a negative model. The Chinese bring to Lloyd's table interdependence, solidarity, consensus and responsible behavior by the powerful. In both societies, intellectuals [171–172] contributed heavily to the construction of these political ideals; and for Lloyd their modern equivalents, academics, have an equal responsibility to think hard and to speak out about matters of concern to all of society. Here Lloyd is certainly practicing what he preaches.

One may of course criticize aspects of either Lloyd's analysis of modern life or his arguments as to what 'good sense' suggests in response. I share a good deal of his cultural background, and, I suspect from reading this, his political and religious opinions too: yet I differed on several points. Many US Republicans, for instance, would have a much stronger reaction. But this is not the place to start arguing over every issue, but to consider his general approach.

The second section is in general a stimulating and sometimes provocative set of arguments, but the relevance of the ancient world to the modern seems more strained than earlier. As with the book as a whole, but more noticeably with these final sections, much is inevitably highly compressed. In particular, there is less room than previously for the nuances of history, though several miniature sketches give a vivid overview of certain issues. To some extent this is an advantage, as it enables a clear sense of the scope that comparative history and its associated issues can encompass without getting bogged down in the details, but it also means that some crucial arguments are not unpacked to the degree that the work they are doing in Lloyd's argument requires. For example, 'we should do well to reflect on how responsible individuals [in China] bore witness to their conception of what served the welfare of all under heaven' through the ideal of a benevolent ruler and a mutually responsible society. Yet the ideal was often not actuality. How are we to put ideals derived from the ancient world into practice in the modern?

The project of using historical ideas and values in contemporary political and ethical argument needs to be handled with care. That an acquaintance with other values, societies, and habits of thought encourages critical thought and may occasionally inspire seems reasonable. The use of particular examples from the past is, I think, most successful in the domain of actual argument, as in Lloyd's use of Aristotle's work on ethical judgment, involving as it does a careful and thorough understanding of what precisely Aristotle meant. Too often, although not by Lloyd, historical comparison is done by cherry-picking superficially similar analogues. In the run-up to the Iraq invasion, various commentators in the media offered a bewildering number of historical parallels in support of their views both for and against the war, including Vietnam, Korea, the British in Iraq in the 1920s, the Crusades, Alexander's campaigns, and even the Trojan War. Similarly, we select as relevant certain values from the broad church of history according to our own social and individual 'leading preoccupations'. Therefore, the usefulness of historical 'lessons' [192] requires as detailed a comparison and as thorough an understanding as possible of the original circumstances and concepts. This level of detailed analysis is not something Lloyd can provide in the scope of what he is attempting here: which is to give a sense of the possibilities involved in historical understanding and careful comparison.

*Ancient Worlds, Modern Reflections* is a wide-ranging, stimulating and latterly provocative work. Arguing that history is more complex than philosophy tends to allow [cf. 190], it makes a persuasive case for the possibility of a *via media* between analytical dichotomies. Continuities and points of contact allow the historian of thought to move in and between distinctive cultural realities, avoiding what in another context Richard Dawkins has called the ‘tyranny of the discontinuous mind’. Genuine generalist expertise allows a manifold understanding, if not a single answer. The chapters concerning the possible lessons of the past are more personal and problematic, but Lloyd’s principal point on modern concerns cannot be doubted: ‘We need to muster all the resources for criticism and analysis that we can, including those from reflections on the past’ [191].

In reviewing this book, I have several times felt that being a Hellenist historian of science, with a working knowledge of some areas of modern science, was not quite adequate to the range of issues and arguments and evidence under discussion. My knowledge of Chinese scientific texts and culture, in particular, is both limited and mediated through authors like Lloyd, Sivin, and Wardy, while my knowledge of Chinese political history approaches nil. The reader is directed towards Sinologists for a critique of Lloyd in those areas. It is perhaps both a tribute to Lloyd and an expression of just how difficult true general expertise is, that more than one reviewer is really needed for this book. However, Lloyd, I suspect, would say that difficulties in acquiring knowledge both deep and broad is no excuse for not trying: this is his attempt to show the benefits of so doing.

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*Pliny the Elder's Natural History: The Empire in the Encyclopaedia*  
by Trevor Murphy

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The monumental *Natural History* of the Elder Pliny (AD 23–79) in 37 books was one of the most influential works of the pre-scientific era. It survived intact, despite its great size, defying the fate of comparable ancient and medieval works. By the 20th century, it had been published in nearly 300 complete or partial editions. As a scientific work, however, its factual accuracy was increasingly challenged. At the end of the 16th century, Sir Francis Bacon was calling for a complete overhaul of ‘the opinions and conjectures of the ancients’ and the institution of a large-scale project to collect fresh data from scratch, a project which, he warned in a letter of 1622, might ‘fill six times as many volumes as Pliny’s history... which includes nevertheless a great many things belonging to philology, to fable, to antiquity and not to Nature’.<sup>1</sup> Indeed, succeeding centuries became increasingly unsympathetic, not only to the perceived unreliability of the *Natural History*’s factual material, but also to its bewildering diversity and apparent lack of overall rationale.

It is only in the last 15 years or so that scholars have sought to reassess Pliny’s work. Recent studies have concentrated on the text as a coherent entity, the creation of an author who was himself the product of his time. Trevor Murphy’s lively, learned, and well-written study is the most recent of several interesting analyses of Pliny’s text as a cultural document which defined and encapsulated the assumptions and aspirations of its era. Such an approach

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<sup>1</sup> ... *impleantur volumina quae historiam C. Plinii sextuplicent... in qua tamen ipsa plurima philologica, fabulosa, antiquitatis non naturae...* [Spedding, Ellis, and Heath 1857–1874, 14.376, trans. 14.377]

to Pliny is particularly fruitful. His descriptions of the elements of nature frequently go beyond factual description to include their roles in human society generally and Roman society in particular. Complexes of interlinked references relating to agriculture, manufacture, medicine, religion, magic, history, geography, and ethnography explain, in effect, not what a laurel tree, an elephant, or iron was, but what they meant to a Roman of the first century AD.

One particular aspect of this ‘meaning’ which has been attracting increasing attention is the relationship between Pliny’s encyclopedic work and the totalizing embrace of Rome’s empire. The *Natural History* can be read as a catalogue of empire and an expression of its optimism and power, an approach which colors two other recent studies [Naas 2002, Carey 2003] which appeared too late to be taken into account in the present volume. It is Murphy’s work, however, which devotes itself entirely to this theme or, more specifically, to the question of power as encapsulated by the empire and the relationship of that power to knowledge of the natural world. It does so, moreover, with regard not only to the general content of the *Natural History*, but also to its structure, in an attempt to explain how and why Pliny selects and arranges his material as he does.

A successful military man and imperial administrator, Pliny represented the known natural world as more or less co-extensive with the Roman empire of the first century AD. For Murphy, Pliny’s manner of representing nature in the *Natural History* is shaped on many levels by the culture of imperial power. In the first part of his study, he examines this relationship with regard to the structure of the text and considers the question of knowledge and power in general terms. The second part explores the portrayal of peoples and places in their relation to the imperial theme, chapter 3 concentrating on ethnography, chapter 4 on geography, and chapter 5 on the edges of the world.

The core of Murphy’s argument revolves around multiple parallels between Pliny and his imperial master and between the *Natural History*’s text and Rome’s empire. The author collects, orders, and displays knowledge in a way which invites analogies with the emperor’s power, in his capacity not simply as political ruler and controller of his empire, but also as arbiter and editor of knowledge of the natural world. The emperor could initiate the military expeditions which were a prime means of expanding and demarcating knowledge

of nature; he could stage the public shows and triumphal processions which showed off the natural spoils of the conquered lands; and he could authorize acceptance or verification of new information: delegations reporting or physically bringing natural novelties and rarities to the emperor are frequently mentioned in the ancient sources.

The contents of the *Natural History* are themselves products of imperial power, whose systematic organization, listing and display by Pliny in his text bears witness to and celebrates that power. Murphy also argues that, like many of the products of empire preserved in its pages, the knowledge contained in the *Natural History* is in itself a commodity, though in a metaphorical rather than commercial sense, conferring status and power on its holder. It should, so Murphy argues, be bestowed rather than bought, which leads him to suggest that Larcus Licinus, whose unsuccessful attempt to buy Pliny's notes is recorded by his nephew [*Letters* 3.5.17], was guilty of a breach of good taste. At all events, he succeeds in showing that the possession of intellectual goods was coveted as a status indicator. The episode as Murphy interprets it has some affinities with the later efforts of Elias Ashmole to gain control of and take credit for the Tradescant collection of curios, which eventually formed the basis of the Ashmolean Museum, named solely after himself [see, e.g., Swann 2001, 38–54].

This metaphorical commodification of knowledge acts as a vital counterbalance to the explosion of opportunities for material greed also offered by empire, which threatens to suffocate intellectual effort. Here, however, as Murphy admits, the tensions engendered work against any straightforward parallels between the ordering of empire and the ordering of Pliny's text. He suggests that the pressure put on knowledge is partially responsible for the discursiveness of the *Natural History*. While this discursiveness owes much to a cultural aesthetic which valued intricacy and variety and, through ancient philosophical discourse, the use of analogy, it was enhanced by Pliny's desire to gather and preserve the obscure and particular aspects of Roman tradition before they were submerged. In this respect, ironically, his structure appears 'contrary to the organizing *imperium* which made its writing possible' [73].

Murphy's treatment of the ethnographical descriptions in the *Natural History* follows trends in modern scholarship pioneered in

the case of the classical world by Hartog's treatment [1988] of the Scythians in the Greek historian Herodotus. Portrayals of individual races and customs scattered through the *Natural History* act as 'windows' onto Pliny's own society [94]: the depiction of their strangeness is important for what it tells us about the Roman moral and social order from luxury to suicide, rather than for any notion of its 'truth'. Chapter 4 turns to more general geographical portrayals and examines the strategies used in the *Natural History* to view the world in a possessive imperialist manner. This is further elaborated by analyzing Pliny's review of the world and its contents in terms of the Roman triumphal procession which paraded, in addition to the human captives, animal, vegetable, and mineral spoils from the conquered territories, together with representations of captured cities and landscapes. The final chapter considers Pliny's depiction of the limits of empire: his idiosyncratic and apparently unhistorical account of the wretched, uncivilized existence of the Germanic Chauci in a northern wasteland serves as an extended metaphor for the limits of the organized civilization of the Roman empire, coterminous with nature itself in both time and space.

Murphy presents a coherent picture of a fascinating but frequently overwhelming text. The reader is carried along by his clear, incisive style. Footnotes tend to be brief, which is generally no bad thing, although there are a few occasions when the reader would benefit from more indication of the background to some of his ideas and the scholarly tradition behind them. A text of this size and complexity can of course be 'read' in more than one way. Murphy, however, has done an excellent job in presenting his particular interpretation in a persuasive and highly illuminating manner. Those approaching the *Natural History* for the first time, and/or wishing to contextualize Pliny's work in the history of science will find an engaging and approachable analysis. Those more familiar with it will appreciate the many fresh and thought-provoking insights Murphy has to offer.

In conjunction with some general conclusions, ideas which appeared earlier in the book, such as the parallel between author and emperor, are developed further in the final pages; others appear more or less for the first time, including a brief consideration of the *Natural History's* legacy in the field of scientific thought. For Murphy, the work's long-term significance in this respect lies in its ordered and systematic display of nature, which influenced later re-assemblies of

nature according to the cultural priorities of successive eras. Thus, 18th-century imperial expansion ‘supplied natural objects to be refined into knowledge by the researches of the intellectual, who in turn converted the diversity of the world into an ordered text. . .’ [216]. At the beginning of this review, I noted one such re-assembly, that proposed by Bacon a century earlier. In advocating a revision of the ‘opinions of the ancients’, he, too, was responding, like Pliny, to the challenges of an expanding world:

*Quin et caelum ipsum imitabile fecimus. Caeli enim est, circumire terram: quod et nostrae navigationes pervicerunt. Turpe autem nobis sit, si globi materiati tractus, terrarum vicelictet et marium, nostris temporibus in immensum aperti et illustrati sint: globi autem intellectualis fines, inter veterum inventa et angustias steterint. Neque parvo inter se nexu devincta et conjugata sunt ista duo, perlustratio regionum et scientiarum. Plurima enim per longinquas navigationes et peregrinationes in natura patuerunt, quae novam sapientiae et scientiae humanae lucem affundere possint, et antiquorum opiniones et conjecturas experimento regere.* [Spedding, Ellis, and Heath 1857–1874, 3.584]

We have succeeded in imitating the heaven, whose property it is to encircle the earth; for this we have done by our voyages. It would disgrace us, now that the wide spaces of the material globe, the lands and seas, have been broached and explored, if the limits of the intellectual globe should be set by the narrow discoveries of the ancients. Nor are these enterprises, the opening up of the earth and the opening up of the sciences, linked and yoked together in any trivial way. Distant voyages and travels have brought to light many things in nature, which may throw fresh light on human philosophy and science and correct by experience the opinions and conjectures of the ancients. [Farrington 1964, 131]

Bacon was arguing that his era should break free of the suffocating embrace of Aristotelian natural science, utilizing its increasing knowledge and control of nature. In ‘imitating the heaven’ however, he unconsciously evoked a similar sentiment from an era whose ideas he was trying to escape. In *Natural History* 27.3, Pliny celebrated Rome’s imperial power and its ability to view and control the known

world as mirroring that of Nature, specifically through a comparison to Nature's ruling principle, the Sun.

*Scythicam herbam a Maeotis paludibus, et euphorbiam e monte Atlante ultraque Herculis columnas ex ipso rerum naturae defectu, parte alia britannicam ex oceani insulis extra terras positis, itemque aethiopidem ab exusto sideribus axe, alias praeterea aliunde utro citroque humanae saluti in toto orbe portari, immensa Romanae pacis maiestate non homines modo diversis inter se terris gentibusque verum etiam montes et excedentia in nubes iuga partusque eorum et herbas quoque invicem ostentante. aeternum quaeso deorum sit munus istud. adeo Romanos velut alteram lucem dedisse rebus humanis videntur.* [Nat. Hist. 27.3]

The Scythian plant is brought from the marshes of Maeotis, euphorbia from Mount Atlas and from beyond the Pillars of Hercules where Nature actually peters out. In another quarter, brittanica comes from islands in the Outer Ocean beyond the main land mass, while aethiopsis comes from a region scorched by the stars. Other remedies besides are transported in every direction for the benefit of humanity, as the boundless grandeur of the Roman peace displays in turn not only the human race with its different lands and peoples, but also mountain peaks and lofty ranges soaring into the clouds, with their produce and their plants. I pray that this gift of the gods may last for ever! So truly do they seem to have given the Romans to humanity as a second sun. [See 131–133]

As noted earlier, Pliny was aware that the 'opening up' of new lands was not always as conducive to the 'sciences' as it was to material commerce and Murphy discusses several passages, notably 14.2–4, in this context [69–73]. However, it is probably 27.3 which comes closest to capturing the spirit of Pliny's text as an imperial enterprise, and justifying the rationale behind this stimulating interpretation of his *Natural History*.

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*Philosophy in Late Antiquity* by Andrew Smith

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Neoplatonism, the most influential philosophical movement of the Roman Empire, combined metaphysical speculation on the esoteric meanings of Plato's dialogues with a contemplative vision of reality. At once erudite and eclectic, as it drew on the six centuries of philosophical development between Plato's Academy and its emergence in Alexandria in the third century AD, Neoplatonism above all used philosophical structures to expound and expand the dimensions of inner experience. In his book, *Philosophy in Late Antiquity*, Andrew Smith traces major developments in the growth of Neoplatonic philosophy from the third to fifth centuries, and then concludes with a look at Christian thinkers who especially aligned themselves with this philosophical movement.

Smith's book is addressed to students with relatively little exposure to the primary texts that he surveys, the abstruse and very prolific writings of Plotinus, Porphyry, Iamblichus, Augustine, and Pseudo-Dionysius. In choosing to focus on Neoplatonism, Smith perhaps succeeds in limiting what would otherwise be a sprawling and unwieldy topic: surely no introductory book could cover all of philosophy in the Roman Empire, including Scepticism, the Aristotelian Commentator Tradition, Stoicism, and Jewish Middle Platonism.

Smith devotes the first part of the book to an explication of Plotinus' *Enneads*. His consideration of Plotinus is by far the most thorough discussion in the book, and this seems only right. It was the brilliantly original work of Plotinus (AD 204–270) as recorded in the *Enneads*, edited and published by Plotinus' disciple Porphyry, that inspired and provided the foundations for the work of later Neoplatonists such as Iamblichus (active AD 245) and Proclus (AD 412–485).

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Nevertheless, what we find in the first three chapters of the book is more than a prosaic or workmanlike summary of Plotinus' doctrines. Indeed, there is more than a little originality and even daring in Smith's explication of how and why Plotinus practiced philosophy.

In the introduction, Smith frames his exposition of Plotinus' philosophy with several anecdotes from Porphyry's *Vita Plotini*, which he published alongside his edition of the *Enneads*. At the age of 28, Plotinus joined Emperor Gordian III's campaign against the Persians and after the failure of that expedition, moved to Rome where he began to teach philosophy. Plotinus engaged whoever wished to attend the lectures (evidently chaos reigned in the classroom, with answers to objections dragging on for days). Senators, doctors, politicians, indeed, the Emperor himself were welcome. But the life of philosophy set one apart, as in the case of Plotinus' student Rogatianus, a senator who renounced his office and became 'an example for those who engage in the life of philosophy' [Porphyry, *Vita* 7.45–46].

In chapters 1–6, Smith explores the Plotinian universe, organizing his entire account of the three major hypostases, soul (chapter 2), the One (chapter 3) and Intellect (chapter 4), around Plotinus' varying and subtle notions of self and self-transformation. For Smith, Plotinus is above all a mystic; and so the theme of Plotinus' fluid notion of self ends in a somewhat surprising affirmation, that in the end the One is in some sense the truest form of self [72–73, quoting and commenting loosely on *Ennead* 6.9.11]. Along the way, Smith points out that the individual as such is characterized by various faculties that involve intellect, discursive reason, perception, and even consciousness in a number of different configurations. While the soul can be viewed primarily as a center of rational activity and agency, as evidenced for example in Plotinus' account of perception as employing activity and judgment rather than impressions, Smith also emphasizes the passages in which Plotinus places intellect or non-discursive awareness at the center of even the individual's core identity.

In chapter 2, Smith moves to a more universal perspective, focusing now on reality as such, the first principle of which is the One. Plotinus is able to configure the One *vis à vis* the rest of reality in multiple ways, as final and efficient cause of all things, as prior to existence, and as the ineffable, utterly transcendent source of all things that is simultaneously nothing at all. Again, Plotinus' explication of

the One depends a great deal on the context within which it is being considered. In some sense, unity is fundamental or prerequisite to existence itself; in another sense, the One has the greatest causal power, so that all things must be its effects. Another approach to the One involves some central Neoplatonist mechanisms, such as, for example, the concept of emanation or self-effusion by which higher realities emit or release traces of themselves that in turn actualize themselves as distinct realities. Thus, Intellect first arises as an inchoate echo of what is not yet distinctively consciousness or knowledge in the One, and then turns back toward (or reverts) to the One as if the latter were its final cause, but in so doing becomes itself a separate hypostasis. Finally, however, the One is in itself unknowable and all of these approaches must be seen as constructions of discursive thought, always subject to revision.

Having described the Intellect's birth from the One, Smith goes on in chapter 3 to explore some of the relationships Intellect enjoys both with its own quasi-objects of knowledge, i.e., Being or the plurality of real beings, as well with its prior and subsequent hypostases. Here we witness Plotinian appropriations of such Aristotelian conceptions as actuality and of intellect's self-contemplation. The second hypostasis, as we have seen, is a subsequent stage of reality that arises when the wisdom inherent within the One turns back on itself, giving rise to Being/Intellect, the intelligible world that consists of intellects each contemplating all the other intellects, rather like a hall of mirrors. This order of reality represents Plotinus' transformation of the Platonic Forms *via* an Aristotelian conception of divine thought eternally contemplating itself, in which both elements of the equation, knower and known, are pure actualities, neither of which has any priority.

Transitory being (*γένεσις* or 'becoming') originates in the third hypostasis, at the level of Soul which is present both on a cosmic level as caretaker of all that is soulless, and as the embodied individual whose destiny is to return to his origin by recovering his lost unity with the One. Chapter 4 explores some of the philosophical innovations involved in Plotinus' doctrine of the soul, including the problem of how soul can be present to body, and the question of how the soul came to be embodied in the first place. Some of these puzzles are inheritances from Plato (i.e., the problem of the relationship between Form and individual); some are articulated as reflexes

against contemporary materialist philosophies. Nevertheless, what remains supremely important for Plotinus is the mission of the soul, to give life to the world and yet to remain detached from it, to care for the universe without becoming lost in it.

Throughout his exposition of the *Enneads*, Smith mentions Plotinus' frequent use of metaphor, e.g., a hand holding a plank is likened to the relationship between soul and body. One important metaphor that Plotinus makes use of to describe the return of the soul to its source is the image of a center surrounded by radiating lines. If the One is the center in the image, then what exactly is implied with respect to the individuality of the soul that makes its return? Is it annihilated, does it lose its own identity? Smith ends chapter 5 by letting Plotinus speak for himself, though perhaps not everyone will agree on the conclusions to be drawn when Plotinus says [6.9.11]: 'if one sees that one's self has become this [i.e. the One]... one reaches the end of one's journey.'

The second section of the book treats the various branches of Neoplatonism that arose after Plotinus in two chapters that survey some of the main tendencies. Chapter 6 discusses the phenomenon of theurgy, the ritual branch of Neoplatonism that arose from its association with polytheist religiosity. Smith focuses on Porphyry's *Letter to Anebo*, a work that survives only in fragmentary form as the preface to Iamblichus' *Mysteries of the Egyptians*. Behind the practice of what looks much like sympathetic magic lay several important doctrines that show Iamblichus innovating on the work of Plotinus. The word 'theurgy' literally means 'activity associated with the gods', and refers to the use of ritual in conjunction with the soul's effort to free itself from bondage to the world of birth and death. Iamblichus insists that knowledge does not deliver the soul from the constraints of embodiment. To complete its cosmic task, the soul must win over the whole chain of being that links our ordinary world with the ultimate principles of reality. The chains of being are the series that each Henad, or divine unity, reproduces all the way down the hierarchy of reality, while the soul itself must gain the assistance of these external powers because it has lost its station in the intelligible world.

Chapter 7 continues the saga of post-Plotinian Neoplatonism, pausing over Proclus' formalization of certain metaphysical ambiguities in Plotinus, and setting the stage for the Christian incorporation

of Proclean doctrine, especially through an emphasis on triads; being-life-intellect and procession-remaining-reversion constitute the most important examples of this prolific idea. The last chapter of the book allows us to glimpse Christian thinkers in light of their immediate predecessors' ways of doing philosophy. For example, Augustine is exercised over the problems of memory and identity, working on topics that seem to be inspired by the *Enneads*: the immateriality of the soul, the life of the mind as a reflection of both time and eternity, the origin of evil, and most of all, the ascent of the mind to the One through mystical contemplation. Another example is Pseudo-Dionysius' emphasis on the *via negativa*, the contemplation of God as pure emptiness, again a reflex of Neoplatonic apophatic theology. This chapter also considers topics such as the pagan-Christian debate over the eternity of the world, and the created or uncreated nature of the soul.

This book contains a wealth of information on its chosen subject and is immensely readable as well as highly erudite. One appreciates the limits that Smith imposes on his subject matter, i.e., his avoidance of emphasis on Neoplatonist scholasticism, and his omission of the Aristotelian Commentator tradition, in the interests of allowing us to glimpse a unique way of doing philosophy that relies on the direct experience of a return to One, and articulates a contemplative vision where ordinary notions of the self, of language, and of reality as a whole are utterly transformed.

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*Cuneiform Texts in the Metropolitan Museum of Art. Volume II: Literary and Scholastic Texts of the First Millennium BC* edited by Ira Spar and W. G. Lambert

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The Metropolitan Museum of Art holds more than 500 cuneiform tablets which range in date from the Early Dynastic III period of the third millennium BC to the latest cuneiform documents written in the first century AD. The present volume, the second of four publishing the whole of the Museum's collection,<sup>1</sup> contains just over 100 literary and scholastic texts from the first millennium BC. Apart from one tablet [No. 33], all of the tablets were purchased from London antiquities dealers by the Reverend William Hayes Ward and acquired by the Museum in 1886. No. 33 was obtained *via* the Rogers Fund in 1956 and has been subject to some modern fakery through the addition of meaningless wedges and trimming of the broken edges to make the tablet appear complete and therefore of greater value. Nothing can be said of the provenance of the tablets bought by Ward except what can be learnt from the texts themselves, which seems to indicate that most of the tablets originated in Babylon during the Hellenistic period.

The tablets are presented in copies drawn by Ira Spar together with translations and commentaries by a range of specialist scholars. Photographs of some of the more interesting tablets are also included. A general introduction to the text corpus and the context of scholarship in first millennium Babylonia is provided by W. G. Lambert,

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<sup>1</sup> Volume 1 (1988) contains tablets, cones, and bricks from the third and second millennium BC and Volume 3 (2000) contains tablets from private archives of the first millennium BC.

and the editions of each group of texts is preceded by an introductory essay by that group's editor. These essays range in scope from a short overview of the tablets in a group, to detailed discussions of the tablets and related published and unpublished examples in other collections. As such, the volume acts not only as a means of publishing the Metropolitan Museum's tablets, but also provides an extremely useful introduction to Late Babylonian scholarship as a whole.

Several of the tablets published in this volume relate to Babylonian science in its various forms. These include magical and medical texts [Nos. 30–33, 69–70], celestial omens [Nos. 36–38, 71], other omens [Nos. 34–35, 39–41], mathematical texts [Nos. 72–77], and astronomical texts [Nos. 78–88]. In the following, I will confine myself to the mathematical and astronomical/astrological texts.

Six mathematical texts [Nos. 72–77] are edited by J. Friberg. All were first published by Otto Neugebauer and Abraham Sachs in *Mathematical Cuneiform Texts* in 1945. Nos. 72–76 contain exclusively lines of long sexagesimal numbers. Nos. 72–74 actually are part of the same tablet, though do not join. They are part of the first tablet of the original table of reciprocals. Friberg believes that Nos. 75 and 76 together with a tablet in the Liverpool Free Public Museum are disconnected fragments of the reverse of a copy of the presumed first tablet of the total 12-place table of reciprocals. The final text [No. 77] is a fragment from a mathematical problem text. The text is apparently a collection of problems, similar in style to some Old Babylonian problem texts. The only more or less fully preserved problem deals with the repair of hoes.

The astronomical texts edited by C. B. F. Walker and the celestial omen texts edited by the late Erica Reiner are of particular interest. I briefly discuss each text in turn below:

- No. 36 is a copy of *Enūma Anu Enlil* Tablets 26 Part III and 27 Part II. It concerns omens drawn from the appearance of the Sun at sunrise and sunset.
- No. 37 contains excerpts of Jupiter omens from *Enūma Anu Enlil*. Those omens well enough preserved to be identified concern the position of Jupiter next to the Moon.
- No. 38 is very fragmentary. It contains omens drawn from the visibility of Mercury. The tablet is of special interest because

its colophon indicates that the tablet was copied from a leather scroll, something that is extremely rare in cuneiform sources.

- No. 71 is a commentary on *Enūma Anu Enlil* Tablet 4 (the heading for this tablet mistakenly says Tablet 5). The tablet is badly preserved and no translation is offered by Reiner. It is interesting to note that the commentary contains alternative explanations for some omens, attributing them to ‘another oral source’ and ‘a third oral source’.
- No. 78 is a list of *ziqpu* stars.<sup>2</sup> Three traditions of *ziqpu* star lists are known outside of MUL.APIN. One list, the most well known because it is found on our best preserved source, AO 6478, and also on a Neo-Assyrian tablet from Nineveh, lists 26 stars. The most common version of the *ziqpu* star list contained only 25 stars and is identical to the 26 star list except for omitting an entry for the distance between the front and rear Twin stars. A third *ziqpu* star list, known only from one source, contains a completely different list of 14 stars. No. 78 contains part of the 25 star list. The text’s editor restores the intervals in time-degrees and double hours between the stars from AO 6478, and therefore is incorrect to remark in the commentary that No. 78 contains the same distances.
- No. 79 is a fragment of a lunar ephemeris for Seleucid Era (SE) 263 calculated by System A; it was previously published by Neugebauer in his *Astronomical Cuneiform Texts* [1955, No. 18]. According to Neugebauer, a fragment in Berlin is a part of the same tablet.
- No. 80 is another fragment of a lunar ephemeris giving eclipse possibilities for at least the years SE 177 to 199(?). Again, the tablet was previously published by Neugebauer [1955, No. 61].
- No. 81 is an extremely interesting and important procedure text for the Moon which partially duplicates Neugebauer 1955, No. 201 and some unpublished tablets in the British Museum. It gives rules for the calculation of the so-called ‘lunar four’, intervals between sunrise and moonset (or *vice versa*) around opposition. These rules are at present only imperfectly understood and careful study of No. 81 and the other duplicates will be necessary to reconstruct them.

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<sup>2</sup> *Ziqpu* stars are stars whose culmination is used for timekeeping.

- No. 82 is a large fragment of a Normal Star Almanac containing predicted planetary passages by a group of reference stars (known as ‘Normal Stars’), planetary phenomena, and eclipses for the year SE 70. This is the first complete translation of a Normal Star Almanac into English. Accompanying the translation is a study of the accuracy of the predicted planetary positions by N. A. Roughton.
- No. 83 is an almost complete Almanac containing predicted planetary phenomena and eclipses for the year AD 31/32. It was previously published by Abraham Sachs [1976, 379–398]. This very late Almanac, one of the latest dated cuneiform tablets, contains several scribal practices characteristic of these late Almanacs such as indenting the second line for every month, abbreviating the name of the planet Mercury to GU<sub>4</sub>, and so forth.
- No. 84 is a fragment of an astronomical table containing (at least) four columns. The table is of an unknown type and it is not certain whether its contents are strictly astronomical.
- No. 85 is a small fragment of a table which may be astronomical.
- No. 86 is a small fragment of a prose text that may be either astronomical or astrological.
- No. 87 is a fragment of a prose text. Walker suggests that it might be a lunar procedure text of an unknown kind due to the term *ki-šir*’s appearing several times. This term can mean something like ‘lunar node’, but the whole text needs close study before its meaning can be established.
- No. 88 is a small unidentified fragment which may be part of the same tablet as No. 86.

The editors and publishers of this fine volume are to be congratulated in bringing to publication this immaculate edition of an important collection of Late Babylonian cuneiform texts.

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Historia: *Empiricism and Erudition in Early Modern Europe* edited by Gianna Pomata and Nancy G. Siraisi

Transformations: Studies in the History of Science and Technology. Cambridge, MA: MIT Press, 2005. Pp. x + 490. ISBN 0-262-16229-6. Cloth \$50.00

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In 1596, the Roman physician Andrea Bacci published a natural history of wines containing staggeringly detailed descriptions of ancient Roman dinner parties drawn from his extensive reading as well as ‘the authority... of various marble tombs’ [336]. Like his earlier works dealing with hot springs and the Tiber, this book seamlessly combined natural history, antiquarianism, and medicine; and ranged over many other subjects such as religious debates, the virtues of his patron, and present-day dining customs. And that was just for a start.

As this collection of essays shows so well, history in the 16th century was a polyvalent discipline; just how polyvalent is indicated by the polyhistor Johann Alsted’s 1615 description of history as ‘the knowledge of everything that is intelligible’ [223]. This volume of essays which runs the gamut from overarching narrative to careful case study in some ways replicates the diversity of its subject matter, namely, the varied career of *historia* from about 1400 to about 1800. Anthony Grafton and Donald Kelley’s essays, as well as the outstanding introduction by Gianna Pomata and Nancy Siraisi, provide the narrative, a story of the Renaissance rediscovery of history and its ascent both as a genre and as an epistemic tool. Especially in the 16th century, in histories of human *res gestae* as well as in natural histories and medical case histories, humanist scholars developed history into a mode of accurate description by means of both direct and indirect eyewitness. They also employed history as defined by Alsted, that is, to give an account of all known things. Conrad Gessner aimed to do just that in his *Historia animalium*, as Laurent Pinon’s excellent essay

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shows. Gessner sought to provide an exhaustive account of absolutely everything known (verified or not) about all animals in the world.

In examining the epistemic status of *historia*, Ian Maclean's essay (in tandem with the introduction) points out that *historia* in Herodotus and Hippocrates was used as inquiry both into natural phenomena and into human deeds. Aristotle narrowed this definition so that history became a stage of knowledge that inquired into the 'how' of things, an activity propaedeutic to the philosophical knowledge of final causes (the 'why' of things). History described and provided particulars, where *episteme* dealt in universals. Under this regime, *historia* could not attain to the knowledge of final causes, and it was thus considered a lesser form of knowledge, an attitude taken over in European intellectual history (although the earlier more expansive view of history never ceased entirely to exist). In the 15th and 16th centuries, the *artes historicae* came into their own as scholars explored how to write history in a classical style and re-discovered the pre-Aristotelian meanings of *historia*. In many cases, they took over Cicero's 'first law of history' [217] that accuracy was primary and distinguished history from rhetoric and poetry. This influenced the developing emphasis on description of particulars and the distrust of theory in some parts of the investigation of nature, and it coincided with an emphasis on autopsy and eyewitness in medicine and medical research into human and animal bodies. In the 17th and 18th centuries, however, in the age of the 'New Science', history and natural inquiry came to be seen as belonging to different spheres of knowledge and possessing very different epistemic values. As F. W. Bierling put it in the 18th century, 'The truths of history cannot easily be compared with those of the natural scientists' [228]. Donald Kelley's essay argues that Vico's *Scienza nova* tried to reverse this view, maintaining in self-conscious opposition to Descartes that

ideas lived in time; memory—individual and collective—was absolutely essential to true science; and imagination was not the threat that Bacon thought it posed but rather a creative and synthetic form of memory. Vico's conclusion, therefore, was that modern students should draw on the whole legacy of Western arts and sciences that embodied this memory. Descartes would purge classical literature and history from

his program of studies, while Vico made them not only foundational but also socially useful in ways that for Descartes were irrelevant. [231]

Vico's expansive view of history was carried forth in the work of Jules Michelet, when in 1825 he told his students

Science is one: languages, literature and history, mathematics and philosophy, and knowledges apparently most remote are actually joined, or rather form a system, of which we in our weakness [can only] consider as separate and successive parts. [234]

That the views of New Scientists prevailed over Vico's *Scienza nova* is manifest today in the disparity between public funding for science and the humanities.

The main motivating inspiration for this collection of essays is the oft-noted but hardly explored intersection between the methods of medicine and history in antiquity and the Renaissance, a point made early on by the great scholar Arnaldo Momigliano. Most of the essays in the volume provide case studies that make clear how deep yet varied this intersection actually was and how important those methods turned out to be for the 'New Science' of the investigation of nature. These essays demonstrate the way in which, between 1450 and 1650, history moved from an activity of compilation and direct observation to firsthand experience, always informed by 'a thick web of references to scholarly learning' [28], to an almost exclusive focus on the temporal rather than empirical by the early 18th century. As noted, only Vico worked against this. A similar hiving off of history from natural history occurred as well, as Brian Ogilvie discusses, with natural history remaining linked to an earlier moralizing natural theology. Gianna Pomata's and Nancy Siraisi's essays focus directly on the intersection of medicine and history, while Martin Muslow's and Peter Miller's essays explore the connections between empiricism and antiquarianism. Almost all essays deal with the ways in which the practice of *historia* developed techniques of observation and description, and the growth of a 'factual sensibility'. Chiara Crisciani's essay compellingly shows the development of a new epistemology growing out of the new position of court physician in the 15th century, who wrote both in Latin and the vernacular for a new audience, while Ann

Blair discusses how the practices of excerpting, compiling, and sorting that went into Theodor Zwinger's massive *Theatrum humanae vitae* of 1565–1586 may have helped develop this new epistemology.

All essays in the volume contribute signally to the examination of the important intersections between history, medicine, antiquarianism, humanist erudition, and the development of empiricism in the early modern period. This valuable set of essays should find a very wide audience among scholars in the humanities. We can only wish that the chasm between the Two Cultures could be bridged for a moment and this volume could carry its vital information about the beginnings of modern science over to the practitioners of the natural sciences.

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*Robert Hooke: Tercentennial Studies* edited by Michael Cooper and Michael Hunter

Aldershot, UK: Ashgate, 2006. Pp. xxi + 335. ISBN 0-7546-5365-X. Cloth \$99.95

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Several years ago Lisa Jardine, biographer of Hooke and Wren, was making a documentary film on the Great Fire of London. While waiting early one morning outside the Monument, as the crew set up the cameras, she was ushered in out of the freezing cold by the attendant. To pass the time, the attendant asked if she had ever seen the basement, and pulling away the carpet and lifting a trapdoor, he revealed an underground chamber which, she quickly realized, had in fact been a purpose-built laboratory in which Hooke and Wren performed experiments. Even more interesting, when several iron trapdoors in the 200-foot column were opened, it also allowed a clear view from the basement past the hinged lid at the top of the column. The column was, as well as a monument to the Great Fire, a zenith telescope with lenses at the ground and upper platform levels, designed to track minute shifts in the position of a fixed star and prove the rotation of the earth [Jardine 2002].

Long telescopes were important to Hooke. His nemesis, Newton, whom he accused of having stolen from him the account of orbital motion as being due to a rectilinear motion and an accelerating force towards the centre, had made a reputation for himself early on when he showed that white light is heterogeneous, and that the colored light-rays from which it is composed are refracted at slightly different angles through a refracting surface such as a lens or a prism. As a result, Newton argued, a telescope using just refracting lenses will always suffer from the problem of chromatic aberration, and this led him to devise a reflecting telescope, which overcame this problem. This is often treated as a decisive triumph in textbooks; but in fact reflecting telescopes had problems of their own, namely, faint images

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and tarnishing of the mirror, and problems of chromatic aberration could be overcome in refracting telescopes if they were long enough. Someone like Hooke, intimately versed in lenses grinding, fine-tuned astronomical observation, and precision instrument construction, realized this. Indeed, Hooke's 60 foot telescope was sufficiently emblematic to appear with Boyle's air-pump (initially designed by Greatorex but radically improved by Hooke) in the frontispiece to Sprat's *The History of the Royal Society* of 1667.

The common portrait of Hooke as irredeemably misanthropic has been questioned in recent years (notably by Feingold in this collection), and some of his misfortunes appear to have been due to political machinations for which he cannot be held responsible, e.g., on Oldenburg's part (as Jardine argues in this collection). Nevertheless, there is no doubt that he was a difficult person, and his long disputes with Huygens (senior and junior) and Newton did his reputation immense damage. But during his lifetime, especially during his later years, he did command significant respect in the Royal Society; and in the last 25 years, his immense contribution to early modern natural philosophy—a contribution which puts him on a par with Galileo, Descartes, Huygens, and Newton—has begun to be recognized. There have been some hurdles to recognition. First, as Ellen Tan Drake notes in her essay in this collection, many of his contributions have been credited to others. Boyle's Law is actually due to Hooke; the discovery of the periodicity of comets was discovered by Hooke when Halley, to whom this discovery is usually attributed, was only six years old; his theory of combustion is credited to Mayhew; 'Newton's Rings' were actually observed and described first by Hooke; his geological work is at least as fundamental as, and in some respects more sophisticated than, that of Steno, to whom the origins of the discipline are usually traced; the Monument and the dome of St Paul's were both designed not by Wren but by Hooke; and so on. These misattributions are now widely recognized. More contentious is the question of centripetal force, which Nauenberg and Gal deal with in this collection. However, it is certainly clear that Newton's radical move to grasping the natural-philosophical significance of seeing orbits in terms of a combination of inertial and accelerated motions which yield elliptical orbits, and not in terms of bodies being held in a natural balance of forces, was prompted by his exchange with Hooke.

An issue raised in both Nauenberg's and Gal's chapters bear directly on the second respect in which there are hurdles to recognition of Hooke's achievement. This is the question of the extent to which one can see science, or natural philosophy as it was then, as, at bottom, a story of a conceptual development in which experimentation and instrumentation play an auxiliary role. Such a view, epitomized in a historian like Koyré and an unstated assumption in virtually all philosophy of science, is tackled head on in Joseph's essay on various natural-philosophical topics treated by Hooke, from studies of springs, air pressure, and the formation and nature of glass drops to combustion and fluid mechanics. Here we are forced to take seriously not just the ingenuity of individual experiments but the very fact that they are constitutive of the Hookean program in natural philosophy in many respects. Joseph, a mechanical engineer, challenges us to take the formative role that technology and instrumentation play in scientific discovery seriously, and Hooke provides excellent material in this respect.

This collection is a successor to an earlier one [Hunter and Schaffer 1989], which was really a pathbreaker. In the intervening 16 years there has been an upsurge in writing about Hooke. Indeed, in the last three years alone there have been two biographies [Inwood 2002, Jardine 2003] a general account of his work [Bennett *et alii* 2003], two monographs on his mechanics [Gal 2002, Chapman 2005] one monograph on his architecture [Cooper 2003], and a collection of essays [Kent and Chapman 2005]. The comprehensive bibliography in the present collection indicates that this sudden interest has been matched in papers and theses. That Hooke is someone who is far more interesting and important than has been evident until recently is clearly established in this collection, and one comes away from it keen to read more.

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*Aristotle and the Principle of Non-Contradiction* by Gianluigi Pasquale

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The best thing about this very brief book on Aristotle's *Metaphysics*  $\Gamma.3-4$  is its determination to treat the principle of non-contradiction (PNC) as a 'law of being'. Of course, Pasquale recognizes that the PNC is also a 'law of thought': the second half of the first chapter is devoted to this dimension of it, and the second of the book's two chapters concerns how we come to know the principle. But he thinks that the PNC is a law of thought because it is a law of being and that we come to know the principle by some sort of intuition of reality. The principle is more commonly discussed in the literature as a logical principle, a common opinion, or a necessary condition of conversation. A law of being is an assertion about things, not beliefs, statements, or reasons. The principle asserts that substances cannot have contradictory attributes. Pasquale sees it as 'protecting' a substance from contradiction.

Pasquale begins his discussion of the PNC as a law of being by contrasting contradictories with the three other Aristotelian opposites [17–29]. Since the PNC concerns predicates of a *single* subject and since a relative opposition exists between two subjects, relatives are not pertinent to the PNC [21]. Whereas contraries have intermediates, contradictories do not [24]; possession/privation presuppose a substrate, but contradiction does not [27]. The significance that Pasquale sees these distinctions as having for the PNC is unclear. The PNC denies that the same predicate belongs and does not belong to a subject, and this is equivalent to denying that *contradictory* predicates belong. Since contradictories are distinct from the other opposites, Pasquale seems to think that the PNC does not exclude

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predicating these other opposites. He notes at the beginning of his discussion that at 1011b17–20 Aristotle lumps contradictories together with contraries and possession/privation; he thinks this means that contraries and contradictories have ‘an equivalent meaning’. But he claims that this is an exception [18–19]. He takes the PNC to deny only that contradictories can be predicated of the same subject.

Pasquale’s mistake is transparent. Aristotle denies that ‘contrary’ and ‘contradictory’ have the same meaning, but it does not follow that one thing cannot be opposed to another in both ways. Aristotle thinks that something’s contrary is included within that thing’s contradictory. Thus, black is not only the contrary of white, it also belongs within non-white. Pasquale is right to distinguish contradiction from other types of opposition. But he seems to think that this means that an *instance* of one opposite cannot be an *instance* of another, for he infers from the fact that contradictories do not have intermediates that the denial of white, non-white, does not include black or any other color but only something outside the genus of color [25]! In fact, the reason that there is no intermediate between white and non-white is that the latter includes *everything* besides white inside and outside the genus of color: there cannot be an intermediate because everything is either white or non-white.

Pasquale next discusses the ‘same subject’ that the PNC denies can admit contradictory predicates [29–36]. He claims that this subject exists and that the PNC ‘protects’ it. The PNC protects one subject from being identified with another, and it also protects a subject from having its accidental attributes identified as essential [30]. As Pasquale puts it: if C is an accident of A, then A is essentially non-C; the PNC protects A from also being essentially C. Further, because each non-substance has its own unity, the principle protects instances of other categories from contradiction [32]. Most importantly, the PNC protects substance, and Pasquale claims that contraries are included within the unity of substance (!), so that PNC excludes only substance’s non-existent contradictory [35—Pasquale’s text is garbled here]. Hence, the PNC serves to *allow* predications but *excludes* non-existent predicates.

Of course, if we already know that the predicate is non-existent, we do not need the PNC to exclude it, nor could the PNC be doing any real work in ‘protecting’ subjects from receiving contradictory

predicates. The principle itself is not a thing that acts; that is part of why it is hard to see it as a law of being. Just what is it about being that makes it impossible for a subject to receive contradictory predicates? That is the real issue. The subject does not need ‘protection’ from what is impossible.

Furthermore, to say that the PNC allows some predications into the ‘unity of the subject’ but excludes others is to continue the error that I noted earlier, the supposition that a denial of some being is ‘absolute’ only in so far as it includes what is *outside* the being’s genus. Thus, non-white would not include black because there is motion and a substrate between white and black, but it would include what is outside the genus of color. So Pasquale wants to say that a subject’s predicates are included in its unity. Surely, though, the PNC excludes predicating white and black of a subject in the same way, at the same time, and so forth, just as much as it excludes predicating white and non-white of this subject, in the same way, at the same time, etc.

Apart from this evident mistake about contradictories, Pasquale has not explained how the subject and its predicates can form a unity. If, as Aristotle assumes, man signifies one thing, such as two-footed animal, then to predicate white of man would make man a plurality. Moreover, since white is different from man, it is also not man. Hence (as Pasquale recognizes [39]), to predicate white of man would be to make man not-man! For just this reason, *any* predication poses an apparent challenge to the PNC. Pasquale sees the challenge although he does not pose the issue this way. To stipulate, as Pasquale does, that predicates belong to the unity of the subject is to accept the legitimacy of predication by fiat, without resolving the issue. In fact, what makes predication allowable is not the subject but the predicate: since there is no intermediate between attribute C and not-C, any subject A must fall under the one or the other. Pasquale is right to say that being is at issue in PNC; but the issue is not what is included within the being of a *subject*, rather it is the being possessed by its *predicate* or by being itself as a predicate.

The really interesting observation that Pasquale makes is that accidental predication, like predicating white of man, challenges the PNC [39]. He claims that the PNC resolves the problem because it stipulates that:

Within the subject substance and accidents have their respective order. Thus, the PNC safeguards, within the subject, the existence together of these two contradictory realities, the substance as substance and the accidents as accidents. [39]

He does not explain why the PNC does this or, indeed, how it could.

The conclusion of Pasquale's intriguing discussion of 'at the same time' [40–47] is that the PNC 'derives from the transcendental unity of being and... guarantees the multiplicity of being in the world' [46]. He means, I think, that the PNC treats motion as a multiplicity of states; since these states do not exist at the same time, there is no contradiction. Hence, the PNC 'protects the multiplicity of being' [43]. This, at any rate, seems the most plausible interpretation of what Pasquale means to say here.

If this 'protection' is like the others, then the multiplicity of beings should be contained within the unity of the subject. But in this case a subject that changes from its own nature *would* be internally contradictory! In my view, the PNC is not *protecting* the multiplicity in this sense, but serving to *separate* multiple stages of a single being. Aristotle's point is that a nature's change is not contradictory because, though it will have contrary characters, the nature does not have them at the same time or, better, together.

The second half of the first chapter [48–67] is devoted to the PNC as a law of thought. In a well-known article, Jan Lukasiewicz [1979] claims that Aristotle argues for the 'psychological Law of Contradiction', the impossibility of believing a contradiction, by taking contrary beliefs as contrary attributes of the believer. Lukasiewicz dismisses the argument on the ground that Aristotle has not established that 'beliefs answering to contradictory sentences are contraries.' Pasquale begins his discussion by arguing that Aristotle holds we have an intuitive understanding of things [49–52].

In my view, Aristotle's identification of a belief about a thing with a state of being, that is, with a form or something connected with a form, suffices to explain why beliefs in contradictions are themselves contradictions. The point is that beliefs are not simply sentences but states of beings. At one point, Pasquale seems to say something like this [55], but he goes on to claim that contrary beliefs could not belong to the same unity of thought [64–65]. He concludes that the PNC protects thought from contradiction [67].

The problem here, as earlier, is that Pasquale ends up simply assuming that the principle must be true and then explaining what that means. In this case, he is concerned with what it means for thought. But, again, the PNC is not doing any real work in protecting thought if such contradictions are genuinely impossible. Many people do seem to hold contradictory thoughts and this fact is probably what fuels Lukasiewicz' denial that believing contradictories is itself contradictory. What we need to see is why contradictory beliefs are impossible to hold. To put the point differently, reflection on the principle of non-contradiction often aims to show that apparent contradictions are not contradictions because they do not belong at the same time, in the same way, and so on. Thus, someone can hold beliefs that are contradictory and not violate the PNC if he holds the beliefs at different times, or of different subjects, or in different ways. The work of the PNC is not, as Pasquale thinks, to form unities of things, orders, or thoughts that are somehow protected, but rather to distinguish individual things or thoughts from others that are different and incompatible.

In chapter 2 [60–109] Pasquale identifies the PNC as the only principle that 'defines being as "it is"' [71–72] and that also makes an object explicit in the soul [78]. Pasquale notes that although Aristotle claims that the PNC is treated by metaphysics, he seeks to establish it by dialectic.

Aristotle's philosophical disciplines, of which metaphysics is one, consist of demonstrative knowledge, whereas dialectic merely probes and tests. However, since the PNC is the highest principle, it cannot be established by demonstration because the premises of such a demonstration would be prior to it. How, then, can the PNC be known by metaphysics? Pasquale's solution is that the metaphysician must also be a dialectician [97]. He thinks that the PNC is known through the type of intuition that Aristotle sketches in the last chapter of the *Posterior Analytics*. The arguments that Aristotle supplies in *Metaphysics* Γ are, then, instances of dialectic that are meant to help those who would deny the principle to intuit its truth. They serve to make deniers conscious of their self-contradiction [108].

Pasquale does not do much to show us how Aristotle's arguments could lead someone to intuit the PNC. He says very little about the actual arguments. Aristotle thinks that we can somehow

intuit essences and that the process of intuition does generally involve dialectic, specifically the dialectic he expounds in the *Topics*. In intuiting an essence, we are somehow grasping the substance whose essence it is, and this substance is the principle of a special science. The PNC, however, belongs to the highest science, metaphysics. To grasp it is not to grasp an essence. The problem with conceiving of an intuitive grasp of the PNC along lines of *Posterior Analytics* 2.19 is understanding what *thing* we grasp when we intuit the PNC. This is what Pasquale really needs to explain. This is particularly important for him since he insists that the PNC is a law of being. Just what sort of being is the PNC itself? Furthermore, it is hardly adequate to show one who denies the PNC that he contradicts himself since he professes to accept the existence of contradictions. What Aristotle does is, rather, to show us that the denier invokes the principle in asserting its denial or in making any other assertion.

*Aristotle and the Principle of Non-Contradiction* is often difficult to follow. There are numerous errors in spelling and grammar. Pasquale should have had the book proofread by a native speaker. From what I can see, there are some intriguing ideas here that are marred by significant mistakes about Aristotle and the failure to explain and argue central claims. Aristotle claims that those who deny the PNC do away with substance or make all things one, yet Pasquale passes over these significant ontological claims. His claim that the PNC 'assures' the existence of essence and accident as different ontic orders [113] is problematic because PNC does not distinguish orders. On the contrary, it is the difficulty of drawing such distinctions that encourages the denial of the PNC. Pasquale inadvertently suggests this point, but the reader suspects that he himself does not take the possibility of the PNC's being false seriously enough to pursue it. Further, Pasquale's notion that Aristotle's arguments are dialectical refutations that promote intuition never gets off the ground because he does not work through the arguments. Despite these limitations, his basic approach to the PNC as an ontological principle is significant and right. That may make this book worth reading.

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*The Heirs of Archimedes: Science and the Art of War through the Age of Enlightenment* edited by Brett D. Steele and Tamera Dorland  
Cambridge, MA/London: The MIT Press, 2005. Pp. ix + 397. ISBN 0-262-19516-X. Cloth \$55.00

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Brett Steele and Tamera Dorland's edited volume grew from presentations made at two conferences, 'Science and Warfare in the Old Regime' in 1998 and 'Colonels and Quartermasters' in 1999. The editors, by collecting these works, are trying to correct what they see as a lack of attention paid to the historical relationship between military technology and science; what attention it has received places it in the 20th, possibly the 19th century, whereas Steele and Dorland see this relationship emerging much earlier, with a significant flowering after the Renaissance. They introduce the collection by claiming, as did Voltaire, that this relationship extends as far back as the time of Archimedes, and then they shed light on that classical beginning. Through the succeeding essays, they hope to answer the question 'In short, when did Archimedes have real intellectual heirs who re-created for themselves his personal union of science and the art of war?' [3]. That brings up a key point of this book, particularly in regard to its title: despite the introduction, the focus of the book is firmly on the 'Heirs' and *not* on 'Archimedes'.

The introduction gives an excellent, concise, historical, and historiographical account of the science-military connection. I found that some parts of this introduction, though, lead the reader down the wrong path by creating some expectations of discussions that never occur in the collected essays (nor should they, I have also come to believe). In describing Archimedes' intermingling of science and war, the editors provide a framework, accompanied by a diagram, that maps connections, decisions, and/or movements made by Archimedes. Steele and Dorland draw on modern terminology to write sentences such as 'For Archimedes, the science of mechanics may have

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also facilitated the optimum coordination of the tactical, operational, acquisitional, and political domains' [6]; and in their brief overviews of each essay, they sometimes employ these terms and framework. But this does not seem necessary or fruitful for full appreciation of the links that they are trying to describe, nor does any of the essays use this language.

A major strength of the book lies in its organization, for which the editors should be commended. The essays have been well-grouped into four sections. Each section either explicitly or implicitly uses a technology or technological process as its focal point (gunpowder weaponry, naval innovations, gunpowder production, and military engineering/artillery). Within each section, the articles, although informative and thought-provoking on their own, are often so compatible that they create a much richer narrative when coupled and grouped together as done by Steele and Dorland.

The four essays in the book's first section, 'The Global Development of Gunpowder Weaponry', describe historical developments and events that occurred whereby formal science was *not* 'a necessary condition for the invention, innovation, and diffusion of the fundamental weapons systems that dominated the late Medieval and Renaissance eras' [13]. One might ask why they are thus included in this work. The answer is that they are crucial in describing the cultural, and especially technical, landscapes that existed prior to the inclusion of formal science: the choice to include science and its impact on certain cultures is made clearer by comparison with an earlier time that lacked this relationship.

In 'Facing the New Technology: Gunpowder Defenses in Military Architecture Before the *Trace Italienne*, 1350–1500', Kelly DeVries extends an earlier study in which he focused on changes made in fortification design and construction prompted by the use of gunpowder weapons used against them, to show how gunpowder weapons changed the nature of siege warfare during this period. His previous study tried to show that the *trace italienne* (a type of defense work design) was an evolution from medieval work, rather than the revolution in design claimed by Geoffrey Parker [Parker 1988]. DeVries obligingly gives enough explanation of his earlier study so that readers will have no trouble understanding how and why this present article offers an even better example in support of his claim. While

both DeVries and Parker had used England and Italy for their earlier studies, DeVries now switches to France and the southern Low Countries as more indicative of this evolutionary change; he believes it is perhaps more fruitful a time and place for this type of study, as this area was more of a hotbed of continuous war. He describes the construction of four basic gunpowder fortification defenses: gunports, boulevards, artillery towers, and pre-*trace italienne* and non-*trace italienne* artillery fortifications. Within the essay, DeVries uses a rich combination of extant structures, historical accounts, and plans as evidence; he includes copies of some of these, and relevant photos that greatly enhance our understanding of the changes made in construction and design.

Frederic J. Baumgartner's article is in many respects a good companion piece to DeVries' study, and a wise choice in organization by the editors. Where DeVries focused on French choices regarding military architecture in the late Middle Ages, Baumgartner concentrates on French choices regarding firearms in the early modern period. In 'The French Reluctance to Adopt Firearms Technology in the Early Modern Period', Baumgartner cites 15th-century losses to Swiss pikemen and the influence of several groups, such as French artisans and the French military forces, as barriers to the adoption of firearms. There are some similarities in Baumgartner's case to the Japanese cultural resistance described by Noel Perrin in *Giving Up the Gun* [Perrin, 1979]. Baumgartner claims that France, as a major participant in 16th-century European wars, would have played a different role if it had not been reluctant to adopt firearms; and that this reluctance impacted the way in which treasury funds were disbursed and allowed Spain (which had adopted a firearms culture) to obtain and maintain an edge. An interesting question emerges from the DeVries and Baumgartner studies as to just where states were placing their attention and funds and why. The articles taken together give a more complete picture.

In an essay showcasing the mastery of sources and care for bibliography that colleagues have come to expect from him and eagerly anticipate, Barton C. Hacker expands our understanding of the introduction and use of gunpowder technologies beyond the European boundaries. In 'Gunpowder and the Changing Military Order: The Islamic Gunpowder Empires, ca. 1450–ca. 1650', his research focuses on three 'gunpowder empires', as designated by Marshall Hodgson

[Hodgson, 1974], that were large military-patrimonial-bureaucratic states: the Ottoman empire in the Near East, the Safavid in Iran, and the Mughal in India [88]. After first reviewing the Mongol successes of the 13th century and the impact that gunpowder firearms had on their decline in the 15th and 16th centuries, Hacker describes the Ottoman janissary corps and its acquisition and use of European gunpowder technology. In the case of the Safavids in Iran, it seems to have been more a problem of wanting firearms but not being able to get them. The Shah, encountering resistance to firearms among his supporters, established a standing army drawn from a slave class. European expansion influenced the rise of the Mughal gunpowder empire in India, in addition to contact with, and acquisition of technology and tactics from, the Ottoman empire. Key in all three empires covered by Hacker seems to be the personal interest taken by the ruler himself in the actual technology. Hacker concludes that, as is clearly shown in these cases, gunpowder use favored well-organized central authority [95].

Citing old fallacies that have been slow to die, Gábor Ágoston has two agendas in 'Behind the Turkish War Machine: Gunpowder Technology and War Industry in the Ottoman Empire, 1450–1700', as he tries 'to demonstrate the need for a more balanced and cautious approach in studying [Ottoman] military technology by broadening the scope of examination' [102]. He does this by first commenting on the questionable biases that exist and have existed in other studies and, second, by looking more closely at the Ottoman war industry and its supply of weaponry and ammunition. For example, Ágoston points out that the employment of foreign technicians and artisans by the Ottomans does not mean they were technologically inferior, as all of Europe was doing the same thing [106]. While the impressive flood of facts can be overwhelming, and at times it seems as if there are two essays here instead of one, Ágoston's contribution is both an enlightening piece of research and a good cautionary tale to historians that no subject has seen its final word. And, as before with the DeVries and Baumgartner essays, reading the Hacker piece followed by the Ágoston piece gives readers a much more comprehensive view of this region and time period.

The second section of the book, 'Naval Innovations: Hardware and Software', contains essays in which the authors explore a subject by focusing on the life and work of a central figure or figures. In

the first essay, Alexzandra Hildred's 'The *Mary Rose*: A Tale of Two Centuries', the central figure happens to be a ship. Although the editors claim that the essays in this section 'address the relationships between early modern science and naval power' [17], and despite revolutionary innovations seen on the *Mary Rose*, Hildred's study demonstrates a 'limited relationship between scientific theory and naval practice' [18]. She argues that major developments in naval warfare during the late-15th and early-16th centuries were prompted by developments in the shipyards, where new armaments and designs were being integrated with the old rather than replacing them, and that the resulting changes in design and construction are indicative of a new stage in the tactics of naval warfare. In many ways, Hildred's study can be viewed as the biography of a famous artifact, which is often much harder to write than that of a person—what 'tale' is the ship able to tell about the changes in its 'life'? Hildred's detective work is impressive, as she draws on the artifact, historical documents such as ship inventories, and visual works in an attempt to tell this tale. Why is this one ship so significant? As Hildred states, 'neither shipwright's plans nor models exist in Britain for vessels of this period' [142]; so the discovery and analysis of the *Mary Rose* provides exciting new avenues for historical research in many areas.

In Lesley B. Cormack's 'Mathematics and Empire: The Military Impulse and the Scientific Revolution', we finally see much clearer connections between science and the military, and 'heirs' (as promised by the editors), emerging in 16th and 17th century Europe. Cormack claims that mathematical practitioners 'signify a connection between the Military and Scientific Revolutions' [182]: 'these men combined mathematical insights with commercial concerns and laid basic foundations for the Scientific Revolution in England' [181]. Mathematical practitioners connected theory and practice in their approaches and investigations. To illuminate these abilities and connections, Cormack focuses on the works of the geographers Edward Wright and Thomas Harriot, who both used their voyages of discovery in their theoretical attempts to explain the world, and who both represent the reliance of research on continuing forms of patronage. The military fits into their stories in a broader way: European rulers, with an eye toward imperial expansion, sought the help of the mathematical practitioners who, in seeking patronage, were more than

willing to look for research areas and to choose issues important to military expansion and practice [195].

Amir Alexander follows Cormack in looking at mathematical practitioners; but where she uses Edward Wright and Thomas Harriot, Alexander focuses on Thomas Harriot and John Dee. As described by Steele and Dorland in their introduction, where Cormack ‘revealed many similarities’ in her study, Alexander’s work highlights ‘vast differences’ between his subjects [20]. In the title of his article, Alexander asks: ‘Harriot and Dee on Exploration and Mathematics: Did Scientific Imagery Make for New Scientific Practice?’ He restates and expands upon this question early in his study, asking ‘Do different scientific approaches draw on different inspiring tales, and do conflicting metaphors tend to generate opposing scientific practices?’ [206]. Again like Cormack, Alexander uses biography as background for exploring such differences as exhibited by Harriot and Dee. For instance, although both men were ‘leading advocates and practitioners of maritime exploration and imperial expansion’ [208], Dee’s arguments for British supremacy sprang from legal and historical foundations, while Harriot’s sprang from a spirit of adventure and the hope of financial gain. Alexander proceeds with his investigations by analyzing maps and drawings made by these men that further serve to demonstrate how they perceived the relationship between mathematics and exploration.

As with the other essays in section 2, Michael S. Mahoney’s ‘Charting the Globe and Tracking the Heavens: Navigation and the Sciences in the Early Modern Era’ focuses primarily on a central figure (or figures), his work and its greater impact. In this case, the subject is Christiaan Huygens, his work on clocks, its impact on the longitude problem, and its broader implications for the new mechanics. Mahoney depicts Huygens as working within the context of the relationship between war and science: Huygens investigated clocks to find practical benefits to navigation for war (and commerce and exploration), but this had benefits to the science of mechanics as well. This work on clocks furthered a relationship between science and the state: Mahoney explains how Huygens and his work on clocks played a pivotal role in the relationship between the Academy of Sciences and the government of Louis XIV.

Brenda J. Buchanan's essay, 'The Art and Mystery of Making Gunpowder: The English Experience in the Seventeenth and Eighteenth Centuries', opens the third section, 'Gunpowder Production: The Refinement of Waste'. In it, Buchanan cites the lack of attention paid by historians to the development of, and experimentation with, gunpowder manufacturing in England during the early modern centuries, as the inspiration for her research [234]. She successfully presents in four phases 'a thorough analytical history of early English gunpowder acquisition' [234] that demonstrates its evolution from a 'craft-based practice to a process based more securely on scientific methodology' [265]. Her story stretches from English attempts to adopt the skills of foreign craftsman through the shift to home manufacture of gunpowder that culminates with the contributions made by Charles (later Sir Charles) Frederick (1709–1785) during his tenure at the Board of Ordnance and the Royal Laboratory in the latter half of the 18th century. Frederick advocated powder manufacture that incorporated both the art and the science of the time; it was good practice coupled with an experimental approach [262]. By the end of the essay, gunpowder has acquired almost human qualities—a life of its own—in Buchanan's narrative.

In 'Chemistry in the War Machine: Saltpeter Production in Eighteenth-Century Sweden', Thomas Kaiserfeld 'addresses how science participated in organizing production' of saltpeter in Sweden during this time period, under the competing influences of agrarian, military, and mining interests [275]. Kaiserfeld presents the reader with an enigma, and effectively demonstrates how it occurred: technical changes in saltpeter production based on scientific findings prompted a reversion to an older institutional condition (control by the peasantry), rather than the rise of a new condition as one might assume. While explaining how a new understanding of saltpeter evolved, he also treats the reader to an array of characters who participated in the debates over who would control its production.

Seymour H. Mauskopf makes a good case for why historians of science should be interested in the development of munitions in the 18th and 19th centuries, rather than being 'usually puzzled and put off' because they think that nothing really happened in that area after the ascendancy of firearms [292]. In 'Chemistry in the Arsenal: State Regulation and Scientific Methodology of Gunpowder in Eighteenth-Century England and France', Mauskopf focuses on 'the

developing role of the state in the regulation of munitions' production and the role of science in the hoped-for amelioration of munitions' [294]. Mauskopf elucidates the role of science in the reform of the gunpowder industry and the improvement of gunpowder by highlighting the organizational reforms of Antoine-Laurent Lavoisier, as a director in the Régie des Poudres, and of William Congreve, as Comptroller of the Royal Laboratory at Woolwich, and their systematic and experimental investigations of gunpowder [314]. As clearly evident in this essay, the reader may notice the emerging theme of 'better war through science'. Mauskopf says that 'given the historical conundrum of gunpowder, science, and the Military Revolution, I want to be cautious with my claims' [315]. But in this brief, well-structured and clear piece, it seems as if his claims are justified, and that historians should start taking note of this, in addition to other topics that might have been getting the same cold-shoulder.

The final section, 'Military Engineering and Artillery', with its two essays, has the clearest connection to the ideas presented in the book's introduction regarding the heirs of Archimedes, although the essays themselves do not bring Archimedes or that connection into their discussion. In 'Eighteenth-Century French Fortification Theory after Vauban: The Case of Montalembert', Janis Langins focuses 'on France and the relation between science and military engineering, a central issue for warfare in both the Baroque and the Enlightenment Ages' [335]. He does this by first looking at the object or artifact, and then moving to the actors. He sets the stage by giving examples of the interaction as it played out in practical military needs, such as the influence of topographical studies on siege warfare and fortification design. Then, using the verbal battle between Marc-René, the Marquis de Montalembert (1714–1800), and the French military engineering establishment over fortification design, Langins explores 'to what extent formal science was used by fortifiers in their material as well as rhetorical designs' [335]. An underlying and recurring question, as pointed out by Langins here and elsewhere [Langins 2003], is what exactly was 'science' in the 18th and 19th centuries? One can appreciate this essay even more by returning to several of the earlier essays, particularly the DeVries piece: the significant developments in fortification design and siege warfare become clearer upon comparison of the essays.

Co-editor Brett D. Steele contributes the final essay in the book. In ‘Military “Progress” and Newtonian Science in the Age of Enlightenment’, he ‘explicitly addresses the convergence of Enlightenment ideals of progress and military practice in the eighteenth century’ [26]. His insightful introduction to the essay points out that modern-day notions of technological progress and success may not apply to 18th-century Europe. ‘More illuminating is to historicize eighteenth-century artillery by asking how close its organizers conformed to the notion of “progress” according to the standards of their own era’ [362–363]. For example, Steele describes how several European schools of artillery, such as the Turin Academy, attempted to unify Newtonian science and artillery practice in a setting of formal education. Weaving together historical data and events, and intellectual developments, Steele paints a very comprehensive picture of ballistics researchers and artillery institutions working within the context of Enlightenment thought.

There are a few disorienting features to this collection. As I pointed out previously, the editors introduce a modern framework that, despite comments in the introduction, is often difficult (and unnecessary?) to reconcile with material presented in the essays. Also, in their introductory comments for each essay, the editors seem to be reading much more into some of the articles than is actually there, sometimes bringing in material that is not covered by the authors (for example, in their discussion of the *tercio* in relation to the Hacker piece). While this is admirable in some ways, it can also be misleading. Finally, though usually in reviews I do not comment on the ‘look’ of the book, there is, I must say, a typesetting or formatting problem throughout the book that is so prevalent as to be distracting. There is often no spacing between the period at the end of a sentence and the beginning of the next sentence, making paragraphs read like huge run-on sentences. Not something I would have expected from this particular press.

When invited to write a book review, one is often asked to comment on the work’s place in the current scholarship of a field. For this collection of essays, it is an easy task: this collection is much of the most current and interesting scholarship addressing the historical evolution of the relationship of science and military technology. And, as I mentioned earlier, the organization of the essays strengthens the readers’ understanding of that evolution. Was (and is) there ‘better

war through science'? Although that may not be answered here, this book demonstrates the ways in which the inclusion of science and the relationship to scientific figures and institutions changed the technology and nature of warfare. Admittedly, if someone does a keyword search on 'Archimedes' and gets the citation for this collection, he might be disappointed. But for those interested in the history of the relation of science and military technology, this is an excellent, long-awaited contribution to the subject.

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*Astronomies and Cultures in Early Medieval Europe* by Stephen C. McCluskey

New York: Cambridge University Press, 2000. Pp. xiv + 235. ISBN 0-521-77852-2. Paper \$22.99

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This is a wonderful book (and congratulations to Cambridge for releasing it in a very affordable paperback). It fills in a chapter in the history of the sciences which has too often seemed populated by caricatures of monks in hair shirts doing little more than copying poorly-understood Latin textbooks in between scraping turnips out of the ground with sticks. I exaggerate, of course, but the point is fair. We know about a 12th-century renaissance, and there is recent interesting (if still too often undeservedly obscure) work being done on the Carolingian period; but now we can add to this picture and fill in not only the previous and intervening centuries, but also details of continuity throughout the period that spans the end of empire in the Roman West through to the high Middle Ages. More than this, the picture McCluskey draws is not just a filling-in but a timely re-thinking of the nature of early medieval science. It is, he shows, really quite different from anything that went before it. Not because of a degeneration—whether cultural, demographic, institutional, economic, or whatever—but because the scholars working on that science had overarching cultural needs for their astronomy to do different things, and because the particular nature of the resources they had access to pushed their astronomy in specific directions.

Calendars and timekeeping loom large in this story, and much of McCluskey's book revolves around the ritual needs of the church and of monastic communities for particular kinds of large- and small-scale timekeeping. These needs pushed the actors in this narrative to investigate (often in books, sometimes in the sky) particular movements of the heavens. What they accomplished, being goal-directed,

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was not what had been accomplished in antiquity, and from an astronomical and technical point of view did not require the same level of sophistication on many fronts (the phrase ‘...required a basic knowledge of...’ recurs frequently in the middle section of the book). Nevertheless, by walking us through the needs of the church and its communities, and by taking us on various tours of what resources those working on astronomical questions in this period actually had access to—in terms of education, texts, mathematics, and so on—we are able to appreciate the kind and quality of their achievement. At the same time, McCluskey gives us a strong appreciation for what we might call the embeddedness of astronomical practices in the cultures in which they operate.

The book’s path is often more thematic than strictly historical, although we might be fooled in this regard by the way it begins with prehistoric stone monuments, and then walks through Celtic solar ritual, Greco-Roman astronomy, and early Christian ritual cycles before taking us into the Carolingian period and up to the birth of universities and the discovery of Arabic astronomy in the final chapters. But I at least think that seeing the narrative as primarily historical would be to miss much of McCluskey’s point in this book. The book is never really about ‘development’ so much as about a continuous (if shifting) action and response between (on the one hand) cultures in general and *ritual* in particular, and (on the other) astronomy. Towards the end of the book, we begin to see a flowering of what had been a kind of by-theme in the earlier parts of the book: the quest for much more exact astronomical knowledge *almost* for its own sake. I say ‘almost’ just because I get the feeling that even here McCluskey is really offering an account that sees the 12th-century pursuit of an *Almagest*, for example, as being inextricably entwined in then-recent changes in the long-standing traditions of (philosophico-religious) cosmology.

Any complaints I might have about the book are really quite minor, and confined to the aesthetic and cosmetic. The cast of characters and their chronology is sometimes not as easy to follow as might have been the case. Part of this is unavoidable due to the book’s structure; but still, little clues would have helped immeasurably. Hrabanus Maurus, to take one example, is introduced on page 35 as ‘abbot of Fulda and later archbishop of Mainz’. He then disappears for some 80 pages, resurfacing briefly on page 115, and then

again on page 145 for some extended treatment of his work in the mid-ninth century. Immediately after this discussion, he is re-introduced, for some reason, as ‘master of the monastic school at Fulda’. I was left shuffling around trying to figure out what Fulda or monastic schools had to do with the discussion on page 150. Nothing that I could detect as it turns out, so perhaps the detail was relevant to the (insufficiently flagged) jump back in time (to 820) that was made with the new chapter subsection. I am not sure. Or perhaps it is simply an unintended artifact of writing chapters and sections in parallel.

Furthermore, sometimes there is strange repetition: we are told of Abbo of Fleury on one page that ‘like Macrobius, he reported erroneously that each sign of the zodiac rises in exactly two hours’, and then again one page later that ‘he followed Macrobius’s view that each sign rose in exactly two hours’. Moreover, for some reason a reference supporting the claim is cited only in the repetition. One wonders if the substantive editing could have been more careful.

Likewise, regarding the plural in the book’s title, ‘*Astronomies*’, why the switch between ‘four traditions’ on page 163 and ‘two traditions’ on page 165? Whereas McCluskey clearly lists the two traditions in the latter instance, the reader is left fishing for what exactly will count as a ‘tradition’ in the former case. Is ‘advocacy of the feast of All Saints’ really meant to count as an *astronomical tradition*? Light is finally shed in the last section of the book, on page 207, where we get a more explicit enumeration of the traditions that McCluskey has seen himself dealing with (there are four again):

- solar horizon observations,
- monastic timekeeping,
- computus, and
- the astronomy of the liberal arts.

Sure, these were all topics extensively covered in the book; but they do interact and interweave in many ways, and the discreteness of any categorization is always a little fluid. So I at least had lost track by this point of what the precise compartments that McCluskey had in mind were. I suppose such minor whinges are mediated to some extent by the quality of the indexing in the book overall, to which the attentive reader can jump back and forth to solve such little conundrums as they arise.

The real strength of the book is shown when we get near the end. As Arabic astronomy begins to trickle into Europe in the early 12th century, we see the Latin writers on the cutting edge of the new astronomy—Adelard, Peter Alfonsi, Raymond of Marseilles—venting their frustration with their hide-bound contemporaries who err in following only (Latin) books and tradition, the very books and tradition that have been the substance of most of McCluskey's study so far. We immediately see their frustration, but at the same time we can see why the accusation is a little unfair. McCluskey's treatment has been balanced, clear, and lively enough to bring those traditions to life, to situate them dynamically in what turn out to be surprisingly rich intellectual, religious, and ritual contexts. Were those working on astronomical topics in the early Middle Ages hide-bound? By the end of McCluskey's book, I was convinced that to ask such a question is to miss the point.

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*Re-Inventions: Essays on Hellenistic and Early Roman Science* edited by Philippa Lang

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In October 2003, Emory University (Atlanta, Georgia) hosted a conference organized by the editor of the present volume, Philippa Lang: ‘Reinventions: Hellenistic and Early Roman Science’ (<http://www.classics.emory.edu/events/reinventions.htm>). The conference, which I attended as an audience member, provided the opportunity—too rare in the United States—for the gathering of scholars working on the history of ancient science. This conference was of particular value, as it encouraged research in a rather under-studied period that was crucial in preserving older knowledge and in formulating new. Thus, it was in this period that the ancient sciences and philosophy—and their many subfields and sects—re-defined and re-invented themselves in relation to one another and to the authoritative figures and practices of the past. Three of the five essays of the present volume were given at the conference, and two are new contributions by conference speakers.

Sir Geoffrey Lloyd gave the keynote address, which is the first essay of the volume: ‘New Issues in the History of Science’ [9–27]. As many readers of *Aestimatio* will know, for more than a decade Lloyd has devoted himself to the study of Chinese and of Chinese science. Here he calls for a ‘genuinely comparative’ and ‘ecumenical’ approach to the history of science that is alert to the differences in the development of scientific traditions in different cultures. It is only by this means, Lloyd contends, that scholars can test their accounts of how and why science developed as it did in their ‘home’ culture, and avoid the temptation to view such developments as inevitable.

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But what is science, anyway? It is hard to define even in the modern world. As Lloyd points out, the ‘hypothetico-deductive experimental method taught in schools’ rarely plays a part in how scientists carry out their work [11]. For instance, it may be a tenet of the scientific method that results should be reproducible, but such verification is seldom conducted, as journals will not generally publish negative results, and scientists cannot afford to devote time producing what is unlikely to be published. Nevertheless, the potential of a given discipline to conform to the ideal of the scientific method plays a role in how scientific it is considered to be. Thus, psychology is frequently not considered a science (or not a ‘hard’—i.e., quantifiable—science), nor is medicine; in fact, I once overheard a chemist remark that biology was ‘not really a science’.

So, if even the scientists among us are not practicing science as they themselves have conceived of it, how are we to define ‘science’ with respect to the theories and practices of ancient cultures? Which of their enterprises—if any—are we to call ‘scientific’? And are we condemned to committing the cardinal scholarly sins of positivism and anachronism if we do? Moreover, if we are to be alive to the differences in approaches, methods, and goals of such enterprises in different traditions, can we legitimately call all of them ‘science’? And, if they are so very different, are they still commensurable? Does genuine ecumenicalism preclude comparison?

Lloyd addresses these broad and fundamental questions at the outset, though necessarily briefly [9–12], before narrowing his focus to the studies of mathematics, astronomy, and harmonics in the Chinese and Greek traditions [12–24]. He agrees with the strictest and most modern conception of science that the data of the phenomenal world are the object of scientific study, but notes that the phenomena are always multidimensional; by implication, then, the purposes of their systematic study can vary and still be scientific. Provided that we avoid measuring early science by a modern yardstick, as was notoriously done in the early years of the history of science, we will remain untainted by teleology and anachronism. As for commensurability, Lloyd argues that there is sufficient common ground in divergent traditions for fruitful comparison. An eclipse is still an eclipse, even if the styles of inquiry concerning it vary.

Lloyd turns first to mathematics where, as he says, ‘our expectations of cross-cultural uniformity are at their highest. Two and two

make four wherever in the world you are and at whatever period in time' [12]. Nevertheless, Chinese and Greek mathematics developed very differently. In direct contrast to their Greek counterparts, Chinese mathematicians had no interest in axiomatization, and so they have been dismissed as being concerned with mere practicalities [14]. Lloyd disputes this conclusion, though he agrees with the premise: Chinese mathematicians may be 'innocent of any drive towards axiomatization' [14], but inquiry into abstract mathematical questions is not absent [14–15], nor are attempts to systematize, though this is done on an analogical—not deductive—basis that establishes conceptual links between categories of problem [15].

Lloyd then steps back to provide the broader conceptual frameworks in which mathematical studies developed in China and in Greece. Chinese cosmology centers on the processes of change called the five phases [16–17]. The Chinese focus not on the essential natures of the substances associated with each phase (fire, earth, metal, water, and wood), as those of us imbued in early Greek philosophy would expect, but on what brings about the destruction and generation of each phase (in fact, the five 'substances' are viewed as processes: e.g., fire is 'burning upwards,' water is 'soaking downwards') [16–17]. Moreover, the assumed conflict between the intelligible and the perceptible that is at the heart of so much Greek philosophy and science—and which generated so much of the heat in the sectarian conflicts of the Hellenistic period and later—appears to be absent in Chinese intellectual traditions, where the senses play a positive role in furthering knowledge. There is no unchanging hidden or higher truth that can be apprehended by reason alone. As Lloyd says, '[T]he Dao may be hard to fathom, but it is not located on the far side of an epistemological or metaphysical gulf' [17–18]. As a result, the Chinese are free to use mathematics to investigate cosmological questions [17]; in fact, in one source, the studies of the heavens and of the five-phase theory are considered to be sub-categories of 'numbers and methods' [17]. In the Greek tradition, however, the place of mathematics in speculations about 'the nature of nature' (*φυσική*) is contested: is mathematics, being abstract, closer to the objects of reason (in Plato, 'mathematical intermediaries' are midway between the perceptible world and the Forms), or is it properly the study of the mathematical properties of physical objects, as in Aristotle [17]?

Can mathematics aid in the apprehension of true knowledge, or not? These would not, it seems, have been sensible questions in China.

Lloyd's next *comparanda* are astronomy and astrology, where China and Greece appear to share a great deal, with scientists in both traditions observing the skies to record the periodicities of planetary movements, and the courses and eclipses of the Sun and Moon [18]. But, Lloyd cautions, the purposes to which the observations were put are strikingly different: the Chinese wished to predict such phenomena as eclipses; the Greeks, to explain them [19]. The Greeks developed planetary models that were used first to reduce apparent irregularities to regularities, and only later for prediction [19], with teleologists claiming that they revealed the order of the universe [19]. The Chinese, despite their focus on prediction, did not have an interest in teleology [20].

Harmonic science, too, provides common ground, with both traditions concerned to express the main concords as ratios between simple numbers [20]. But in Greece, competing theories obtained in harmonics as in so many other intellectual and artistic pursuits. And, as elsewhere, the assumed dichotomy between reason and perception was the basis of the dispute. As the opposing methodologies were acknowledged to be incompatible with one another, analysis could not be undertaken until decisions on certain methodological questions had been made [20–21]. Chinese theorists reveal no such overriding concern with methodological or epistemological purity; in fact, they apparently had no compunction about rounding off to make their analyses work in the case of very complex ratios [21].

In sum, science should be defined, in Lloyd's view, fundamentally by its aims, not by its methods. Those who seek to understand, predict, and explain the phenomenal world are scientists and, by this definition, we can see some ties between very ancient and the most modern science [22]. If there is no single method that is 'science', and if the objects of scientific study are multidimensional in their meaning, there is no inevitable course for science to take, though judgments can be made about success [24]. Lloyd is calling upon historians and philosophers of science to set aside explanations that rely upon inevitability as an *a priori* assumption, and to take up instead the question of 'why the investigations that were undertaken took the form they did in different ancient societies' [21]. It is only by

working comparatively, Lloyd argues, that scholars can test ‘which features of which types of inquiry can be correlated with what other aspects of the intellectual, cultural and political situation in which the investigators worked’ [22]. Greek scientists and philosophers, for instance, developed their views in a highly competitive marketplace of ideas, while their Chinese counterparts were concerned to persuade powerful rulers of the right course of action [21–22]. The former context, Lloyd and Sivin have suggested, may have fostered an interest in foundations, theories of knowledge, and a proclivity for axiomatic-deductive demonstration; the latter, by contrast, would have required discretion and persuasion [21–22].

Lloyd is perfectly correct, in my view, to warn scholars away from unwarranted *a priori* assumptions, and to urge us to rethink certain basic definitions and questions. I am also persuaded that to do the sort of comparative work that Lloyd proposes has the potential of being fruitful in the ways that he suggests (and probably in other ways, as well). I do not see, however, that the examples that he has provided make his case for such fruitfulness. As fascinating as it is, for instance, to gain a nodding acquaintance with Chinese mathematics, astronomy, and harmonics, and the intellectual and cultural contexts in which they developed, I do not see that any specific hypotheses concerning the development of those same disciplines in Greece have been strengthened or disproved. Moreover, the very vigor of Greek intellectual debate makes challenging specific hypotheses on a comparative basis difficult. Chinese scientists may have been fortunate to develop in a tradition in which empirical evidence was not thought to war with reason; but Greek scientists of course had an empiricist tradition, too. The Platonic eclipse was not a total one. Lloyd in fact points to the Greek propensity for debate and, indeed, for the utter refutation of opposing views, and contrasts it with the greater decorousness of Chinese scientific rhetoric, for which he suggests state control of Chinese science may have been responsible. But Greek science followed its course first under oligarchy, then democracy, and then imperial rule; and the vigor of intellectual debate does not seem to have waxed and waned in any predictable way with these phases. How, then, does the Chinese situation elucidate the Greek? It seems to me that we learn that Chinese rulers were more acutely aware than their Greek counterparts of the potential power of knowledge, and I find myself wondering why the Ptolemies,

for instance, did not make more extensive political use of the research at Alexandria. Perhaps this is the sort of question Lloyd hopes comparative work will raise, though it is arguably more in the realm of political history than history of science.

Karin Tybjerg's chapter, 'Hero of Alexandria's Mechanical Geometry' [29–56], is a fascinating examination of the work of this relatively under-studied mathematician who flourished in the first century AD. Tybjerg argues that Hero's work bridges the divide, deep in both antiquity and now, between the 'lower form' of applied mathematics used for such practical applications as land measurement and architecture, and the 'higher' theoretical mathematics of Euclid, Archimedes, and Apollonius.

Hero was thoroughly educated in the Euclidean-Archimedean tradition: he wrote a commentary on Euclid's *Elements* (preserved now only in fragmentary form in an Arabic commentary), and refers frequently to the works of Archimedes and of other theoretical mathematicians [30–31]. But he also takes on practical problems, such as land measurement and instrument construction; and so his work offers, as Tybjerg sees it,

a rare view of the interaction between geometry, mechanics and professional mathematics; it shows that these enterprises were closely related in the ancient world and that some demonstrative procedures combined elements from several traditions. [31]

Tybjerg deals at length with several of Hero's treatises (*Metrica* [31–41, 43–44, 46–48, 53], *Mechanics* [41–44], *Dioptra* [46–48, 51–52], *Catoptrics* [48–49]) and makes reference to several others. She demonstrates Hero's skillful adaptation of the methods and proofs of Euclidean/Archimedean geometry to practical mechanics and geometry, including to irregular figures (a certain sign that he was interested in practical applications). The result, in Tybjerg's view, is the creation of a new theoretical discipline, mechanical geometry [54].

Ian Mueller's 'Remarks on Physics and Mathematical Astronomy and Optics in Epicurus, Sextus Empiricus, and Some Stoics' [57–87] is a detailed and thorough account of how certain Hellenistic

thinkers differentiated physics and mathematics in the course of discussing astronomy and optics. Mueller begins with Epicurus' vehement rejection of astronomy (Epicurus refers to the 'mad, inappropriate behavior of those who esteem the emptiness of astronomy' [60]), which is based on the unverifiability of its explanations [59]. Physics, for Epicurus, is the study of the principles of atomism; since these principles cannot be accurately applied to 'the things in the sky', it is useless to speculate about them; multiple explanations are possible, and there is no basis for making a decision about which one is correct [59].

Mueller then takes up the topic of *paideia*, and of the disdain for it shared by Epicurus and the Sceptic, Sextus Empiricus [61–64]. Among the subjects of a liberal education were *ἀστρολογία/ἀστρονομία*. Epicurus rejects the typical curriculum *tout court*, as it is not the study of physics, famously advising his student Pythocles to 'flee all *paideia*' [62]. Sextus withholds criticism of mathematical astronomy and weather forecasting, reserving his criticism for that part of *ἀστρολογία* that has to do with casting horoscopes. (His attack proceeds on practical and epistemological grounds: it is difficult to determine the time of birth or of conception, or which zodiac sign is on the horizon; and one is hard pressed to account for the differences among people born at the same time [64].)

The major section of Mueller's paper discusses mathematics and physics in five Stoic texts that are—or could be—related to Posidonius/Geminus. In Diogenes Laertius, mathematics shares with physics the investigation into such things as the size and revolutions of heavenly bodies, but physics alone asks about the nature of the cosmos (e.g., the substance it is made of, whether or not it is generated, and whether or not it has a soul) [65].

Mueller looks next at a passage of Posidonius/Geminus found in Simplicius' commentary to Aristotle's *Physics 2* [66–72]. Here the distinction between astronomy and physics is similar to that found between mathematics and physics in the Diogenes Laertius passage already discussed: astronomy is concerned with size, shape, motion, speed, eclipses, and so forth; physics, with knowing the substance of the heavenly bodies, and their coming to be and ceasing to be, and so on [67]. Here, however, both disciplines might offer proofs on the same subject (e.g., that the Sun is huge, or that the Earth

is spherical) [67]. But the ways in which the two carry out their demonstrations will differ: the physicist will proceed, apparently, by logical argumentation and will offer causal explanations, but will not use mathematics; the astronomer will never give a causal explanation, but will offer hypotheses that have no physical justification, and will use mathematics [67–71].

Mueller analyzes passages in Strabo and Proclus that may be traceable to Posidonius/Geminus, and that tell a broadly similar story [72–82]. In Strabo, physics is self-dependent and unhypothetical; it carries within itself its own principles and justifications; it investigates the general characteristics of the heavenly bodies and their underlying natures. Astronomy relies upon physics, and is relied upon by geometry (in the sense of Earth measurement); as above, astronomy calculates the orbits, eclipses, and other particulars of the heavenly bodies [72–76]. Proclus' characterization of astronomy (*ἀστρολογία*) is much the same as in the accounts above in dealing with the size and movements of the heavenly bodies [76–82]. Proclus, however, says nothing about the use of mathematics in astronomy, and little about astronomy's relation to physics; he does, though, emphasize the use of astronomical instruments in the calculation of elevations, distances, and positions. And Mueller, reasonably enough, sees this as acknowledging the practicality and precision with which astronomy is characterized in the other sources he analyzes.

Mueller also introduces us to a little-known anonymous excerpt on optics that conforms in some respects to the ideas on optics expressed in Diogenes Laertius and Proclus/Geminus [cf. 65–66, 79–80] and that may be a source for the latter [82–85]. For present purposes, the chief point of similarity is the attribution of the capacity to provide causal explanation to optics. The excerpt also mentions theories and hypotheses in optics—elements absent from the discussion in Proclus [83]. Little is said about the theories, but the author elaborates upon the hypotheses, which appear to have a mathematical basis [83–85]. The author then takes pains to distinguish optics from physics along much the same lines as with mathematical astronomy and physics: optics deals with the particulars and is based on mathematics; physics investigates the larger, broader, and more abstract questions. Optics differs from astronomy, however, in having the capacity for providing causal explanation—something usually reserved

for physics [85]. Mueller proposes that optics enjoyed this more elevated status because, although it ‘pays no attention to physics’, unlike astronomy, its hypotheses are compatible with Stoic physics [85].

James Allen’s ‘Experience as a Source and Ground of Theory in Epicureanism’ [89–106] is a fascinating investigation of the ground shared by Epicureanism with both empiricism and rationalism. Allen first defines the terms used by the medical Empiricists: ‘*peira*’ refers to one observation and to the knowledge that arises from it; ‘*empeiria*’ to repeated observations and to the knowledge or memory that arises from them; ‘*historia*’ is the knowledge acquired from the observations and knowledge of other people [91]. The understanding of causes has no place here, and it is unclear how one would become a doctor, or practice any other art, with only *peira*, *empeiria*, and *historia* at work. Most Hellenistic philosophers and scientists followed Aristotle in supposing that causation was understood by a separate rational faculty that based its insights on experience [93].

The Epicureans, says Allen, took a stronger position even than this, asserting that knowledge ‘either consists in or arises out of a grasp of the evident’, opinions about which could be assessed by attestation and non-attestation [93]. But what of the non-evident? With a physics based on atoms, the Epicureans enter the realm of the rationalists, who claim that we have a rational faculty capable of grasping the non-evident [89]. Opinions about the non-evident are assessed for their truthfulness by contestation and non-contestation: an opinion about the non-evident is contested when its observable consequences are shown by observation to be false, and is not contested when its observable consequences are not shown by observation to be false [93–94].

The obvious imbalance in this position, whereby a weaker test—mere non-contestation—is all that is required to prove the veracity of an opinion or theory about the non-evident, permits the Epicureans to pass well beyond the usual framework of empirically-based theory outlined above. This position seems to have been required by Epicurean physics. Allen observes that

... Epicurus seems to have regarded all the theories compatible with the phenomena as objectively possible. Indeed, he seems to have held that they are true in the sense of being

realized either at some time in our world or in some other world in the infinite universe. [95]

In other words, if we cannot show an opinion or theory to be false, then it must be true at some time or somewhere. That is why non-contestation is sufficient to prove veracity.

Allen proposes, moreover, that Epicurus goes a step further: the phenomena, being signs of the non-evident, are analogues of the non-evident. To the degree that a theory is similar to the phenomena, it is in agreement with them; this is the guarantor of a theory's being true in the sense of its being possible somewhere or at some time. Allen suggests that the tests for claims about possibility may be different from those for universal theories:

When put forward as universal explanations, holding of all times and places, [theories] qualify as true if they are merely not contested by the phenomena, but when reformulated as claims about possibility, each has a contradictory, viz., the proposition that it is not possible, which is in conflict with the phenomenon that it resembles and which was the basis of the analogy that is its source. This would mean that theories—conceived as claims about objective possibility—follow from the phenomena to which they are analogous. The grounds that the phenomenon on which an analogous theory is based furnish for accepting the theory would then complement the grounds furnished by the fact that theory is not contested by the phenomena quite generally. [98]

Allen notes that the Epicureans did not push this line of thinking as far as they might have. If, in grasping the phenomena, we grasp how things can and must be, are we not some way towards having a causal explanation? And, if we are, have we not put a foot on either side of the rationalist-empiricist line [98–99]? There is no extant Epicurean text of our world, however, that acknowledges this among the possible truths.

In the last section of his essay, Allen takes up the question of how, in the Epicurean view, conclusions could be drawn from the phenomena about the non-evident [101–105]. He begins with a discussion of *epilogismos*, which is used very differently by Empiricists and Epicureans. Among the former, it is the everyday reasoning of ordinary persons about evident, or temporarily non-evident, matters; for the

latter, it seems to be a pre-condition for inferring a non-evident conclusion from the phenomena: it is not the inference itself [101]. The two schools are in agreement that, on its own, *epilogismos* cannot lead to conclusions about the non-evident, but only about the phenomena [103]. But what sort of knowledge can be derived about the phenomena *via epilogismos*? The Empiricist will know the order, patterns, and frequency of the occurrence(s) of the phenomena, and so will be able to reason about them and form expectations about similar unobserved or future phenomena [104]. The Epicurean will gain knowledge, even if incomplete, of the natures and powers of the phenomena, and so will be able to infer that unobserved, and even unobservable, items are necessarily the same or similar [104]. In sum, experience, for the Epicureans, ‘prepares the way for the more than empirical grasp of the phenomena that in turn supports rational insights about non-evident matters’ [105].

The last essay of the volume is the editor’s innovative contribution ‘Medical and Ethnic Identities in Hellenistic Egypt’ [107–131]. Lang proposes that Greek medicine was a distinct cultural artifact, and so played a role in maintaining ethnic identity among Greek immigrants living in Ptolemaic Egypt. She is well aware of the problems consequent upon her topic and sets them out from the start—e.g., How do we establish ethnic identities? What is the evidence for the blurring of identities through intermarriage and other forms of cross-cultural exchange? How do we define ‘Greek medicine’ and ‘Egyptian medicine’? [107–109].

Lang identifies certain traits as being characteristic of, or exclusive to, either Greek or Egyptian medicine [109–117], though she is generally careful not to overstate her case, and acknowledges a fair degree of overlap [125–129]. She maintains, however, that there were enough sufficiently sharp distinctions between the two traditions that Greek medicine could serve as an identifiable artifact and expression of Greek culture [109]. Egyptian medicine, Lang asserts, was far more institutionalized than was Greek medicine; in fact, it was entirely enmeshed in civil and religious power structures, and so came to value tradition and authority [110–111]. While there was change and innovation over time, we see with Egyptian medicine nothing like the intellectual rivalry that we find in Greek medicine [111–112]. There is a hint here of a false assumption, common among Hellenists,

that the well-known vigor of Greek intellectual life would necessarily bring about positive change in a given discipline. But one should bear it in mind that while the ‘marketplace of ideas’ has the potential for culling out flawed theories and practices, it is also capable of promoting them if they are couched in persuasive speech. Indeed, many erroneous theories and practices espoused in the Hippocratic corpus, for instance, probably owed their survival largely to rhetorical defenses of the sort launched by the author of *On the Art*. Egyptian healers, on the other hand, were apparently assessed at least in part on the basis of their training and expertise:

Differences between [Egyptian] healers were overwhelmingly due to variation in their training and consequent expertise, their social status and their personal skill and preferences, rather than to competing and explicit differences in theory and methodology. Status and acknowledged expertise were derived from a high degree of medical-magical knowledge, preserved in written form in the temples. [111]

I do not take it as a given that evaluating a doctor based on his education, skill, and expertise, rather than on his ability to articulate competing theories and methodologies is necessarily the inferior choice. There are also two particularly noteworthy exceptions to Lang’s view: the Egyptian Smith Surgical Papyrus reveals little or no trace of dependency on religion, while the widespread Greek cult of Asclepius is, of course, a religious healing cult. All that said, I am generally in agreement with the view that Egyptian medicine was more entwined than was Greek with magic and religion, and with the social and political apparatus of magic and religion.

The other key distinguishing features of Greek medicine that Lang proposes are anatomical investigation, naturalistic explanations for physiology and illness, and internal surgery for non-traumatic illness [112–117]. The Egyptians, familiar with internal human anatomy through mummification, had no need to carry out further exploration, and the enmeshing of their medicine with religion and magic precluded the need for naturalistic explanations, and discouraged the development of invasive surgical practices. Patients of both ethnic groups, Lang contends, would expect healers to practice medicine in accord with their respective traditions [117].

Lang proposes that the ethnographic portrayals of Herodotus, Hecataeus, and others, encouraged the attribution of socio-cultural characteristics to ethnicity [117]. Accordingly, she suggests that

Greeks and Egyptians of the Ptolemaic era perceived differences, real but un-nuanced and exaggerated, between Egyptian practices and Greek medical discourse. This fostered an explicit definition of Greek medicine, particularly in the form in which it was practiced by the intellectual elite of Hellenistic society, as specific to Greek culture, especially in the wider context of an immigrant society inserted into a foreign country and culture. [117]

Lang derives her view from a careful analysis of certain relevant tax policies [117–125]:

- exemption from the obol-tax for residents labeled ‘Hellenes’,
- exemptions from the salt-tax for ‘Greek physicians’ and others whose occupations would be useful to the Ptolemaic civil and military authorities, and
- the imposing of the *iatrikon* (the medical tax).

The exemptions, she argues, tended to privilege Greek language and culture, and so all those who could ‘sound and act Greek’ [119] ‘whether through birth, Hellenization, or some combination of the two’ [118]. The *iatrikon* was levied on certain categories of Greeks—details are not clear—for the purpose of paying for physicians’ services when needed [119]. Lang suggests that this was a Ptolemaic innovation that was loosely based on pharaonic precedents and on the system of public physicians in many mainland Greek cities [121]. The primary purpose, she carefully argues, was to encourage the presence of Greek physicians in the Egyptian *chora* (they were far more plentiful in the cities), where there was a growing presence of Greek immigrants [124]. As Greek physicians, they would, of course, be able to offer their Greek immigrant patients care in their own language—an inestimable advantage that Lang certainly recognizes [124]. But they also, she suggests, represent a ‘distinctive part of Greek cultural experience and expectations’ because their medical practices were clearly identifiable as Greek [125], though there will have been overlap with Egyptian practices [125–130].

The conference that Lang organized and the volume that has grown out of it are valuable contributions to our field. Lang is to be applauded for her role in bringing to the light scholarly work that is at once thorough-going, innovative, and provocative. I hope readers of this review will be spurred to give each of these articles the time and attention it deserves.

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Ars/Techne. *Il manuale tecnico nelle civiltà greca e romana. Atti del Convegno Internazionale Università 'G. d'Annunzio' di Chieti-Pescara, 29–30 ottobre 2001* edited by Maria Silvana Celentano

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Readers who approach this collection expecting papers on a wide range of technical handbooks will find themselves misled by the title. Out of 14 contributions, all but three focus, some rather narrowly, on rhetoric, which is the editor's main specialty and also the topic of a similar collection published by her in 2004.

The volume betrays its origin as conference proceedings in the usual ways: quality and pitch vary; the individual bibliographies at the end of each paper end up repeating themselves; and some papers could have done with a bit more finish. The order, which follows that of the conference program, is more or less chronological, from the fourth century BC to the early Middle Ages. The reader (at least, this reader) would have greatly benefited from a more extensive introduction by the editor, offering some general reflections and/or drawing some overall conclusions and/or—as seems customary for editors these days—giving an inkling of what the papers contain. To supply this latter, in what follows I will provide brief summaries of the individual articles, in the order in which they appear in the book. My reflections on the volume as a whole will come at the end.

Marie-Pierre Noël opens '*La place du judiciaire dans les premières τέχνηαι λόγων*' with the question, Were there two traditions of rhetoric in classical Greece, judiciary and non-judiciary? The latter tradition, more philosophically inclined, was taught by the sophists and thus emphasized oral performance and transmission. The former, on the other hand, was communicated through textbooks. Noël comes to the conclusion that the distinction did not necessarily reflect the state of things in classical Athens. Instead, it may have

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originated from the desire on the part of Plato to draw a line between rhetoric and philosophy, with his questioning, especially in *Phaedrus* and *Gorgias*, of the status of rhetoric as a *techne* and, in particular, as a *politike techne*.

Two papers on Isocrates follow: Maddalena Vallozza, in her '*Isocrate, il πολιτικὸν πρᾶγμα e la τέχνη impossibile*', explores the possibility that he wrote a textbook of rhetoric, particularly given that there is a tradition attributing such a *techne* (here in the sense of written account of a *techne*) to him. Most scholars have rejected such a tradition as unreliable, but Vallozza is more interested in understanding how the attribution originated in the first place [20]. This leads her to an interesting analysis of the notion of *tetagmene techne*, which recurs in Isocrates' *Against the Sophists*, and of the issue of whether something like rhetoric can be formulated in terms of written and, hence, fixed rules and prescriptions ('*rigidi precetti di un manuale*') [20]. Again, Antonino M. Milazzo's '*L' A Demonico attribuito ad Isocrate*' describes the contents of a pamphlet attributed (perhaps spuriously) to Isocrates. Milazzo inclines for its authenticity [33], albeit admitting that the text was heavily reworked in the course of its manuscript tradition [36]. He underlines the significance of *Ad Demonicum*, which purports the importance of *paideia* for political life, for the history of ideas and a better understanding of fourth-century Athenian society.

The next two papers are linked by their emphasis on papyrological sources. Maria Rosaria Falivene's '*A scuola nell'Egitto tolemaico: testi dalla "biblioteca" di Al Hiba*', which is more than a fully argued article, is a programmatic declaration of intents, or, as Falivene herself says, a sketch of a research project [48], prefaced by some historiographical remarks on using papyri as evidence. The issue Falivene addresses is in itself extremely interesting: What were the textbooks for the first generation of Greeks in Ptolemaic Egypt? She aims to reconstruct the content of ancient libraries through papyri, and her specific case-study is the library (or libraries) of Al Hiba, a town that perhaps had its own school of rhetoric. In '*Gli Hermeneumata. Testi scolastici di età imperiale tra innovazione e conservazione*', Eleonora Tagliaferro focuses in particular on a bilingual (Greek and Latin) text for language learning which was known as *Interpretamenta pseudodositheana* or *Hermeneumata* and probably dated largely to the

third century AD, with parts from the early fourth century. Tagliaferro relates this text to the wider issue of Roman literary education and briefly suggests that it addressed the necessity, arising in late antiquity, of learning Latin (a point also made by Lucia Calboli Montefusco in her contribution [127]). The practical character of the *Hermeneumata* is indicated by the fact that it provided no grammatical instruction; that in it verbs tends to be declined in the forms most commonly in use, rather than in all their possible forms [57]; and that it contains instances of spoken, everyday language.

Laurent Pernot's '*Gregorio di Nazianzo (or. 33, 6–7) e l'elogio retorico delle città*' discusses in detail a passage in one of the fourth-century AD bishop's speeches. Pernot argues that the text can be understood by relating it to a treatise attributed to the rhetorician Menander. In his contrast of small town and big city, Gregory appears to have followed a number of *topoi* put forth in Menander's work. The possibility of such a link points to the fact that the boundary between Christian and pagan literature at the time was blurred [79, 90].

A change in course from papers dealing with rhetoric is represented by Eleonora Rocconi's '*L'Introduzione pitagorica alla musica di Tolemeide di Cirene*', which discusses the extant evidence for a treatise on music written by a woman, Ptolemais. The title of the treatise along with some fragments has been preserved by Porphyry in his commentary on Ptolemy's *Harmonics*. The date of Ptolemais is uncertain, but Rocconi inclines for the early Empire, and 'certainly not after the first century AD' [101]. The transmitted title of her treatise and the fact that many women seem to have been associated with Pythagoreanism point to Ptolemais' philosophical affiliation. Yet, we know from Plato's *Republic* that Pythagorean musicologists downgraded the use of sensory experience in the study of music—experience however was at the core of Aristoxenus of Tarentum's investigations on sound. Now, Ptolemais cites the followers of Aristoxenus with little hint of disagreement, and could thus cast light on a phase of research where divergences between groups and methodologies were not yet crystallized [104–105]. The epistemic debate she reports on appears to have been much less polarized than it would seem from Plato, with both *kanonikoi* and *mousikoi* (the former more in the Pythagorean, the latter more in the Aristoxenian line) recognizing the role of *both* reason *and* sensory experience, while

formulating their relationship in different ways. Ptolemais even describes a third group of musicologists, who put reason and experience on the same footing [107]. Rocconi concludes with the following assessment: ‘Ptolemais of Cyrene’s *A Pythagorean Introduction to Music* thus presents itself (at least the parts that survive) as a handbook of rather good scientific calibre, careful in impartially describing the ancient music-theory scene [...] and correct [...]’ [108]. The article is accompanied by an appendix with Ptolemais’ fragments in Greek and an Italian translation. The interest of the topic is obvious, and, while Rocconi’s account of it seems persuasive, she does not push her argument very far, or take any big risks in, for instance, revisiting sources like Plato or the Hibeh papyrus in the light of Ptolemais’ fragments. Some lines of enquiry which I expected to be explored further are surprisingly left on the side: what role Ptolemais’ fragments play in Porphyry’s commentary is one; the second is Ptolemais’ gender itself, especially given that Nicomachus of Gerasa’s treatise on harmonics was dedicated to a woman (a fact Rocconi must be familiar with).

I admit that Paolo d’Alessandro’s piece ‘*Un’ interpretazione metrica varroniana da Cesio Basso a Rufino d’ Antiochia*’ defeated me. After several readings, my best guess is that d’Alessandro comes to the conclusion that a grammar text by Diomedes contains (*via* Caesius Bassus and Carisius) some fragments from Varro’s *De sermone latino* book 7. One wonders whether this—in itself important—result needed to be expressed in such cryptic, high-academic-style language that even a well educated native speaker is left in a bit of quandary about it. As it happens, I also had reservations, albeit of a different nature, about the next piece.

‘*La Disputatio de rhetorica et de virtutibus di Alcuino*’ shifts the chronological focus to the early Middle Ages, and to a text which is in the form of a dialogue between Charlemagne and Alcuin. Ancient sources for the *Disputatio* appear to include Cicero’s *De inventione*; and Lucia Calboli Montefusco discusses whether and how Alcuin could have had access to this text [129–131], and what he seems to do with it. Unfortunately, a great deal of the paper is devoted to an indictment of the medieval scholar’s understanding of his sources and of his knowledge of rhetoric. Several instances where Alcuin diverges from his (alleged) source are explained (or rather, explained away, in my view) on the basis of his general incompetence or patent mistakes [137], which repeatedly leave Calboli Montefusco ‘flummoxed’ [136].

She even concludes the paper by saying: ‘I have taken the great Alcuin to trial and I have been his accuser’ [141]. This begs the question: Should historians be in the business of assessing their sources’ rhetorical (medical, mathematical, philosophical) competence? Calboli Montefusco might answer that such an approach is part of source criticism, and that it enables historians to answer questions such as, Did Alcuin access Cicero’s text, and what version of Cicero’s text? In this case, her sustained attack leads her to the conclusion that perhaps Alcuin’s mistakes were due to the fact that he had a ‘*testo rimaneggiato*’ (a text that has been worked and reworked) of *De inventione* [140]. But what excludes the possibility that the *rimaneggiamento* was by Alcuin’s himself? And what excludes the possibility that Alcuin changed (reworked, modified, rearranged) his sources deliberately (an idea not dissimilar from what Ulrich Schindel suggests for his own source [156])? Why should his rhetorical knowledge be judged on the standard of his understanding of Cicero—or rather, why should his rhetorical knowledge be judged on the standard of *our* understanding of Cicero? After all, if he is found so wanting, I for one am left wondering why we should bother to study Alcuin at all. Either we are interested in what rhetoric meant for Alcuin on his own terms, in his time and place, and for his audience, and then that is what we should try to reconstruct (Calboli Montefusco takes too easy a way out at 140); or we are not interested, and then we can just stick to Cicero and congratulate ourselves on our excellent grasp of all that he had to say about rhetoric.

In comparison to the previous two, Ulrich Schindel’s contribution is a better example of clearly-written, balanced source criticism. This time, the subject is an anonymous late ancient grammar treatise also known as *Anonymus Ecksteinii*, which was edited by Schindel himself in 1987. In ‘*Influenze reciproche tra commento esegetico e manuale sistematico*’, Schindel uses the *Anonymus*, among other things, in order to explore the mutual relationship of the two extant categories of intermediate-level handbook from late antiquity: commentaries on authors such as Virgil, Cicero, and Sallust; and *artes grammaticae*. He shows that commentaries used categories and notions found in treatises of grammar, and that in their turn treatises of grammar used illustrative examples drawn from commentaries. Somewhat reinforcing one of Pernot’s main conclusions, Schindel shows that another anonymous *ars grammatica* deployed examples taken

from commentaries to classical pagan sources as well as from texts of biblical exegesis.

Next, Gabriella Moretti in *‘Il manuale e l’allegoria. La personificazione allegorica delle arti liberali come tradizione del genere manualesco’* argues that the personifications of the liberal arts found in late ancient literature (most famously Martianus Capella’s *De nuptiis Philologiae et Mercurii*) originate earlier, possibly in classical Greece. She traces a brief history of the use of such personifications, and underlines the importance of the Muses in providing a blueprint for ‘doctrinal women’ [165]. Moretti also links the personification of the liberal arts to treatises on liberal arts. Some of these reflect in their organizational structure the belief in the interconnectedness of the arts; others use personifications as a ‘literary strategy well-suited to a meta-disciplinary discourse’ [168]. This is particularly in evidence in the case of Martianus Capella, who explicitly discusses whether the personifications of the liberal arts, which are an instance of allegorical usage or a *vox ficta*, have a place in accounts that are concerned with imparting true instruction such as textbooks.

Taking his cue from a phrase by Roland Barthes, who attributed a *‘rage taxinomique’* to ancient rhetoric, Pierre Chiron, in his *‘À propos de l’hyperbole et de la « rage taxinomique »’*, starts, as he puts it, from a fact and a prejudice, and asks two related questions. The fact is that, from the first century BC until late antiquity, within the tradition of rhetorical handbooks, we find works that consist merely of lists of rhetorical figures, often without any apparent organizational criterion [187]. The prejudice is that this type of treatise marks a decline of the rhetorical art which coincides with the rise of the Roman Empire and the Second Sophistic. Chiron’s two questions are: Why the appearance of this format? and, Does it really represent a ‘sterilization of rhetorical reflection’ [188]? In order to answer them, he focuses on one example: the hyperbole, and on its definitions, rather than its usage. Hyperbole generates controversy because, while giving rhetoricians an opportunity for impressive displays of skills, it departs from reality. Thus, its use underwent harsh criticism in the name of sobriety and precision of speech. This makes it a particularly good example for Chiron’s analysis. After surveying a number of accounts of rhetoric from Aristotle to the Byzantine Choeroboscus, he concludes that the rhetorical lists are much less homogeneous than generally thought; for instance, their treatments of hyperbole vary.

What is more, their apparent sterility can be read in a more positive light, as simplicity and ease of use [200–201]. Chiron also observes that lists are only one type of rhetorical handbook; and there is no reason to think they were used, or meant to be used, in isolation [202]. As for the lack of hierarchical structure in the lists, Chiron argues, taking his cue from Demetrius’ treatise, that perhaps the nature of rhetorical figures itself—forms whose efficacy and character completely change depending on their content—is such that it does not allow for systematization, but lends itself much better to the enumeration format [203].

Next, Luigi Spina’s ‘*Un uso particolare dei testi nei manuali di retorica*’ stems from a larger, collective project on the role of late ancient commentaries in shaping textual tradition. Spina presents three examples of how treatises of rhetoric not only cite earlier authors, but also change their citations to illustrate specific points or specific categorizations specific to their discipline. I find what Spina suggests generally convincing; but the paper seems still quite close to its origin as a conference contribution, addressed to a public of rhetoric specialists. The reader would have benefited from a clearer statement of the argument and conclusions, especially since the general topic of the ongoing research project is of interest for a wider audience.

And finally, in ‘*Manuale di grammatica, manuale di retorica e κρίσις ποιημάτων*’, Gualtiero Calboli explores the relation between grammar and rhetoric in the context of the Roman world, with the crucial linked issue of how Greek models were used or modified to suit the needs of Latin. Calboli points out the ethical resonance of theories of language and its massive use of examples taken from poetry, and discusses the possible influence of Stoicism on early formulations of grammar and rhetoric in Rome.

Overall, this volume prompts reflection on a well-known contemporary phenomenon: the tyranny of the publishing marketplace. Many Anglo-American publishers would, I expect, have returned the contributions in Celentano’s collection with the demand that they be rewritten or modified for a wider public, that the long passages in Greek and Latin be translated, and that the arguments be clearly stated and the conclusions even more clearly and forcefully articulated. On the one hand, one applauds the fact that somewhere in Europe someone—the Italian Ministry for Education, Universities

and Research, subsidized this publication—can be free from that tyranny and produce a volume which is unashamedly directed to experts or those aspiring to be such.

On the other hand (to reprise my comment on d'Alessandro's piece), scholarship need not mean obscurity or narrowness. It must be possible to write complex philological discussions in a way simpler than some of the papers do here; and it is definitely possible to preface and conclude a paper with a clear statement of what one wants to achieve and what has been achieved. Equally, it must be possible to be scholarly and at the same time to aspire to a little more originality or relevance. This reader would have liked to see some assumptions challenged: for instance, the idea that later authors misunderstand their sources if they do not read them in the same way we do today (an approach well in evidence in Calboli Montefusco's paper). Or the idea that we may be entitled to pass judgment on a source's correctness or scientific calibre, especially when it is technical rather than literary. (In comparison to what are such judgments to be made and what is to be gained from giving out marks to ancient authors?) Or the idea that *techne* is tantamount to a textbook, rather than being an activity or a practice—some of the papers did address the issue of how these textbooks were to be used; but I saw overall very little reference to rhetoric in practice, such as one could have reconstructed from, say, historical accounts. Indeed, the whole notion of what constitutes a handbook or textbook was taken for granted, whereas some of the contributions here would have very appropriately lent themselves to opening up the whole question of genre.

In conclusion, this volume will probably add valuable pieces to our understanding of ancient rhetoric, text transmission, and late ancient written culture; but will not, in my view, break significantly new ground. Its specialist character may put off the general reader, but historians of ancient rhetoric and grammar will no doubt appreciate its contents.

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*Marsilio Ficino: Platonic Theology. Volume 6, Books XVII–XVIII*  
translated by Michael J.B. Allen. Latin text edited by James Han-  
kins with William Bowen

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Marsilio Ficino (1433–1499) lived and worked at a time when the Italian peninsula was brimming with enthusiasm over the discovery and translation of classical Greek manuscripts arriving from the East. It was a time when tired scholastic Aristotelianism found itself face to face with a lively idealistic Platonism mixed with the ebullience of a new Humanism. The fall of Constantinople in 1453 made available a body of literature that, up until that time, had only played an indirect influence on the intellectual maturation of Europe. Ficino himself played a major role in the translation and dissemination of this newly accessible literature. He was not only endowed with an extraordinary capacity to render Greek into Latin quickly and accurately, but he displayed an uncanny ability to remember what he had read in even the minutest of detail.

At an early age, Ficino showed a keen interest not only in literature, but also in the natural sciences, the methods of which were still rather crude at the time. His father was a successful physician, and Ficino's writings show that he was especially familiar with common procedures in the medical arts of the period. Above all, Ficino's education led him more deeply into a practical approach to philosophy that flowed from contemplation, mysticism, and ascetic discipline. Like any learned man of the Renaissance, he was passionately interested in all areas of science and letters, yet he constantly believed knowledge to be at the service of a higher vocation towards unity with the Divine. In Ficino's mind, a firm grasp of the physical sciences was no less important than a deep understanding of speculative philosophy for the attainment of eternal beatitude.

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Yet this Renaissance man also lived before the full flowering of the scientific revolution. He died a half-century before Copernicus' *De revolutionibus* and almost a full century before Newton's *Principia mathematica*. Consequently, while he adheres to much of the science of the past, his reader senses a deep hunger for the scientific progress yet to come.

Thanks to the assiduousness of translator Michael J. B. Allen and editor James Hankins, the I Tatti Renaissance Library has offered a six volume edition of all 18 books of Ficino's masterpiece, *Platonic Theology* (*Theologia platonica de immortalitate animorum*). While this work is primarily an attempt to systematize the Platonic tradition's theory of the immortal soul, it holds no little interest for historians of science seeking to understand better the period immediately preceding the scientific revolution of the 16th century. The reader quickly gains a sense of the ersatz intellectual *milieu* characterizing the early Renaissance in which philosophy blends with theology, astronomy with astrology, and scientific theory with the arts of magic. Though I touch upon the more salient aspects of this entire work for the history of science, this review will focus more narrowly on the most recently published sixth and final volume of this handsome set, encompassing books 17 and 18.

Ficino had already well established himself as a premiere scholar in Florence by the time he began writing *Platonic Theology* in 1469. He had always been of a rather delicate constitution, and at that time he had just recovered from a severe bout of melancholy. *Platonic Theology* reveals a certain sense of sobriety towards philosophical methodology, without losing an enthusiasm for Plato and his philosophical legacy. In that same year, Ficino had completed a Latin translation of the Platonic dialogues, which were quickly devoured by the Florentine *literati*, including Ficino's friend and generous patron Lorenzo de' Medici, who had recently acceded to power over the Florentine republic.

Ficino's primary aim in *Platonic Theology* was to present a series of philosophical arguments for the immortality of the soul, a topic that had received surprisingly less attention in the Middle Ages than one would expect. Ficino's broader plan was to realize a comprehensive reconciliation between Platonic philosophy and Christian theology. His cosmology is solidly based on the Plotinian theory of

the world's procession from, and return to, the Divine Head as the source and summit of all being.

The first four books of *Platonic Theology* present an exhaustive series of arguments for the immortality of the soul. In addition to his use of traditional arguments (*rationes*), Ficino also employs confirmations (*confirmationes*) and signs (*signa*). Ficino supports each of these with evidence borrowed from the most authoritative figures in the Platonic tradition, from Proclus to Plotinus to pseudo-Dionysius the Areopagite. Arguments, confirmations, and signs all depend on the idea that finite immaterial substances are necessarily dependent on an infinite immaterial substance. Though Ficino does not hesitate to use principles drawn from the Aristotelian philosophy of nature when helpful (form/matter, act/potency, substance/accident), he leans more heavily upon Neoplatonic ideas of immaterial dependency and emanation. He avoids arguments along the lines of 'motion' and 'becoming' and focuses rather on substance and being. Ficino consequently favors theoretical notions over empirical methods. He moves in a Neoplatonic fashion from unchangeable nature towards sensible nature.

The idea of 'likeness' is strongly prevalent in Ficino's analysis. Scientists after Ficino began to pay more attention to similar physical behaviors of worldly phenomena. In particular, attention toward quantitative change allowed for measurement (facilitated by the use of more precise instruments of measurement), which opened the door to the possibility of discovering universal abstract laws expressed in mathematical formulae. However, Ficino stresses that similarity primarily and more perfectly consists in the realm of the super-sensible. Like resembles like not in a quantifiable or measurable way, but precisely in the type of perfection constitutive of immaterial substances. Mathematical principles are not arrived at through repeated observation and measurement, but rather *a priori* through the mind's similarity to the divine substance.

In a way, such an approach sufficed for the artistic culture surrounding Ficino. Wisdom (*sophia*) was pursued through the humanities rather than the empirical sciences as understood today. In many ways, Ficino represents a culture that subordinated practical to aesthetic ends. A resurgence of interest in the relationship between

the practical arts and speculative philosophy during the early Renaissance has inspired some fascinating studies [cf. King 2000]. Architects, for example, frantically devised methods of construction that would allow aesthetic aspirations to be realized more easily. Large cathedrals topped with enormous domes were undoubtedly sought in order to showcase political prowess and imitate the magnificent achievements of Greco-Roman civilization, but the philosophical ideas of a chain of being, divine emanation, and the perfection of numerical ratios drove the pursuits of both scientists and artists.

Books 6 and 7 of *Platonic Philosophy* turn to more particular arguments for the immateriality of the soul and its divine similitude. Ficino returns to Aristotelian natural philosophy, though clearly in its more Platonic elements. Ficino reviews Aristotle's arguments for the soul's immateriality with an eye toward how the latter would have addressed specific groups within the atomist and Stoic schools. Ficino evinces a great harmony between Plato and Aristotle on these points as he proceeds to reconsider Plato's analogy of the cave in book 6 of the *Republic*. Only later did philosophers begin to point out the differences between Plato and Aristotle in natural philosophy. Ficino shows he is not ignorant of Aristotle's difference with Plato over the metaphysical status of the Forms, but the difference has considerably less import for him than it does for philosophers today. Science (in the sense of *episteme*), Ficino remarks, strives for a knowledge of causes, in the writings of both Plato and Aristotle. Aristotle recognized the soul and other immaterial substances as ultimate causal principles, and to this extent he was much indebted to Plato.

In books 9 and 10, we find that Ficino emphasizes the more Platonic elements of other ancient philosophers, both those who preceded Plato and those following him. He refutes the materialism of Epicurus and Lucretius as untenable, relying once more on the notion of 'fittingness' that is most characteristic of immaterial substances. In these books, Ficino paves the way for a scientific view of reality based on *logos*. Though the empirical sciences had not yet advanced to a stage where evidence for *logos* emerged from mathematical laws of physical phenomena, Ficino is confident that a principle of order must logically exist on account of the divine similarity of the created world. In demonstrating the existence of the immateriality and immortality of the soul, Ficino implicitly opens up the possibility of abstract, 'immaterial' laws that govern inanimate things. Whereas

Ficino flirts with pantheism throughout *Platonic Theology*, his more general idea of a rational order pervading the world strongly suggests that abstract laws of motion would easily be found at some time in the future.

In books 14 and following, Ficino in fact presents a detailed argument of caution. He does not want to lead the reader into an Averroist understanding of the world in which one soul unites all intellectual substances. Ficino returns to the medieval debate over the relationship between the ‘passive’ and ‘active’ intellect. The basis for this distinction, which is enigmatic in Aristotle, is that the mind both apprehends and understands. It both receives and acts. In philosophical terms, it is both a *mens mensurans* and a *mens mensurata* (a measuring mind and a measured mind). Averroës (1126–1198) had purported a metaphysics that made it impossible for a plurality of intellects to understand universal principles identically without a corresponding understanding principle identical in itself; hence the need for a single agent intellect to explain all universal knowledge. Individual subjects are able to receive the sensible properties of things as individuals, but a universal understanding of the things displaying those properties can only be explained by a unified understanding principle.

Ficino’s refutation of Averroës, based on clear Thomist lines of reasoning, shows that Ficino had not left Scholastic arguments behind. He rather re-appropriated them within his Neoplatonic framework, emphasizing the difference between the Ideas separate from the world and the ideas apprehended by the human mind. Though the latter may only be a shadow of the former, individual knowing subjects have the power to understand the latter precisely because of the human mind’s assimilation to the divine source behind the former. Furthermore, Ficino realized that any doctrine undermining the proper autonomous existence of the soul placed his religious orthodoxy in question. He ardently desired to maintain his Christian orthodoxy throughout *Platonic Theology*, as he concludes this work with the inscription, ‘*in omnibus quae aut hic aut alibi a me tractantur, tantum assertum esse volo quantum ab Ecclesia comprobatur*’ (‘in all I discuss, either here or elsewhere, I wish to maintain only what meets with the approval of the Church’).

For all his desire to remain within the limits of Christian orthodoxy, Ficino was held under considerable suspicion by church authorities

both during and after his lifetime. Ironically, he was eventually held under just as much suspicion by scientists, including Galileo, who found themselves at odds with the Church. *Platonic Theology* shows that, in many ways, they shared the same mission, though the inspiration was literary in the case of Ficino and scientific in the case of Galileo.

Allen's translation of Ficino's work is a crucial contribution to Renaissance studies. Though Ficino had few ingenious insights to offer into the nature of scientific methodology and autonomy in respect to speculative principles, his work helps us to appreciate the revolutionary changes taking place between the mid-14th and 16th centuries. The sources of learning changed considerably, but the passion for learning was very much the same. Scholars must be careful not to dismiss Ficino on account of his primitive views of science. As one reads *Platonic Theology*, it can be quite shocking to find the author moving from a finely-tuned analysis of difficult philosophical principles to bizarre references to magic, astrology, alchemy, and the occult. Yet we could easily find other such startling contrasts in any intellectual period preceding or following the early Renaissance.

A closer reading of this work reveals that Ficino's fascination with Platonism stems from more than just a voracious appetite for rediscovered Greek manuscripts: the Aristotelianism of the Scholastic period was gradually losing its appeal, and was increasingly despised as an arid approach to arcane questions. On more than one occasion, ecclesiastical authorities, such as the saintly Archbishop of Florence, Antoninus, tried in vain to persuade the cleric (Ficino was ordained a priest in 1473) to concentrate more on Thomas Aquinas and less on Plato. Yet, in his writings, Ficino drops hints that he not only finds Platonism more appealing from a philosophical point of view, but that he recognizes several serious shortcomings in Aristotle's natural science. The Stagirite had a monumental influence on medieval, and especially Thomist, metaphysics; but towards the beginning of the 14th century, this influence had the adverse effect of encouraging a dogmatic approach to Aristotle's entire corpus.

One example may be found in the enduring respect paid to Aristotle's laws of motion, which were repeatedly revisited and reworked before finally being abandoned. Most egregious, however, was Aristotle's astronomy, which, because it denied the existence of empty

space, proposed an explanation of planetary motion that was overly cumbersome.

Of course, Ficino was not quite able to find more satisfying explanatory principles of the physical world in the works of Plato. Indeed, most of Aristotle's errors were the result of his direct indebtedness to Pythagoras and Plato at the time he developed his physical theory. *Platonic Theology*, however, reveals that it was not so much dissatisfaction with Aristotle *per se* as disillusionment with the methods of Scholastic interpreters during the late Middle Ages that spurred Ficino to search for alternative explanations. Many aspects of Ficino's theory of the soul are actually quite Aristotelian, in as far as he relies on the Peripatetic to help him refute the Averroist doctrine of a single intellect permeating all intelligent beings. Yet Ficino's attraction to simplified explanations of both the universe and the individual soul based on circular motion shows that Ficino viewed Plato as a promising alternative to the various dogmatic approaches to Aristotelian science emerging especially in the late Middle Ages.

In book 15, chapter 7 of *Platonic Theology*, for example, Ficino unhesitatingly adopts Aristotle's theory of act and potency to illustrate the relationship of soul to body. In book 14, chapter 2, however, he shows caution in the way he draws upon Aristotle's law of motion to support his own Platonic theory of the soul's inclination toward the good and the true.

*Platonic Theology* manifests a continuing fascination with mathematical explanations of worldly phenomena that had begun with Pythagoras and was passed on through both Plato and Aristotle. Although there were enormous strides during the early Renaissance towards a greater understanding of human anatomy, experimental methods in the physical sciences had yet to be developed. Consequently, though Ficino and his contemporaries vastly expanded their knowledge of human physiology, they were less inclined to question the numerical basis of earthly and heavenly motions explained in terms of more and less 'perfect' numerical proportions. For this reason, Ficino is closely associated with the advancement of art—Botticelli, Raphael, Titian, and Michaelangelo were all directly inspired by the Platonic Academy in Florence—but not with progress in the physical sciences. Ficino tended to move from abstract number to physical reality in his attempt to understand the world, just as Plato tended to move from the ideal to the real.

English translations of Ficino's works have the notorious reputation for quickly going out of print. It would be sad if the same destiny were in store for Allen's translation. His translation renders a daunting neo-Latin style into elegant English. It will provide readers unfamiliar with Latin a glimpse of a period both glorious in its artistic achievements yet in many ways quite rudimentary in its scientific understanding of the world. Familiarity with Ficino and other humanists may not considerably increase our understanding of scientific methods, but it will enhance our appreciation of the ways in which theoretical and speculative philosophy influence our scientific way of looking at the world.

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This slim, elegantly written volume by Asger Aaboe might have been more accurately titled, ‘*Highlights of Planetary Theory from Babylon to Kepler*’, since that is in fact its subject. Lunar theory is mentioned in passing, but mainly to explain its absence. The book begins with an introductory description, characterized as ‘Chapter 0’, of the principal phenomena of naked eye astronomy necessary to understand what follows.

Chapter 1 describes the arithmetical models and methods employed by astronomical scribes from Babylon and Uruk to depict the dates and positions of the planets’ main synodic phenomena—appearances, disappearances, stations, and (for outer planets) oppositions. Especially noteworthy, since they are not published elsewhere, are the reconstruction of Jupiter’s daily motion in Table 5, and the illustration in Figure 4 of the interrelations of the functions comprising Lunar System A. This is an area of the author’s particular expertise; and his account, which emphasizes the crucial role of period relations in Babylonian theory, is uncommonly readable as well as authoritative.

In many respects the crux of the book is chapter 2, which surveys the kinematic models depicting planetary motions, from their qualitative origins in the homocentric spheres of Eudoxus, through Ptolemy’s first simplified and then detailed quantitative models, to the improvements introduced by Islamic astronomers, and finally to the transformations of these models by Copernicus and Tycho Brahe. This ambitious survey focuses on the geometrical relationships of the several models, and combines clear yet rigorous descriptions with novel and uniquely instructive illustrations of the fine details of Ptolemy’s equant models and their modifications by al-Tusi, Qutb al-Din,

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and Ibn al-Shatir. Of particular note is the author's discussion of efforts to circumvent the philosophically distasteful equant motion. In all, the chapter comprises an admirably clear survey of the essential elements and evolution of kinematic planetary theory.

Two points are emphasized here and subsequently. The first is that Ptolemy's models yield planetary positions—where the planet is if you look for it—as well as any later models until Kepler's. The second is that while Copernicus' transformation of Ptolemy has the singular advantage of establishing the relative distances of the planets, it has no sensible advantage over the Tychonic system, which—as depicted in the splendid frontispiece [see Figure 20 and the book cover] to Riccioli's *Almagestum novum* [1651]—was preferred to Copernicus' by contemporary astronomers, perhaps because it is how we actually see the planets from the Earth.

After extended immersion in the mathematical details of kinematic planetary theory, chapter 3 presents a less mathematically demanding description of the fine structure of the Ptolemaic cosmological system of nested spheres, a system much maligned in conventional commentaries, but which, as the author notes, 'prevailed for nearly a millennium and a half in the West, and for longer in the Near East'. The account illustrates the internal consistency of this system with clarity and economy, adding little-known details about the recovery of its textual underpinnings in Ptolemy's *Planetary Hypotheses*.

In the fourth and last chapter, the author leads the reader gently (only two integrals) through the properties of 'Kepler Motion [viewed from] from Either Focus', to show that, but for second order differences, the angular motion of a planet moving about the Sun in one focus of an ellipse is very nearly uniform about the empty focus. This paves the way for an original answer to the question of whether the vector sum of the eccentricities of Earth and planet can be extended rigorously to a vector sum of eccentricity plus equant, as implied in Ptolemy's models. The answer is presented exquisitely in Figure 15 towards the end of the chapter.

In short, Aaboe's book provides a clear, authoritative, and frequently original introduction to the principal elements of mathematical planetary theory before Newton, which experts will find rewarding and novices accessible. It deserves and will repay a wider audience, despite its unfortunate mispricing by its publisher.

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*Classics in the History of Greek Mathematics* edited by Jean Christianidis

Boston Studies in the Philosophy of Science 240. Dordrecht/Boston/  
London: Kluwer Academic Publishers, 2004. Pp. x+461. ISBN 1-4020-  
0081-2. Cloth \$187.00

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*Reviewed by*

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The volume reprints 19 essays, distributed in six parts. These are the 'Classics' referred to in the title, namely, contributions standing as fundamental in the development of the field. The selection of the essays to be reprinted has been made by six distinguished experts; every part is preceded by an introduction that puts the selected essays into their contexts, often providing useful additional information. The parts, the respective editors, and the reprinted essays are:

Part 1. The beginnings of Greek mathematics (H.-J. Waschkies)

J. Mittelstrass. 1962–1966. 'Die Entdeckung der Möglichkeit von Wissenschaft'. *Archive for History of Exact Sciences* 2:410–435.

Á. Szabó. 1956. 'Wie ist die Mathematik zu einer deduktiven Wissenschaft geworden?' *Acta Antiqua Academiae Scientiarum Hungaricae* 4:109–151.

W. R. Knorr. 1981. 'On the Early History of Axiomatic: The Interaction of Mathematics and Philosophy in Greek Antiquity'. Pp. 145–186 in J. Hintikka, D. Gruender, and E. Agazzi edd. *Theory Change, Ancient Axiomatics, and Galileo's Methodology: Proceedings of the 1978 Pisa Conference on the History and Philosophy of Science*. Dordrecht/Boston.

Part 2. Studies on Greek geometry (R. Netz)

W. R. Knorr. 1983. 'Construction as Existence Proof in Ancient Geometry'. *Ancient Philosophy* 3:125–148.

K. Saito. 1985. 'Book II of Euclid's *Elements* in the Light of the Theory of Conic Sections'. *Historia Scientiarum* 28:31–60.

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G. E. R. Lloyd. 1992. 'The *Meno* and the Mysteries of Mathematics'. *Phronesis* 37:166–183.

Part 3. Studies on proportion theory and incommensurability  
(K. Saito)

O. Becker. 1932–1933. 'Eudoxos-Studien I. Eine voreudoxische Proportionenlehre und ihre Spuren bei Aristoteles und Euklid'. *Quellen und Studien zur Geschichte der Mathematik, Astronomie, und Physik* B2:311–333.

K. von Fritz. 1945. 'The Discovery of Incommensurability by Hippasus of Metapontum'. *Annals of Mathematics* 46:242–263.

H. Freudenthal. 1966. 'Y avait-il une crise des fondements des mathématiques dans l'antiquité?' *Bulletin de la Société mathématique de Belgique* 18:43–55.

W. R. Knorr. 2001. 'The Impact of Modern Mathematics on Ancient Mathematics'. *Revue d'histoire des mathématiques* 7:121–135.

Part 4. Studies on Greek algebra (J. Sesiano)

K. Vogel. 1933. 'Zur Berechnung der quadratischen Gleichungen bei den Babyloniern'. *Unterrichtsblätter für Mathematik und Naturwissenschaften* 39:76–81.

G. J. Toomer. 1984. 'Lost Greek Mathematical Works in Arabic Translation'. *Mathematical Intelligencer* 6:32–38.

T. L. Heath. 1910. 'Diophantus' Methods of Solution'. Chapter 4 in *Diophantus of Alexandria: A Study in the History of Greek Algebra*. Cambridge.

Part 5. Did the Greeks have the notion of common fraction? Did they use it? (J. Christianidis)

W. R. Knorr. 1982. 'Techniques of Fractions in Ancient Egypt and Greece'. *Historia Mathematica* 9:133–171.

D. H. Fowler. 1992. 'Logistic and Fractions in Early Greek Mathematics: A New Interpretation'. Pp. 133–147 in P. Benoit, K. Chemla, J. Ritter edd. *Histoire de fractions, fractions d'histoire*. Basel.

Part 6. Methodological issues in the historiography of Greek mathematics (S. Unguru)

S. Unguru. 1975–1976. 'On the Need to Rewrite the History of Greek Mathematics'. *Archive for History of Exact Sciences* 15:67–113.

B. L. van der Waerden. 1975–1976. 'Defence of a "Shocking" Point of View'. *Archive for History of Exact Sciences* 15:199–210.

- A. Weil. 1978. 'Who Betrayed Euclid? (Extract from a Letter to the Editor)'. *Archive for History of Exact Sciences* 19:91–93.
- S. Unguru. 1979. 'History of Ancient Mathematics: Some Reflections on the State of the Art'. *Isis* 70:555–565.

A collection of studies such as this is a tool for the working historian not only because it reprints essays often difficult to find, but also because it offers a cross-section of the main historiographical currents that represents well the evolution of the field in the last decades. As is clear from the list, in fact, while several technical articles are presented (especially in parts 4 and 5), the majority of them is concerned with methodological issues, thereby greatly enlarging the boundaries of part 6.

In this respect, the collection testifies to the essentially historiographic character of the scholarly production in the last three decades. The domain of research portrayed in the book underwent a phase transition with the pivotal article by S. Unguru 'On the Need to Rewrite the History of Greek Mathematics'. This article reacted against the interpretation in algebraic terms of certain portions of the ancient Greek corpus, the so-called 'geometrical algebra' invented by P. Tannery and championed by H. G. Zeuthen and, after him, by B. L. van der Waerden. The ideology, expressed or unexpressed, underlying the 'geometrical algebra' interpretation was that, after all, proved mathematical statements are necessarily true; as a consequence, an allegedly invariant 'mathematical core' is independent from the language in which it is formulated. After a series of more or less rude reactions, partly represented in part 6, Unguru's article entailed a whole recalibration of the historiographical attitude towards mathematics as done in the past. An approach in which modern symbols and notions were employed as a matter of course to explain Greek mathematics was replaced by one in which efforts to understand it 'in its own terms' and attention to the cultural context seem to have finally become a common historiographical practice. (To be sure, not everything that was written before Unguru's paper was algebraically-dressed, as von Fritz' and most notably Becker's seminal papers attest.) Such a renewed attitude produced a wide-ranging spectrum of contributions. These range from strictly technical papers such as Saito's (recall that the algebraic interpretation of book 2 of the *Element* was the stronghold of the 'geometrical algebra') to studies in

which a respectable amount of historical data coming from a variety of sources is collected and given a consistent interpretation, such as Knorr's fourth essay here presented. However, the main outcome was the conception of studies in which making some methodological point is among the main goals, if not the main goal. A confirmation of the fact that this is the current historiographical stance comes from the very volume under review: among W. R. Knorr's massive and often technically overwhelming production, three of the four articles selected focus on methodological issues.

What makes the book even more valuable, despite the radical changes just outlined, is that one finds in it essays, such as Vogel's or Heath's, which are representative of the 'algebraic' approach. This is not the mark of a schizophrenic attitude of the editors, but should more properly be taken to suggest that accounts made in the ancient fashion can still prove valuable in guiding an algebraically-minded reader through such difficult texts as Diophantus' *Arithmetica*. As remarked above, such accounts can even be taken, still today, to say something *true*, although in a wrong historiographical perspective, on certain portions of Greek mathematics.

Interestingly enough, the renewed attention to contextual issues produced a new type of *a priori* arguments, less patently unsound than the algebraic interpretations and thereby much more difficult to uncover. Such are for instance impossibility arguments. In them, from the mere fact that certain mathematical steps are not attested in the Greek mathematical corpus (e.g., the usual operations on common fractions), a *blocage mental* of sorts is inferred on the side of the Greek mathematicians (the lack of the *notion* of a common fraction). Of this kind is David Fowler's paper reproduced in part 5—and there confuted. It is obvious that such arguments are unmethodical; and from a factual point of view, they simply ignore that Greek mathematics has not been transmitted to us in its entirety.

Investigations on the interactions of mathematics with other branches of Greek thought, most notably philosophy, got greatly enhanced in the enlarged view created by the renewed historiographical perspective, despite Knorr's effort to defend a strictly internalist position in the first essays of his among those selected. Curiously enough, the book under review gives more prominence to papers in which an alleged connection between mathematics and philosophical

issues is shown not to exist. A case in point is the foundational crisis following the invention (or discovery, using a term that appears to be nearer to the underlying ideology of Greek mathematics) of irrationality. That such a crisis was nothing but a historiographical figment was first shown in Hans Freudenthal's paper. Knorr returned to this issue with his usual effectiveness, pointing out, in the third essay of his here reproduced, that the figment was in fact almost a necessary outcome of a cultural *milieu* such as the one of Weimar Germany. The same *milieu* could explain the purposes of most of Becker's contributions to the study of Greek mathematics, the one here reproduced included. Another case of a demonstrably false link is dealt with in the third of Knorr's contributions selected, where it is shown that Zeuthen's thesis that constructions were intended as existence proofs in Greek mathematics is not supported by the actual evidence. (Actually, Knorr endorses an interpretation of Zeuthen's thesis that, while being the current one, is far stronger than the one borne out by an equanimous reading of his original article: at least judging from the number of self-references, Knorr's paper seems to have been more a self-invited essay-review of his own, forthcoming book *The Ancient Tradition of Geometric Problems*, rather than an unbiased assessment of Zeuthen's position.) The renewed emphasis on the cultural environment in which Greek mathematicians moved has opened the field of ancient mathematics to the fresh, and at times rather unconventional, views of scholars coming from other domains, most notably historians of ancient thought. It is disappointing that such contributions are represented in the volume by Lloyd's article only, in which pointless speculations seem to be the only content of any discernible originality.

It is absurd to question the choices of the editors, but two remarks should be made. First, part 5 seems, frankly speaking, much too specific. One is led to suspect that the editor of the part, and of the whole volume, chose the argument in order to show that the authors of the two articles presented are actually wrong in contending that Greek mathematicians had no notion of a common fraction. In fact, the introductory essay is uniquely concerned with presenting examples from Diophantus' *Arithmetica* that falsify such a contention, especially as advocated by David Fowler. Yet the reader had already at his disposal the same set of examples, devised to make the same point, in Knorr 1991.

Second, articles dealing with issues of textual tradition are totally absent. Recent studies, however, have permitted a better, if only provisional, assessment of the relationships between the Greek and the Arabic tradition of the *Elements*: this domain of research deserved more attention. The short paper by Gerald Toomer on the Arabic tradition of Greek mathematical treatises presents a state of affairs that has greatly evolved since then. Maybe an article showing how actual textual issues are treated by the working historian of mathematics would have served the interests of the reader better.

Essays are reproduced that date back more than 40 years, and written in French or German. This is a very important feature of the book, especially because a large portion of contemporary scholarship appears to resort almost exclusively to the most recent secondary literature and to contributions written in English.

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*Hebrew Medical Astrology: David Ben Yom Tov, Kelal qatan. Original Hebrew Text, Medieval Latin Translation, Modern English Translation* by Gerrit Bos, Charles Burnett, and Tzvi Langermann

Transactions of the American Philosophical Society 95.5. Philadelphia: American Philosophical Society, 2005. Pp. ix + 121 with 4 illustrations. ISBN 0–87169–955–9. Paper \$24.00

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The main subject of this book, Hebrew medical astrology, is a neglected field of study. Further, in the study of Hebrew medical astrology during the Middle Ages, no books and even almost no articles especially devoted to the particular question of the utility of astrological indications (taken from Moon in particular) for treating various kinds of diseases have been published until now. True, ‘astrology played only a small part’ not only ‘in Arabic medicine’ (see the quotation of the historian of medicine Haskell D. Isaacs found in this book [19]), but also in Medieval Hebrew medical literature. Its role was substantially a marginal one, even in the period and geographical areas in which a greater number of Hebrew medical manuscripts was copied, i.e., in 14th- and 15th- century Spain, Provence, and Italy.

General treatments or at least some traces of this ‘science’ can be found in some manuscripts, as well as in some of the extant fragments of the Cairo Genizah. However, only a few works especially devoted to Hebrew medical astrology are still extant. First of all, there is a very important Medieval Hebrew tract, the *Book of the Luminaries* (*Sefer ha-me’orot*) by Abraham Ibn Ezra, written in 1148 in Béziers (Provence) [Sela and Freudenthal 2006, 20 and 35]; it was published by Meir Baqal in 1971, but is still in need of a really critical edition. Then, there exists the *Concise Summary* (*Kelal qatan*) by David ben Yom Tov Po<sup>c</sup>el, which is the subject of this book. Moreover, there are: a very short tract, apparently a summary (not the complete text [33n69]) of a work on astrological medicine by Pinhas of Narbonne

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(14th century), found in two manuscripts now in Boston and in Oxford; an anonymous medical compendium, found in one manuscript written in Italy in the 16th century, now in Cambridge; some notes about various astrological recommendations, including references to a medical use of astrology, found in two manuscripts at least (one in Oxford, copied in Byzantium around 1430, and the other in El Escorial). Finally, some observations about this ‘science’ were made by a well-known Medieval Jewish physician and translator, active in 13th-century Catalonia, Shem Tob ben Isaac of Tortosa [22–25]. (In any case, this ‘science’ does not include talismanic medicine, i.e., the employment of astrological talismans in medicine, which appears to have attracted some Jewish physicians in the same period and *milieu*.)

David ben Yom Tov Po<sup>c</sup>el, the author of the above mentioned work, should not be confused with the well-known author of a Medieval Hebrew treatise on logic, the Portuguese Jewish philosopher David ben Yom Tov Ibn Bilia. According to Tzvi Langermann [15], the former was a Jewish astronomer living in Provence in the first half of the 14th century. Apparently, he was also the father (not the son) of Jacob ben David ben Yom Tov Po<sup>c</sup>el Bonjorn, an astronomer active in Perpignan (then in Catalonia) in 1361. There are some reports about his life and work, which have been collected in a recent book by José Chabás [Chabàs i Bergon 1992, 40–44]. According to them, his name was David Bonjorn del Barri; he was born in Catalonia at Cotlliure around 1300; and he died after 1352 (probably before 1361) in Barcelona, where he worked as astronomer for the king of Aragon, Peter IV. Surely, Po<sup>c</sup>el was the nickname of his son, Jacob; probably, it was also his family name in Hebrew.

The Hebrew text of the *Concise Summary* is transmitted in four manuscripts, found in Oxford, Saint Petersburg, Paris, and Verona. The ‘base manuscript’, which is regarded as the best one and has been selected here for the edition, is that in Oxford [Bodleian Library, Michael Add.19], where the text is found on folios 9v–11v; the other three manuscripts have been employed for correcting it in some points. There is also a Medieval Latin translation of the work preserved in an unique manuscript in Barcelona and surely written in Catalonia before 1446. Among the main sources of the *Concise Summary*, there are pseudo-Ptolemy’s *Centiloquium* and in particular Ibn Ezra’s *Book of the Luminaries* [12–15].

Chapter 1 of the book, by Tzvi Langermann [1–34], begins with a historical sketch of astrological medicine in Antiquity and the Middle Ages; then, it gives information about the author, the extant manuscripts of the Hebrew and Latin texts, and the contents of the work; finally, it outlines a concise history of Hebrew astrological medicine. Chapter 2, by Gerrit Bos [35–61], includes the edition of the original Hebrew text of the *Concise Summary*. Chapter 3, by Charles Burnett [63–82], includes a critical edition of the Medieval Latin translation. Chapter 4, by Gerrit Bos [83–98], includes his own English translation of the work which is based upon a comparison between the Hebrew text and the Latin one. At the end of the book, there are: a glossary of Hebrew terms that is rendered into English and compared with the Latin corresponding terms as found in the translation [99–108], a bibliography [109–112], and an index of key terms [113–121].

This book is a very interesting and very detailed case-study of Hebrew medieval astrology. As stated by Resianne Fontaine on the cover jacket, it ‘will be consulted by all interested in (...) the history of medicine and astrology, the history of Hebrew science, medicine, astronomy, and astrology, or the history of ideas’. I have only to add some very slight observations to it which mostly concern the index of the work, and which might be employed for a future, revised edition. As a matter of fact, the index ends with the word ‘signs—airy’ [121], so that numerous words mentioned both in the book and in the index itself (e.g., ‘summary’, ‘Sun’, ‘tables’, ‘world’) are omitted. Moreover, an index of the many manuscripts (in Arabic, Hebrew, Judaeo-Arabic and Latin) quoted or mentioned in the text, which would probably be of some utility to the scholars, is lacking. Here below, I give a list of these manuscripts in alphabetical order, including citations of the pages of the book where they are mentioned:

Barcelona, Biblioteca de Catalunya

n. 634: 16, 35–59, 63–82

Birmingham, University of Alabama, Reynolds Historical Library

n. 5087: 20

Boston, Countway Library of Medicine

hebr. 2: 22

Cambridge, Cambridge University Library

Add. 1022.2: 23

- Chicago, Newberry Library  
Or. 101: 18, 34n79
- El Escorial, Biblioteca de San Lorenzo del Escorial  
n. 913: 9  
G IV 9: 24
- Jerusalem, Mossad ha-Rav Kook  
n. 1317: 19
- Munich, Bayerische Staatsbibliothek  
arab. 802: 29n23  
arab. 816b: 20
- New York, Columbia University Library  
X 893 M 6857: 19
- New York, Jewish Theological Seminary Library  
n. 2720: 28n4  
n. 16030: 19
- Oxford, Bodleian Library  
Hunt. Donat. 21 (Neubauer 2130): 22  
Marsh. 410 (Neubauer 2091): 24  
Michael 88 (Neubauer 2168): 31n47  
Michael 551 (Neubauer 1321): 30n29  
Michael Add. 19 (Neubauer 2042): 16, 35–59  
Opp. 179 (Neubauer 2090): 20  
Opp. 763 (Neubauer 2009): 30n33
- Paris, Bibliothèque Nationale de France  
hébreu 884: 28n9  
hébreu 1034: 31n37  
hébreu 1051: 21, 25, 33n66  
hébreu 1065: 16, 35–59  
hébreu 1082: 21  
hébreu 1162: 33nn72–73, 75  
hébreu 1192: 20
- Parma, Biblioteca Palatina  
parmense 2919: 28n9  
parmense 2637: 34n82
- Princeton, Princeton University Library  
Garrett Collection, n. 1075: 4

Rome, Biblioteca Apostolica Vaticana

vat. ebr. 348: 19

vat. ebr. 376: 20

vat. ebr. 382: 30n33

Saint Petersburg, Library of the Saint Petersburg Branch of the Institute of Oriental Studies of the Russian Academy of Science  
C 76: 16, 30n32, 35–59

Turin, Biblioteca Nazionale Universitaria

A. III. 12: 19

Verona, Biblioteca Civica

n. 204: 16, 35–59

Vienna, Oesterreichische Nationalbibliothek

heb. 29: 28n9

As Tzvi Langermann [21] points out, some quotations in Judaeo-Arabic taken from a ‘treatise’ (Arabic *maqala*) on astrological medicine ascribed to the well-known Medieval Islamic philosopher, al-Fārābī, are found in a Paris manuscript (hébreu 1082, folio 33v). It should be stressed that a ‘treatise’ (Hebrew *iggeret*) on astrology ascribed to al-Fārābī is quoted by the 14th-century Jewish philosopher Moses Narboni (1300–ca. 1362) in his still unpublished commentary on Averroes’ *De substantia orbis* [Steinschneider 1869, 75–76]. It would be interesting to see if these two references are taken from the same work.

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Steinschneider, M. 1869. *al-Fārābī (Alpharabius), des arabischen Philosophen Leben und Schriften*. Saint Petersburg.

*In memoriam*  
Asger Hartvig Aaboe  
(26 April 1922 – 19 January 2007)

Asger Aaboe, Professor Emeritus of History of Science, of Mathematics, and of Near Eastern Languages and Literatures at Yale, died at his home in North Haven, Connecticut on January 19, 2007 after a brief illness. He was 84 years old.

Asger was born in Copenhagen in 1922. His father was an army officer whose family came from Egaa ('Oak Brook'), a village north of Aarhus; and, as Asger once explained, his family name means 'one who lives by (boe) the brook (aa)'. He graduated from the Østre Borgerdvdskolen gymnasium, once presided over by the classicist J. L. Heiberg (1854–1928), and entered the University of Copenhagen in 1940, the same year as the German invasion of Denmark. There he studied mathematics, astronomy, physics, and chemistry; and was especially influenced by the mathematician Harald Bohr, brother of Niels and uncle of Aage, Asger's friend and classmate.

In 1947 he earned the equivalent of a Masters degree (Candidatus Magisterii) with the historical thesis 'The Determination of Areas and Volumes in Antiquity, Especially in the Works of Archimedes'. The following year, he held a Visiting Lectureship at Washington University in St. Louis, where he met his first wife Joan Armstrong, whom he married in 1950 and who died in 1990. Returning to Denmark in 1948, he was 'Adjunkt' in Mathematics at Birkerød Statsskole until 1952, when he came again and permanently to the U.S. as an Instructor in Mathematics at Tufts University.

In 1955 Asger became the sole graduate student at the time in the History of Mathematics Department at Brown, where he commenced a long and close association with Otto Neugebauer and Abraham Sachs, earning his Ph.D. in 1957 with the dissertation 'On Babylonian Planetary Theories'. Tufts made him Associate Professor in 1959, and in 1961 he was invited to Yale by Derek Price as a Visiting Associate Professor in the newly formed Department of the History of Science and Medicine. In 1962 he received joint appointments as Associate Professor with tenure in the History of Science and Medicine and the Mathematics Departments. He became a full Professor in both departments in 1967, and additionally in the Department of

Near Eastern Languages and Literatures in 1977. From 1970 to 1980, he was President of the Connecticut Academy of Arts and Sciences and in 1975 was elected a Foreign Member of the Royal Danish Academy of Sciences and Letters (which published several of his most significant papers as handsomely produced monographs). He retired in 1992 and married Izabela Zbikowska in 2006. He is survived by his widow, Izabela, four children from his former marriage (Kirsten, Anne, Erik, and Niels) and twin grandsons (Samuel and Tyler).

Asger's scholarship included 37 technical papers and reviews, several of which concerned Greek and Babylonian mathematics as well as topics pertaining to Greek astronomy. However, his primary focus and achievement was expanding our understanding of Babylonian mathematical astronomy. Though a late-comer to Assyriology, he added roughly 50 published texts dealing with mathematical astronomy—many relating uniquely to its development—to the 300 or so published by Neugebauer in his *Astronomical Cuneiform Texts*, making many joins on visits to the 'Students Room' at the British Museum in the process. His editions of these texts were invariably accurate and accompanied by exquisite hand-drawn tables which set an exceptional aesthetic standard.

One of his most significant papers appeared in 1964: entitled 'On Period Relations in Babylonian Astronomy' [*Centaurus* 10:213–231], it describes the fundamental connection between period relations and the most powerful of the Babylonian techniques for depicting variations dependent on zodiacal longitude. Known as System A and widely encountered in both lunar and planetary theories, this technique had been described by Neugebauer and others in ways that were mathematically accurate, but awkward to work with and difficult to recognize as 'Babylonian in manner' as Asger put it in a subsequent comment. The essential insight of the paper was that any variation which was a function of longitude and which recurred after  $\Pi$  events and  $Z$  zodiacal revolutions, must occur at  $\Pi$  distinct positions separated by a like number of intervals,  $Z$  of which comprise a single event, and that simply varying the length of such intervals resulted in the powerful System A methodology. In addition to seeming much closer to a Babylonian framing of the problem, this insight greatly facilitated the analysis of System A procedures, and virtually all subsequent work on this technique is indebted to it.

A second, and even more significant, contribution was a series of four papers published from 1968 to 1979 (the last with N. T. Hamilton), which addressed a central unresolved issue of Babylonian lunar theory. In lunar ephemerides classified as belonging to System A, it had long been understood that the function denoted as column  $\Phi$  served as an effective argument of anomaly in computing the variation due to lunar anomaly in the length of one month. Nevertheless, its physical significance had remained obscure, as had the motivation for its role in the theory. In the first paper of this series, Asger published a key text which identified  $\Lambda$ , as depicting the variation due to lunar anomaly in 12 months and showed that  $\Phi$  depicted the variation due to lunar anomaly of 223 months, confirming with textual evidence an earlier conjecture briefly proposed by van der Waerden. Thus, for the first time in the 70 years following its discovery by Kugler was the physical significance of  $\Phi$  securely established. The three following papers published new textual evidence and expanded on this discovery, culminating in the decipherment and description of a similar scheme for the variation of six months in the last paper of the series. Together the four papers securely identified for the first time the principal component schemes of the System A theory of lunar anomaly and their arithmetical relationships, transforming our understanding of this elegant and powerful theory.

In the midst of this series, a paper published in 1975 with Jan Henderson on the treatment of lunar latitude, and regarded by Asger as one of his most satisfying, substantially clarified a complex and hitherto murky component of the System A lunar theory, exhibiting in the process—again for the first time—the fundamental period relation governing nodal elongation. While difficulties still attend our understanding of this element of the theory, this paper remains the starting point for future investigations.

These papers and their accompanying new textual materials are only the most conspicuous of Asger's contributions to our understanding of Babylonian astronomy and mathematics. In addition he published two books, directed towards a student readership, which explore in appropriate depth and with a mathematician's sensibility exemplary episodes in the history of ancient mathematics and astronomy. The first, *Episodes from the Early History of Mathematics*, published in 1964 and still in print in several languages, provides an elegant introduction to Babylonian and Greek mathematics, as well

as to Archimedes and Ptolemy among other topics. Its companion volume, *Episodes from the Early History of Astronomy*, published in 2001, is actually a concise survey, lucidly written with original demonstrations, of the main developments in planetary theory from the Babylonians to Kepler.

Like many of his compatriots, Asger wrote English in a distinctively clear and fluid style, accompanying his commentaries with beautiful hand-drawn tables and diagrams unmatched in contemporary machine prepared copy. In a field where understanding is stitched together from fragmentary bits of evidence and subject to frequent revision with the decipherment of each new tablet, his contributions are distinguished by the robustness with which they have withstood such revision as new facts have emerged.

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*Reading Plato's Theaetetus* by Timothy Chappell

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Pp. 246. ISBN 3-89665-315-6. Cloth € 48.50

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Chappell's recent commentary on Plato's *Theaetetus* follows the format of Cornford's classic *Plato's Theory of Knowledge* [1935] in that it offers a translation of individual sections of text followed by brief commentary. Its main differences from Cornford are an analytic approach, and a systematic survey and critique of alternative scholarly viewpoints. Chappell's commentary is, therefore, more rigorous and philosophically subtle than Cornford's. This is certainly the book's greatest merit. Occasionally, however, one gets the impression that the discussion has strayed far away from the *Theaetetus* and that this difficult dialogue has become even more complicated.<sup>1</sup> In addition to offering philosophical analysis of individual passages and an interpretation of the dialogue as a whole, Chappell ventures outside of the dialogue to address its place within the Platonic corpus and the issue of whether it supports a unified or revisionist model of Plato's thought. He defends a modified version of Cornford's 'Unitarianism' in arguing that the *Theaetetus*, although a late dialogue that does not mention Forms, implicitly defends the need for Forms in any correct account of knowledge.

The book consists of 40 brief sections that include for each passage a useful summary of the argument, Chappell's own translation of the relevant text, and a detailed commentary on various issues that the passage raises. The translations are colloquial, easy to read, and for the most part accurate; there are, however, several additions,

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<sup>1</sup> See, e.g., the discussion of 'Socrates and Wittgenstein on definition' [35-36]; and the author's interpretation of Socrates' dream theory in terms of Russell's and Wittgenstein's Logical Atomism [208-211].

omissions, and eccentricities throughout.<sup>2</sup> All Greek is transliterated. The book is in dire need of an index, but it does offer a glossary of technical terms and abbreviations (of which the author makes abundant use). There is a series of introductory essays that provide background on Athens, Socrates, Plato, the Platonic dialogues and their standard grouping, Plato's philosophy and approach, and the Stephanus numbering system. These essays suggest that the book is intended for an audience of newcomers to Plato; but the fact that the author presumes familiarity with modern philosophers such as Locke, Hume, Wittgenstein, and Russell suggests a more experienced reader. It is the opinion of the present reviewer that the discussions of modern philosophy tend to be cursory and unhelpful. Take, for example, the following:

The Wax Tablet passage offers us a more explicit account of the nature of thought, and its relationship with perception. The picture now on offer says *explicitly* that perception relates to thought roughly as Humean 'impressions' relate to Humean 'ideas'. [178: emphasis added]

Two additional points of criticism: Chappell's remarks about other scholars' views can be dismissive, even condescending.<sup>3</sup> And

<sup>2</sup> For example, the addition of 'X's and 'Y's as the indefinite objects of knowledge in 192a1ff. See also the following translation:

It is the theory that... all predication of any [predicate] to anything is strictly inaccurate... For nothing is ever one, either subject... or predicate.

for the Greek

οὐδ' ἄν τι προσείποις ὀρθῶς οὐδ' ὅποιονοῦν τι... ὡς μηδενὸς ὄντος ἐνὸς μήτε τινὸς μήτε ὀποιουοῦν. [152d3–6]

which literally rendered is

Nor could you correctly refer to anything nor to anything as of whatsoever quality... since nothing is one, either as a thing or as of whatsoever quality.

<sup>3</sup> A good example is the following:

McDowell has two further suggestions about what is achieved by objection H. These suggestions are rather *recherché*, and anyone not interested in a close encounter with the intricacies of McDowell's thought might reasonably move on to section 22. [115]

finally, there are several typos and inaccuracies throughout the book (which have been listed at the end of this review).

Prior to his discussion of the text of the *Theaetetus*, Chappell offers a concise but helpful introduction to the debate between ‘Unitarians’ and ‘Revisionists’. He defines the former as those who ‘argue or assume that Plato’s works display a unity of doctrine and a continuity of purpose throughout’ [16]. The latter, he explains, ‘retort that Plato’s works are full of revisions, retractations, and changes of direction’ [17].<sup>4</sup> Chappell takes the central issue in this debate to be whether Plato ever abandoned the theory of Forms between the ‘doctrinal’ Middle dialogues (*Phaedo*, *Symposium*, *Republic*, and *Phaedrus*) and the ‘critical’ Late dialogues (*Parmenides*, *Theaetetus*, *Sophist*, and *Statesman*). The typical Revisionist take on the *Theaetetus*, Chappell explains, is that the dialogue does not appeal to the theory of Forms at all and thus represents Plato’s epistemological reflections once he had abandoned that theory. The usual Unitarian response, in turn, is that Plato has shown in the *Theaetetus* that a definition of knowledge is impossible without appealing to the Forms. The theory of Forms, therefore, is implicitly at the center of the dialogue.

Chappell himself admits that on many issues both Unitarianism and Revisionism in their extreme forms are implausible and that it is reasonable to compromise. He criticizes attempts to date to the Middle Period those dialogues that appeal to the Forms (as Owen did for the *Timaeus*), as well as attempts to show that late dialogues like the *Theaetetus* somehow invoke the theory of recollection [21: cf. nn145, 171]. Chappell does stand by the Unitarians, however, on the question of whether Plato is employing an indirect argumentative strategy in the *Theaetetus* in order to prepare the reader for the role of Forms in defining knowledge.

Chappell concludes his introductory comments with a brief survey of some of the main interpretations of Plato’s overall purpose in the *Theaetetus* [22–24]. He dismisses the ancient view that it is a skeptical work that ultimately encourages suspension of judgment.

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<sup>4</sup> Chappell’s list of Unitarians includes: Aristotle, Proclus, ancient and medieval commentators, Berkeley, Schleiermacher, Ast, Shorey, Diès, Ross, and Cherniss. His list of Revisionists includes Lutoslawski, Ryle, Robinson, Runciman, Owen, McDowell, Bostock, and ‘many recent commentators’ [16–17].

Chappell, however, does acknowledge the aporetic qualities (such as Socrates' Midwife illustration and his disavowal of knowledge at the end). But the relevant object of doubt, Chappell argues, is any attempt to define knowledge on empiricist terms (i.e., to claim that knowledge derives solely from sense-perception). Platonism and its theory of Forms were exempt from Socrates' critique in the first place; indeed, it is through the elimination of alternatives that they in turn are validated.

Chappell goes on to argue that Socrates' objection to Theaetetus' initial attempt to define knowledge by listing examples of knowledge [145e7–147c6] cannot be a criticism of the *Republic's* distinction between knowledge and belief according to their objects (thus Revisionists such as Ryle, Robinson, and McDowell) because it lists types of knowledge rather than objects of knowledge [37–38]. Chappell rather reads Socrates' criticism as directed against the empiricist—that is,

the philosopher who bases all knowledge on sensory experience... [and who] thinks that we acquire, for instance, the concept of a dog simply by exposure to examples of dogs. [38]

A weakness in Chappell's argument here is that the empiricist doctrine as he states it, along with the texts that he cites [Aristotle, *An. post.* 100a4–9; and Locke, *Essay* 2.1), address how we come to form concepts.<sup>5</sup> So, if Theaetetus were expressing such an empiricist viewpoint, then he should be assuming that he has formed a valid concept of knowledge through exposure to various types of knowledge. But this is not what Theaetetus assumes. His answer to Socrates' request for a definition is simply as follows:

I think the things that one might learn from Theodorus are kinds of knowledge: geometry [etc.]... All of these are nothing other than knowledge; each of these is nothing other than a kind of knowledge. [146c7–d2: Chappell's translation, 33]

What Theaetetus has done is to identify several types of knowledge as knowledge. He does not appeal to those examples as sources of a concept of knowledge itself. It would have been helpful for Chappell

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<sup>5</sup> Locke's subject in *Essay* 2.1 is 'whence the Understanding may get all the Ideas it has, and by what ways and degrees they may come into the Mind'. Be that as it may, it has dubious significance for determining which particular philosophers or philosophy (if any) Socrates is criticizing here.

to explain why Theaetetus' belief that 'examples... are enough for a definition of knowledge' [38] entails empiricism.

Moving on to the Midwife passage, Chappell takes a Revisionist stance (against Cornford and McDowell) on the question of whether Plato is alluding to the doctrine of recollection [46–47]. He emphasizes instead the very reasonable view that this passage is meant to propose the method of discussion in the *Theaetetus*:

It is going to be an *experimental*, tentative, and probably unsuccessful dialogue, like the aporetic dialogues. It will try out a number of suggestions about the nature of knowledge.<sup>6</sup>  
[46]

Chappell continues:

So read, the midwife passage can also tell us something important about the limitations of the *Theaetetus*' inquiry. The limitations of the inquiry are the limitations of the main inquirers, and neither (the historical) Socrates nor Theaetetus was a card-carrying adherent of Plato's theory of Forms. Perhaps the dialogue brings us only as far as the threshold of the theory of Forms precisely because, on Socratic principles, one can get no further. To get beyond where the *Theaetetus* leaves off, you have to be a Platonist. [47]

Plato devotes the majority of the *Theaetetus* to an examination of Theaetetus' initial definition of knowledge as perception, which Socrates' ends up restating and refuting in terms of Heraclitus' metaphysical doctrine of flux and Protagoras' epistemological doctrine of relativism [151d8–187a9]. Chappell presents as two possible interpretations of this discussion the Unitarian and the Revisionist readings. He understands the former reading as taking Plato to be concerned with validating Protagoras' and Heraclitus' theories as true for the sensible world, although not for the intelligible world of Forms. Conversely, Chappell's account of the Revisionist interpretation holds that Plato's point is to refute these theories as entirely false and invalid even for the sensible world [48–49]. Chappell himself defends a version of the Unitarian reading. He does so on the grounds that in his series of objections to the thesis that knowledge is perception

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<sup>6</sup> The emphasis in quotations from Chappell's book are in the original unless indicated otherwise.

Socrates appeals to two crucial distinctions: first, ‘between the claim that the objects of perception are in flux, and the claim that everything is in flux’; and second, ‘between bare sensory awareness, and judgement on the basis of such awareness’ [86: cf. 63, 140, 146–48].

Theaetetus’ second definition of knowledge states that knowledge is true belief [187a9–201c7]. Chappell interprets this as saying that knowledge is ‘judgement about immediate sensory awareness’. He takes the main point of Socrates’ discussion of this definition to be the question of how such judgments can arise [151]. This discussion, Chappell explains, is concerned exclusively with explaining the possibility of false belief in order to refute the empiricist’s view that knowledge and belief are ‘simply constructs from immediate sensory awareness, with no magical extra ingredients (such as Plato’s Forms) thrown in’ [152]. The ‘corollary’ of this refutation, according to Chappell, is ‘that we need something else besides sensation to explain belief. In modern terms, we need irreducible *semantic properties*. In Plato’s terms, we need the Forms’ [152]. The point of Plato’s objection to the second definition, Chappell argues, is that the distinction between true and false belief does not even make sense unless one can explain how sense impressions come to be ‘concatenated so as to give them semantic structure’ [232]. Again, Chappell’s argument is that Plato wants the reader to see Platonism as the solution to the problems involved in the empiricist’s explanation of false belief [cf. 152n122]. But the author is not clear about why the success of Platonism should follow from the failure of empiricism, and in particular how Forms can explain the ‘semantic structure’ of beliefs.

Theaetetus’ third definition of knowledge is that knowledge is true belief with an account [201c8–210d4]. Chappell argues that in discussing this definition Plato is trying to find a sense of the word ‘account’ that will ‘explain how sense-experience alone can provide a basis for semantic structure, and in particular for the possibility of *reference*’ [199]. Chappell here is especially concerned with the fact that Socrates discusses and refutes four interpretations of Theaetetus’ third definition of knowledge, but that ‘none of these is Plato’s own earlier version of [that definition], which... says that knowledge = true belief with an account *of the reason why the true belief is true*’ [201]. Chappell points to this fact in order to support his view that the concluding *aporia* is a literary device and does not reflect genuine uncertainty. Plato, he argues, is not trying to clarify his own view of

knowledge but rather wants to eliminate the views of his opponents [199–201]. He explains:

[Unitarians] can say that Plato's strategy is to refute what he takes to be false versions of [the third definition] so as to increase the logical pressure on anyone who rejects Plato's version of [the third definition]. In particular, he wants to put pressure on the empiricist theorists of knowledge. . . . What Plato wants to show is, not only that no definition of knowledge except his own. . . is acceptable, but also that no version of [the third definition] except his own is acceptable. [201]

Once again, the author does not say how exactly this 'logical pressure' works and what exactly it entails.

The main shortcoming of Chappell's study is that it neglects to elaborate the didactic point of this indirect argumentative structure. After pointing to Theaetetus' three failed attempts to define knowledge, Socrates concludes on a positive note:

Well then, Theaetetus, if you ever try to conceive again after this. . . the effect of this inquiry will be that better ideas than these will fill you. Whereas if you stay empty, you will come down less heavily on your friends, and be gentler with them. For you will have the modesty not to imagine that you know what you do not know. This is all my skill can do for you, and nothing more. [210b11–d1: Chappell's translation, 236]

How does Chappell explain this passage? It is one thing for Socrates to say that the aporetic outcome to Theaetetus' inquiries into knowledge clears the way for better ideas and allows him not to think that he knows what he does not know. But it is another thing entirely to suggest that the elimination of empiricism implies some specific doctrine as the better alternative. In addition, Socrates says that the only result of the conversation has been that Theaetetus will not believe that he has knowledge when he does not, 'and nothing more'. How does Chappell square this conclusion with his view that the conversation leaves us with a definition of knowledge 'as true belief with an explanation *why* that belief is true' [233], which is certainly more than Theaetetus' freshly learned modesty? Chappell does not elaborate, but he does offer the following brief (and unfortunately vague) conjectures:

... there may be much more to the ending than that. It may even be that... we have seen hints of Plato's own answer to the puzzle. Perhaps *understanding* has emerged from the last discussion... as the key ingredient without which no true beliefs alone can even begin to look like they might count as knowledge. Perhaps it is only when we, the readers, understand this point... that we begin not only to have true beliefs about what knowledge is, but to understand knowledge.<sup>7</sup>  
[236–237]

In sum, *Reading Plato's Theaetetus* is a helpful analytic guide for interpreting individual passages and issues in the *Theaetetus*, even when the author's treatment of the dialogue's relation to Plato's other writings is somewhat superficial and speculative.

### Corrigenda

- 20 in 'Cornford's and Ross's **Revisionist**', read 'Unitarian'
- 23 in 'cp. section **34c(i)**', read '34c(ii)'
- 49 'issues of Plato interpretation interlock' makes no sense
- 49 in 'G.E.L. **Own**', read 'Owen'
- 53 in 'is introduced **is**', read 'as'
- 54 missing macron on *aesthesis*
- 67 'coming to be becoming' is redundant
- 71 in 'any **direction** solution', read 'direct'
- 89n66 'bout' = 'about'?
- 120 'sesctions' should be 'sections'

<sup>7</sup> Nor are Chappell's earlier remarks very helpful:

Plato means us to conclude that the attempt to know knowledge, if successful, will produce an account of knowledge which 'circles back on itself'. The moral is that, because all knowledge depends on the possession of an understanding of an 'explanation why' which itself has to be known, knowledge is irreducible to true belief. What needs to be added to true belief to get us to a correct definition of knowledge is always going to be circularity-generating, because what will need to be added is, roughly, *understanding*; and understanding implies not only knowledge but even something like wisdom. [233–234]

- 172 in 'when **that** we made', omit 'that'  
194 there is no 'section 10c, above'

In addition, the glossary has incorrectly alphabetized the following entries: 'Forms' and 'Flux', 'Recollection' and 'Reading B', and 'Ubiquity of Opposites' and 'Sense data'. An entry on Nominalism would have been useful.

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*Logistics of Warfare in the Age of the Crusades: Proceedings of a Workshop held at the Centre for Medieval Studies, University of Sydney, 30 September to 4 October 2002* edited by John H. Pryor

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Logistics does not normally fall within the purview of the history of science, although the Pentagon defines it as ‘the science of planning and carrying out the movement and maintenance of forces’ [U.S. Joint Chiefs of Staff Organization 1988, 206]. This is science in the same sense as it was used in the late 19th century to denote any systematic activity with rules and principles that are subject, at least in part and often unstated, to numerical manipulation. In 1878 a professor of military engineering, Col. J. B. Wheeler drew the distinction between art and science for his students, cadets in the U.S. Military Academy at West Point: principles, analyses, rules,

all these belong to the ‘*Science of War*’. The application of these great principles and rules belongs to the ‘*Art of War*’.  
[1878, 7: emphasis in original]

Another army officer, Capt. Henry Metcalfe, expressed the meaning of science and art for many 19th-century thinkers in his classic 1885 management treatise. Science and art were allied but distinct. ‘Art seeks to produce certain effects, Science. . . [to investigate] the causes of these effects’. Regardless of the art, he continued, ‘there always seems room for a corresponding science, collecting and classifying the records of the past so that the future operations of the art may be more effective’. Arsenal administration, Metcalfe’s specialty, provided a concrete example: it ‘is in great measure an art, and depends upon the application to a great variety of cases of certain principles, which, taken together, make up. . . the science of administration’ [Metcalfe 1885/1960, 47].

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The idea that logistics forms a distinctive area of military science and the art of war scarcely existed in Western military thought before the mid-19th century, and even now junior officers may have trouble understanding its importance, as retired Maj.-Gen. Julian Thompson of the Royal Marines reminds us. Logistics, he writes,

was a subject about which I knew nothing during the early part of my career. It was only after graduating from the British Army Staff College at Camberley, that I was forced to take an interest in what, hitherto, I had regarded as something strictly for quartermasters, or 'blanket stackers'. I was posted to the headquarters of the Far East Land Forces, based in Singapore, on the staff of 'Q' Operations, the staff branch responsible for seeing that the logistic plans and operations in the theatre meshed in with the operations requirement; and for directing the efforts of all the theatre logistic services to that end. The colonel at Camberley responsible for my division commiserated with me on my ill fortune in not landing one of the more glamorous operations jobs, and I agreed with him. [Thompson 1991, xi]

Only as a senior officer did he come to appreciate the importance of logistics. Armchair generals talk strategy, begins one of the several versions of the old aphorism, but real generals talk logistics.

Unfortunately, with rare exceptions, that straight talk by real generals about logistics appears to be confined to active duty. When they turn to writing memoirs or military history, they seem as likely as anyone else to remain silent on just those issues that often dominated their professional lives—feeding, clothing, equipping, sheltering, transporting, paying, and meeting all the other needs of the troops, the practical work required to deploy, sustain, use, and refit armed forces. Like most of us, they prefer to recount great deeds and extraordinary events, not the humdrum routine of everyday military life. Historians have largely tended to follow suit. Military writing has been preoccupied with, as Arthur Bowler observed a generation ago in his remarkable study of British army logistics in the American Revolution,

the exploits of men on the field of battle while condemning to limbo by the process of neglect the more prosaic activities

of contractors, commissaries, quartermasters, sutlers and administrators generally. [Bowler 1975, 3]

Lack of glamour notwithstanding, the historical study of logistics, at least for 20th-century wars, has grown considerably, even leaving aside the product of staff studies seeking lessons learned, which have proliferated since the late 19th century, as exemplified by James A. Huston's history of army logistics [1966] or the contribution to the U.S. Army's Vietnam Studies series by Lt. Gen. Joseph M. Heiser, Jr. [1974: cf. Shrader 1992]. Martin van Creveld's broad survey [1977] and the collection edited by John A. Lynn [1993] have helped define logistics as a field of historical study. But work on pre-19th century logistics remains sparse, largely because the material for such studies must be sought piece by piece in the archives of modern Western states. Bowler's book [1975] on British army logistics shows what can be done, as does Geoffrey Parker's astute study [1972] of Spanish logistics in the Netherlands wars of the 16th and 17th centuries. The almost complete absence of quantitative data for armies before the 16th century forces the historian who wishes to understand the logistics of pre-modern armies to expand the available evidence with reason, speculation, and careful calculation. It can be done, as demonstrated by Donald Engels [1978] in his study of the logistics the Macedonian army under Alexander the Great and by Jonathan Roth [1999] in his more recent analysis of the logistics of the Roman Army at war.

Now John Pryor and his colleagues have assembled from a 2002 workshop a collection of 13 papers on the *Logistics of Warfare in the Age of the Crusades*. As the conference organizer and book editor, Pryor has set a clear agenda. Based on his brief description of the conference in his preface, his introduction, and the points emphasized in his concluding chapter, the book's thesis may be stated as follows: quantitatively considering the role of logistics in medieval warfare in general, and the Crusades in particular, can significantly expand our understanding, even if attempts at quantification must rely on limited data and assumptions that may prove faulty. Pryor's introduction is in fact a case study intended to demonstrate exactly what that entails. Although something of a departure from his earlier work, which centered on naval logistics, the gap proves smaller than one might have expected [e.g., Pryor 1982, 1993, 2001]. Taking a specific military movement, Bohemond's slow march from the Adriatic

shore to Constantinople in 1096–1097, Pryor seeks to quantify the amounts of food and other resources required by men and animals, partly by a careful reading of the appropriate primary and secondary sources, and partly by applying what is known about the logistics of more recent infantry and cavalry movements. He considers the nature of the route, the numbers of men and animals, how much room they required, the hours of daylight, the provisioning of galley crews and crusaders, the conversion of wheat to flour to bread, animal feed at rest and at work, provision carriage, and grazing. Quantification of this kind requires numerous assumptions, some of which may well be wrong, but is very suggestive about how one might provide real substance to the logistics of a medieval army.<sup>1</sup> Pryor's concluding digest is perhaps less a summary of the conference papers than an opportunity for him to reinforce these points with reference to the work of his fellow panelists.<sup>2</sup>

Half the remaining twelve articles follow Pryor's lead more or less closely. Bernard Bachrach's contribution adheres most closely to the Pryor model. He begins with a strong plea for paying attention to logistics and a critical review of the existing literature. If his analysis seems a little sketchier than Pryor's, the reason may be that he includes much of his substantial body of work on the logistics of medieval armies by reference rather than detailed repetition [e.g., Bachrach 1993, 1999, 2005]. Here he offers a quantitative discussion of the Crusader force, its situation at Nicaea, the 95-kilometer march to Dorylaion, and its combat-ready arrival, concluding that the crusaders must have relied extensively on Byzantine supplies and logistic organization.<sup>3</sup> Charles Glasheen looks at a different march from the First Crusade, that of Peter the Hermit and his minions from Cologne to Constantinople. Plumbing the textual sources to determine (in so far as possible) who and how many accompanied Peter the Hermit, what time of year they traveled, and what route they took, Glasheen discusses the range of possibilities for supplying such a host. Considerations of access to grain and meat through

<sup>1</sup> Chapter 1: 'Introduction: Modelling Bohemond's March to Thessalonikē', by John H. Pryor (Centre for Medieval Studies, University of Sydney), 1–24.

<sup>2</sup> Chapter 14: 'Digest', by John H. Pryor, 275–292.

<sup>3</sup> Chapter 3: 'Crusader Logistics: From Victory at Nicaea to Resupply at Dorylaion', by Bernard S. Bachrach (Department of History, University of Minnesota), 43–62.

purchase, forage (or pillage), and gift, as well as their bulk, means of transport, and spoilage lead him to conclude tentatively that the crusaders probably carried most of their own provisions through the Germanies, relied chiefly on supplies they bought through Hungary, and enjoyed imperial largesse during the final stages of their journey.<sup>4</sup>

Like Pryor and Bachrach, John Haldon is no stranger to the study of medieval military logistics [e.g., Haldon 1997, 1999]. His contribution complements Bachrach's study in particular, but several others as well, by identifying and quantifying the major factors in Byzantine logistics, which also helps clarify the logistics of crusading armies passing through Byzantine lands. Among the critical factors in understanding Byzantine logistics that Haldon cites were the demographic context, the rate of agrarian production and types of crops, the direct impact of transient military populations on particular regions, the mapping of troop movements to the terrain through which they passed, the possible tracks and roads they followed, the associated effects of climate and season, and the weight of provisions that could be transported on foot, pack animals, or wheeled transport.<sup>5</sup> Several articles in this collection discuss or allude to the problems of buying provisions, but Alan Murray addresses the topic directly. The critical and problematic role of physical coin in the medieval economy is the focus of his enlightening discussion of the financial underpinnings of First Crusade logistics. He offers a detailed account of the availability of local coinage, its acquisition by crusaders, money changing and rates of exchange, regional uses of silver and gold, the establishment of markets, and the growing problems of bearing the increasing weight of coins from plunder, tribute, and gift even as numbers of crusaders and animals declined.<sup>6</sup>

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<sup>4</sup> Chapter 7: 'Provisioning Peter the Hermit: From Cologne to Constantinople, 1096', by Charles R. Glasheen (Department of History, University of Northern Florida), 119–129.

<sup>5</sup> Chapter 8: 'Roads and Communications in the Byzantine Empire: Wagons, Horses, and Supplies', by John Haldon (Centre for Byzantine, Ottoman, and Modern Greek Studies, Birmingham University), 131–158.

<sup>6</sup> Chapter 12: 'Money and Logistics in the Forces of the First Crusade: Coinage, Bullion, Service, and Supply, 1096–1099', by Alan V. Murray (Institute for Medieval Studies, University of Leeds), 229–249.

Other articles address logistical aspects of crusading more qualitatively than those so far considered, though they are by no means devoid of calculations. Working on his fine history of the First Crusade, John France [1994] came to appreciate the importance of military logistics. Here he relies on the relatively abundant data on provisioning provided in the sources for the Second Crusade to approach the question of logistics through a narrative of both the march overland and the naval expedition, with major attention to the provision of food. Although less concerned with detailed calculation than Pryor, Bachrach, or Glasheen, France's logistical angle of vision still manages to throw new light on the nature of the crusade.<sup>7</sup> Logistics may also help explain how crusaders destined for Egypt instead attacked Constantinople in the Fourth Crusade. Thomas Madden [1993, 2003] is best known for his work on the rise of Venice and its role in the Fourth Crusade. Here he credits the Venetians with honoring their contractual obligation to provision the crusaders for up to a year, then explains why the crusaders failed to pay what they owed, lost Venetian support, and increasingly found themselves forced to react to the shortage of food, either actual or prospective, rather than to policy or strategy. This in turn led them to become embroiled in Byzantine dynastic politics with such disastrous results.<sup>8</sup>

Although naval aspects of the Crusades appear in a number of articles, the logistics of seafaring crusaders provides the focus of two articles, neither of them notably quantitative. Ruthy Gertwagen adds to an already long list of articles on eastern Mediterranean ports and harbors [see Gertwagen 1996, 2000, 2004]. This one presents a general review of military transport in the eastern Mediterranean that emphasizes the special importance of frequent watering stops and the trials of sea transport for men and horses. The main goal is identifying the places where galleys and transports traveling eastward might stop to replenish stores, rest crews, and find shelter.<sup>9</sup>

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<sup>7</sup> Chapter 5: 'Logistics and the Second Crusade', by John France (Department of History, University of Wales Swansea), 77–93.

<sup>8</sup> Chap. 11: 'Food and the Fourth Crusade: A New Approach to the 'Diversion Question,' by Thomas F. Madden (Department of History, St Louis University), 209–228.

<sup>9</sup> Chapter 6: 'Harbours and Facilities along the Eastern Mediterranean Sea Lanes to Outremer', by Ruthy Gertwagen (Oranim Academic College, Israel), 95–118.

Contrary to modern perception, overland routes from northern Europe to *Outremer* and back tended to be easier and quicker than the sea lanes, according to Richard Unger, the well-known medieval maritime historian [Unger 1994, Hattendorf and Unger 2003]. The difficulties of the sea passage to the eastern Mediterranean helps explain the readiness of northern crusaders to shift their attention to the pagans, mainly Slavs, who dwelt along the rivers leading to the Baltic, especially after the pope granted them the same remission of sins that applied to crusades against Muslims.<sup>10</sup>

Two articles in the volume make no gesture toward quantification, and seem to me marginal at best to the study of military logistics as well. John Dotson studies the transformation of Genoese and Venetian fleets during the first half of the 13th century, from a mix of oared warships of various sizes and large armed sailing ships to more homogenous galley-dominated war fleets, which seems interesting and persuasive, but only slightly and indirectly addressed to logistics. The same may be said of Benjamin Kedar's intriguing little treatise on early Muslim and European maps, which grants Muslim maps a greater degree of sophistication and potential utility than European, but dismisses both as so remote from modern concepts (and accuracy) as to provide little basis for logistic planning.<sup>11</sup>

Finally, two of the authors address non-Western armies, one quantitatively, the other less so. Reuven Amitai [1995] is the author of an important book on the Mamluk-Mongol war of the late 13th century. Here he attributes Mamluk success in turning back Mongol incursion chiefly to Mongol logistic problems. He seconds the thesis advanced by John Masson Smith, Jr., in 1984 that limited forage and water in Greater Syria precluded the Mongol assembly of an army large enough to compensate for the individual Mongol soldier's inferiority to the Mamluk professional soldiery [see also Morgan 1985].

<sup>10</sup> Chapter 13: 'The Northern Crusaders: The Logistics of English and Other Northern Crusader Fleets', by Richard W. Unger (Department of History, University of British Columbia), 252–273.

<sup>11</sup> Chapter 4: 'Ship Types and Fleet Composition at Genoa and Venice in the Early Thirteenth Century', by John E. Dotson (Department of History, University of Southern Illinois at Carbondale), 63–75; chapter 9: 'Reflections on Maps, Crusading, and Logistics', by Benjamin Z. Kedar (Institute for Advanced Studies, Hebrew University of Jerusalem), 159–183.

Even a one-sided Mongol victory, as in the 1299 Battle of Wādīl-Khaznadār, could not be exploited because Mongol forces had to withdraw to summer pastures.<sup>12</sup> Most of Yaacov Lev's essay on infantry in Muslim armies deals with Fatimid Egypt, centering on the role of slave soldiers (predominantly black) as the primary infantry force and the ethnic tensions which roiled the military establishment, a subject for which he is well known [see Lev 1987, 1997]. Only with the end of Fatimid rule in 1171 did mounted archers supplant infantry as the backbone of Egyptian armies. This change followed directly from the introduction of the land-for-service *iqta* system as the exclusive basis for supporting a standing army. Provincial magnates, who now disposed of the bulk of resources, preferred to furnish cavalry, while the sultan could no longer afford to maintain loyal slave forces, mainly infantry. Basing his judgment on the literary sources, Lev concludes that the desert between Egypt and Palestine posed no serious obstacle to medieval armies, whether on foot or mounted.<sup>13</sup>

The importance of the subject of medieval military logistics and the difficulties of doing it justice are both manifest in this exceptional volume. On the positive side, editor and publisher have gone to unusual lengths to make it a unified work. The book contains a special section of 14 full-page maps plus a gazetteer covering all the articles, especially important for a book devoted in great part to the discussion and analysis of troop movements over considerable distances across lands and seas familiar only to experts. It also sports a glossary of technical terms, a consolidated bibliography, and a full index. Pryor has also contributed a final chapter that summarizes the main points made by the several articles and identifies the major outstanding problems. Like all collections, this one is uneven, though here it is not so much a question of quality, which is uniformly high, but of relevance to the central topic. If medieval military logistics has not yet received its full due in *Logistics of Warfare in the Age of the Crusades*, this volume clearly points the way toward more ambitious and more systematic work. Following the 2002 conference on which

<sup>12</sup> Chapter 2: 'The Logistics of the Mongol-Mamlūk War, with Special Reference to the Battle of Wādīl-Khaznadār, 1299 C.E.', by Reuven Amitai (Department of Islamic and Middle Eastern Studies, Hebrew University of Jerusalem), 25–42.

<sup>13</sup> Chapter 10: 'Infantry in Muslim Armies during the Crusades', by Yaacov Lev (Dept of Middle Eastern Studies, Bar-Ilan University), 185–207.

this book was based, the University of Birmingham became the base, along with Princeton University, for an international project on medieval logistics that extends far beyond what might be considered purely military matters, to the production, distribution, and use of resources, and ultimately embracing entire social and economic structures.<sup>14</sup> The proceedings of the project's first workshop were recently published: Haldon 2006 focuses specifically on the geographical and geophysical substrate of logistics.

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<sup>14</sup> Go to <http://www.medievallogistics.bham.ac.uk/> (Birmingham) or [http://his.princeton.edu/people/e91/medieval\\_logistics.html](http://his.princeton.edu/people/e91/medieval_logistics.html) (Princeton).

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*Expounding the Mathematical Seed: A Translation of Bhāskara I on the Mathematical Chapter of the Āryabhaṭīya* by Agathe Keller

Science Networks: Historical Studies 30–31. Basel/Boston/Berlin: Birkhäuser Verlag, 2006. Pp. liii+172, xii+240. ISBN 3–7643–7291–5 and 3–7643–7299–0. Cloth \$218.00

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Towards the close of the fifth century AD—to be precise, in AD 499—Āryabhaṭa composed at the young age of 23 years a work in Sanskrit which he named simply *Āryabhaṭīya* or *Āryabhaṭa's Work*. Consisting of just 121 couplets spread over four chapters, it is the first extant text on mathematical astronomy in India. In keeping with the general style of *śāstras* (i.e., systematized *corpora* of knowledge), the text is extremely concise and would remain unintelligible without the explanations by a teacher or a commentary. In the subsequent centuries, therefore, several commentaries came to be written on this fundamental text.

Among such commentaries, the earliest extant one was composed by Bhāskara I in 629 at Valabhī in the modern state of Gujarat. Bhāskara could not have been Āryabhaṭa's direct pupil, but he certainly belonged to the circle of the latter's followers; and his commentary was held in great esteem by all the subsequent commentators who made avid use of it. Besides this commentary, Bhāskara also authored two original treatises: the *Mahābhāskarīya* (*The Larger Work by Bhāskara*) and the *Laghubhāskarīya* (*The Smaller Work by Bhāskara*). In these two works, as in the commentary, he follows generally Āryabhaṭa's school of astronomy, but does not subscribe to the master's theory of the earth's diurnal rotation [Chatterjee 1974].

The second chapter of the *Āryabhaṭīya*, consisting of 33 verses, is entitled *Gaṇitapāda* and is devoted to mathematics. The arithmetic and geometry discussed here are more extensive than what is required for the astronomical computations envisaged in the other

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chapters. Therefore, this chapter can be seen as an independent treatise on mathematics, indeed, as one of the earliest extant treatises on mathematics. In his commentary on this chapter on mathematics, as in his commentary on the other chapters, Bhāskara analyses the syntax of the terse sentences of the original, explains the literal meaning, investigates the possibility of alternative interpretations, anticipates and refutes possible objections to the issue at hand, expounds the mathematical procedures, offers suitable examples, and solves them. Sometimes for a single rule he gives several examples. In fact, the commentary on this chapter contains as many as 120 examples with their solutions. Thus, the commentary on this chapter documents, for the first time, the mathematical practice in India in the early seventh century.

Therefore, it is highly commendable that Agathe Keller devotes her study to Bhāskara's commentary on the mathematical chapter of the *Āryabhaṭīya*. Her study consists of two volumes. The first volume contains an introduction and an English translation of Āryabhaṭa's verses as well as Bhāskara's commentary on them, while the second volume is devoted to the analysis of this commentary.

The long introduction preceding the translation discusses in detail the contents of Bhāskara's commentary, its structure and its method of exposition. It is stated that, according to Bhāskara, 'the rule given in the treatise is a seed (*bīja*) which the commentator expounds' [1.xli]. This explains the title of the present work.

Coming to the actual translation, it must be stated right away that it is not an easy task to translate Sanskrit commentaries into non-Indian languages, because the commentator, like a teacher in the class room, first analyses the syntax and grammar of the primary text, gives a word-by-word meaning, and then explicates the original author's statement—all this with copious citations from diverse authorities. During the past two centuries since the time Colebrooke [1817] translated into English the mathematical chapters of Brahmagupta's *Brāhmasphuṭasiddhānta* and Bhāskara II's *Līlāvati*, several Sanskrit works on mathematics and astronomy have been translated into English and other European languages, but so far no commentary has been fully rendered into English. This is so not because Indologists 'privilege treatise over its commentaries', as Keller unfairly accuses them [xxvi], but because the peculiar style adopted

in the Sanskrit commentaries does not easily lend itself to translation. The importance of the commentaries in all branches of Sanskrit learning has been recognized and evaluated, both in the Indian tradition and by modern Indology. In fact, western Indology could not have come into being without the commentaries paving the way for the understanding of basic Sanskrit texts. In the Indian tradition too, commentaries are looked upon with due respect. Commentators like Patañjali in the field of grammar,<sup>1</sup> Śankara in philosophy, Abhinavagupta in poetics and dramaturgy, Mallinātha in poetry are household names in India. Keller's statement 'A similar disregard of commentaries can also be found in the field of history of mathematics' [xvi] is therefore unwarranted. Colebrooke, the first modern scholar of Indian mathematics, in his work just mentioned, gives copious citations from various commentaries on Brahmagupta's *Brāhmasphuṭasiddhānta* and on Bhāskara II's *Līlāvati*. Bibhutibhusan Datta in his *Science of the Śulba* [Datta 1932], and Bibhutibhusan Datta and Avadhesh Narayan Singh in their *History of Hindu Mathematics* [Datta and Singh 1935–1938] have given as much importance to commentaries as they did to the primary texts. In the last decade, the Japanese scholars Hayashi, Kusuba, and Yano have published excellent studies based on Nīlakaṇṭha's commentary of the *Āryabhaṭṭya*, together with annotated translations of several large extracts from this commentary [Hayashi, Kusuba, and Yano 1997].

Be that as it may, the book under review is the first attempt to translate a Sanskrit commentary on a mathematical text fully, and it deserves to be recognized as a pioneering venture. The text of the commentary was edited and published in 1976 by Kripa Shankar Shukla [Shukla 1976] who made a name for himself with the publication of several Sanskrit mathematical and astronomical texts, and with his meticulous studies. The manuscript material used by him was rather meagre and was removed by about 1000 years from Bhāskara's time. In the circumstances, Shukla reconstructed the text in an exemplary manner. Even so, there remain some passages which were poorly transmitted, or the reconstruction of which is not wholly

<sup>1</sup> I fail to understand what made Keller denigrate this commentary by writing, 'An *infamous* grammatical commentary authored by Patañjali, that all educated Indian pandits knew' [xlii n109: emphasis added]. Certainly nothing that she has written on this commentary, nor, for that matter, anything anybody ever wrote on it could lead to such a judgment.

satisfactory. Keller has sought to improve the text of the commentary by going back to the palm leaf manuscripts written in Malayalam characters and has succeeded in some cases.

The translation which she provides for Āryabhaṭa's rules and Bhāskara's commentary is reasonably accurate and reliable, but sometimes it tends to be too literal, giving preference to the primary or etymological sense of a term rather than to its contextual meaning. Thus, the primary meaning of the Sanskrit word *karṇa* is no doubt 'ear', but it has also the secondary meaning of 'hypotenuse' in a geometrical context. There is no particular virtue in rendering *karṇa* throughout as the 'ear' in this translation [27 *et passim*]. After all a translator must pay attention to the author's intention; it is certain that Bhāskara, when he used *karṇa*, thought of the hypotenuse and not of the ear.

Sometimes the translation lays the wrong emphasis. The translation of the very first benedictory verse of the commentary is marred by such misplaced emphasis:

*yan-nāma-saṃsmaraṇa-mātra-bhavābhavāni śreyo'subhāni*

Homage to that Śiva whose name, only when meditated upon, creates and destroys <respectively> good fortune and misery for the gods, demons and men. [6]

Compare this with Shukla's more felicitous rendering:

I bow to God Śiva... a mere recollection of whose name is a source of fortune and end of misfortune for gods, demons and men. [Shukla 1976, xix]

More successful than the translation are the Supplements, that is, the detailed commentary and analysis of Bhāskara's commentary on each of the 33 verses of the second chapter of the *Āryabhaṭīya* [vol. 2.1–185]. Here one sees the historian of mathematics competently reconstructing the actual arithmetical and geometrical procedures envisaged by Bhāskara, and elucidating their relevance in solving astronomical problems. Especially valuable are the reconstruction of the mathematical tools [75–89]; the Rule of Three and its variants, and their application in astronomy [118–127]; and the Pulverizer and its astronomical applications [142–185].

The study is enriched by a number of useful appendices. Since mathematics arose in India as an aid to astronomical computations,

Keller discusses most lucidly the basic assumptions and methodologies of Sanskrit astronomy in an appendix entitled ‘Some Elements of Indian Astronomy’ [186–195]. This is followed by several glossaries, an extensive bibliography and an index.

Notwithstanding the occasional unevenness of the translation, this is an important work, throwing as it does valuable light on the state of mathematics and its relation to astronomy in seventh-century India. This is also the first significant publication to appear in this century on the history of Indian mathematics.

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*Secrets of Nature: Astrology and Alchemy in Early Modern Europe*  
edited by William R. Newman and Anthony Grafton

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Cet ouvrage collectif se propose de montrer comment l'astrologie et l'alchimie, reléguées de nos jours parmi les « sciences occultes », ont joué pourtant un rôle important dans les siècles passés et notamment au début de l'âge moderne. La première partie de ce volume se propose, à travers sept études sur des auteurs particulièrement représentatifs [ch. 1-7], d'analyser les caractéristiques de l'astrologie et de l'alchimie ainsi que leurs rapports dialectiques (quand il y en avait) au début de l'âge moderne en Europe. La deuxième partie [ch. 8], aborde la question de l'historiographie de l'alchimie et en montre la situation paradoxale, qui porte encore de nos jours les stigmates de l'occultisme du XIX<sup>e</sup> siècle.

Le livre débute par un article introductif<sup>1</sup> où Grafton et Newman commencent par tracer une succincte histoire de ces deux disciplines et en esquisser les aspects particuliers. Ainsi l'astrologie, considérée par Ptolémée (II<sup>e</sup> siècle après J.-C.), comme une partie de l'astronomie mathématique, était conçue comme une forme de divination destinée à prédire les effets des corps célestes sur la terre. Au début de l'âge moderne en Europe, elle était l'un des instruments intellectuels les plus importants pour l'analyse des problèmes pratiques et politiques, au point qu'essayer de comprendre la société et la culture de cette époque sans l'astrologie reviendrait au même que tenter de comprendre la société moderne sans l'économie et la psychanalyse. Quant à l'alchimie, née elle aussi à Alexandrie au début de notre

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<sup>1</sup> Chapitre 1: « The Problematic Status of Astrology and Alchemy in Premodern Europe ».

ère comme pratique artisanale du travail des métaux, elle fonde sa théorie sur la philosophie grecque et est considérée pendant tout le Moyen âge comme une partie de la philosophie naturelle, souvent au même titre que la médecine. Les auteurs posent ensuite la question fondamentale: quels rapports subsistaient entre ces deux disciplines? La forme de convergence la plus évidente depuis l'antiquité semble consister dans le fait que l'astrologie permet de trouver le moment favorable (*καίρος*) pour effectuer les opérations alchimiques. Bien que l'astrologue et mage anglais John Dee en 1564, dans son ouvrage *Monas hieroglyphica*, définissait l'alchimie comme *astronomia inferior*, les auteurs montrent dans la dernière partie de cette introduction (« The 'Unity of the Occult Sciences' Reexamined ») que le véritable lien entre ces deux disciplines est en fait assez faible. En effet, la célèbre pratique des *Decknamen* planétaires, à savoir l'usage de noms secrets à l'occurrence des planètes, pour indiquer les métaux que les alchimistes du Moyen âge héritèrent des Arabes et des Grecs, permet d'établir un rapport assez superficiel entre les deux disciplines et n'est pas du tout le signe d'une dépendance théorique. En effet, déjà depuis le Moyen âge, ces deux disciplines étaient reconnues comme distinctes, ayant des méthodes et des fins propres et très différentes. Si plusieurs auteurs de la Renaissance suggèrent des liens entre astrologie et alchimie, ces liens ne semblent pourtant pas se fonder sur des principes communs mais plutôt sur des rapports d'analogie. Les six contributions qui suivent visent à illustrer cette situation dialectique de correspondances, intersections mais surtout de divergences entre ces deux disciplines. En effet, on remarquera que la plupart de ces articles abordent l'une ou l'autre discipline de manière indépendante en montrant ainsi leur autonomie fondamentale dans les buts et les principes.

Les deux premières interventions concernent Girolamo Cardano (1501–1576), l'un des plus célèbres astrologues de la Renaissance. Germana Ernst<sup>2</sup> décrit la carrière astrologique de Cardano en soulignant sa tentative de purifier la discipline en revenant à ses racines ptolémaïques, à savoir à son caractère naturel et conjectural qui oriente mais ne détermine pas la vie humaine. L'intervention de Grafton et

<sup>2</sup> Chapitre 2: « *Veritatis amor dulcissimus*: Aspects of Cardano's Astrology ».

Nancy G. Siraisi est consacré aux rapports entre médecine et astrologie chez Cardano<sup>3</sup> et montre qu'en réalité il maintenait séparés les deux champs en les considérant fondés sur des principes théoriques et pratiques propres. Quant à l'alchimie, son intérêt pour elle était assez marginal et il la considérait plutôt comme un art concernant les poisons et l'invocation des démons. H. Darrel Rutkin<sup>4</sup> analyse la question de l'influence de certains motifs d'astrologie généthliaque, employés par Johann Kepler dans *l'Astronomia Nova* (1609), sur la lettre dédicatoire de Galilée à Côme II dans le *Sidereus Nuncius* de 1610. Bien que la question de cette influence reste difficile à trancher, cette étude montre bien le rôle important que l'astrologie généthliaque revêtait dans la culture de la Renaissance et notamment dans les écrits scientifiques de deux astronomes éminents comme Kepler et Galilée. De même que Cardano, ces deux auteurs ne montrent pas d'intérêt particulier pour l'alchimie. En revanche, l'alchimie devient un thème central dans les interventions suivantes. L'intervention de N. H. Clulee<sup>5</sup> analyse le rôle du mage élisabéthain John Dee dans la constitution du mouvement des Rosecroix sur le Continent et discute les origines de sa notion d'*astronomia inferior* en montrant qu'elle dérive de l'interprétation cosmologique de Trithemius de la célèbre *Table d'émeraude*. En prenant son point de départ dans l'épisode burlesque des placards des Rosecroix à Paris en 1623, Didier Kahn<sup>6</sup> montre comment le mouvement des Rosecroix tout en étant mélangé avec des thèmes alchimiques, privilégie surtout, plus que l'astrologie technique, le millénarisme et les prophéties bibliques.

Enfin Lauren Kassel<sup>7</sup> consacre son intervention à Simon Forman (1552–1611), une sorte de médecin alchimiste sulfureux qui fusionna l'alchimie pratique avec des interprétations bibliques hétérodoxes, la médecine et l'astrologie dans un mélange hétérogène qui impressionna remarquablement ses clients amateurs de savoirs secrets.

<sup>3</sup> Chapitre 3: « Between the Election and My Hopes: Girolamo Cardano and Medical Astrology ».

<sup>4</sup> Chapitre 4: « Celestial Offerings: Astrological Motifs in the Dedicatory Letters of Kepler's *Astronomia Nova* and Galileo's *Sidereus Nuncius* ».

<sup>5</sup> Chapitre 5: « *Astronomia inferior*: Legacies of Johannes Trithemius and John Dee ».

<sup>6</sup> Chapitre 6: « The Rosicrucian Hoax in France (1623–24) ».

<sup>7</sup> Chapitre 7: « *The Food of Angels*: Simon Forman's Alchemical Medicine ».

Le volume s'achève avec un remarquable *status quaestionis* sur l'historiographie alchimique existante<sup>8</sup> où Newman et Lawrence M. Principe posent la question fondamentale: comment comprendre et comment étudier de manière correcte et scientifique la littérature alchimique ?

Cette partie finale est à mon avis la plus intéressante et stimulante du livre, non seulement pour les spécialistes de la période historique concernée dans ce volume, mais aussi pour tous les historiens des sciences de toutes époques. Car elle constitue, en quelque sorte, un manifeste extrêmement lucide et constructif de l'historiographie de l'alchimie valable de l'antiquité à l'âge moderne.

Après avoir évoqué le processus irréversible de dépréciation scientifique de l'alchimie, déclenché par la séparation opérée par les Lumières entre celle-ci et la chimie, les auteurs montrent comment une très grande partie de l'historiographie contemporaine sur l'alchimie se trouve encore sous l'influence pernicieuse de l'occultisme du XIX<sup>e</sup> siècle. Les figures de proue de cette interprétation « spiritualiste » qui concevait l'alchimie essentiellement comme une transformation spirituelle de l'individu, furent Mary Anne Atwood en Angleterre et Ethan Allen Hitchcock aux Etats-Unis. Ces deux personnages n'étaient pas du tout intéressés par l'aspect chimique et technique de cette discipline, mais au perfectionnement de l'âme de l'alchimiste. Cette tendance à privilégier le versant mystique dans l'alchimie se poursuit au XX<sup>e</sup> siècle avec Carl Gustav Jung et Mircea Eliade, qui abordent l'alchimie respectivement à travers la psychologie et l'anthropologie. Jung interprète les symboles des textes alchimiques comme des « images archétypales » de l'inconscient collectif. Mircea Eliade, de son côté, interprète l'alchimie comme une expérience initiatique et une vision organique du monde en opposition à la vision mécaniste de la science moderne. Il interprète, par exemple, les descriptions des fourneaux des alchimistes comme référées à la « grande matrice tellurique » où la pierre philosophale est un embryon en croissance. On assiste ainsi à un phénomène très curieux et paradoxal: l'introduction de l'occultisme dans des structures savantes propres de l'historiographie, ce qui explique le succès que les interprétations de ces auteurs ont eu dans le milieu des historiens de l'alchimie, ce

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<sup>8</sup> Chapitre 8: « Some Problems with the Historiography of Alchemy ».

qui a été beaucoup moins évident dans le cas de l'interprétation spiritualiste.

La principale faiblesse de ces interprétations consiste à réduire la complexité de la tradition alchimique à un ou deux de ses aspects ou, pire, à lui imposer des critères étrangers et anachroniques. Par exemple, très souvent les images alchimiques se réfèrent tout bonnement à des opérations de laboratoire sans qu'il soit nécessaire de recourir aux « images archétypales ». Par ailleurs, il faut aussi se méfier de la tendance excessivement « présentiste » d'un certain positivisme moderne qui vise à établir à tout prix des connexions avec la science en négligeant le contexte culturel et historique des textes étudiés. Le fait de rejeter les interprétations spirituelles et ésotériques de l'alchimie ne signifie pas qu'il ne faut pas tenir compte de ses aspects religieux et spirituels, qui dans les écrits alchimiques s'accompagnent souvent de la philosophie naturelle. Il ne faut pas tomber dans l'erreur qui consiste à confondre la méthode avec le contenu. La seule voie souhaitable est donc celle de l'approche érudite, bâtie sur une rigoureuse critique textuelle et sur la contextualisation historique des auteurs.<sup>9</sup> On ne peut que partager la revendication de cette exigence, qui exclut tout appel à l'irrationnel en y opposant une approche qui, comme l'a bien souligné Robert Halleux [1979, 57], « est plus qu'une nécessité scientifique: c'est une exigence de santé mentale ».

Le volume est complété par la biographie synthétique de chaque contributeur et par un index qui réunit les noms des auteurs et des principales notions figurant dans les textes. On regrettera un peu l'absence dans cet index des noms figurant aussi dans les notes, ce qui aiderait le lecteur à mieux s'orienter en l'absence d'une bibliographie générale.

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<sup>9</sup> Un exemple de la réalisation de cette opération est la nouvelle édition en cours de la collection des *Alchimistes grecs* des Belles Lettres.

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*The Cognitive Structure of Scientific Revolutions* by Hanne Andersen, Peter Barker, and Xiang Chen

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When Thomas Kuhn wrote *The Structure of Scientific Revolutions*, he identified both cognitive and social influences on scientific change. For him, ‘naturalizing’ the understanding of the history of science required attention to both domains. Yet Kuhn’s large legacy, in spite of the many disciplines affected, left few scholars pursuing the specifically cognitive side of his approach. Further, as the authors of *The Cognitive Structure of Scientific Revolutions* note, there is today no ‘Kuhnian School’ among historians of science, nor do most philosophers of science regard his approach with more than a measured scepticism.

Andersen, Barker, and Chen (ABC, hereafter) seek to change this situation by presenting a cognitive formalization of some aspects of Kuhn’s theory of scientific change. They argue that such an approach can revive Kuhn’s utility for work in the history of science and in the philosophy of science. The formalization is based on recent work in cognitive science dealing with concepts and conceptual change in thinking. ABC’s larger goal, Kuhn aside, is to argue that, as they state summarizing one of their case studies, ‘cognitive factors are ineliminable in reaching a historical understanding’ [98]. The book describes the approach in some detail, applying it to three case histories of scientific change to show its power. Two of the cases (19th century reclassifications of birds and the discovery of nuclear fission) are treated relatively briefly, and one, the Copernican Revolution, is examined in more depth.

All three authors are known for their substantial contributions to the history of science, and for cognitive-historical accounts of particle physics [e.g., Andersen 1996], the Copernican revolution [Barker

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1999], and the wave theory of light [Chen 2000]. All three have previously written about Kuhn [Barker, Chen, and Andersen 2003]. The present book unifies their overall argument and provides an extended rationale for their post-Kuhnian cognitive-historical approach.

The history of cognitive formulations of concepts is briefly treated in the beginning of the book. The traditional ‘feature theory’, that concepts consist of lists of defining attributes, was attacked beginning in the 1960s, first *via* Eleanor Rosch’s ‘prototype theory’, in which concepts are organized psychologically by prototypes that abstract away less important detail (a robin is a ‘better’ bird than a penguin, hence closer to the prototype). Later extensions by experimental psychologists were based on Wittgensteinian family resemblances. The approach was similar to that originally used by Kuhn in *Structures* and developed explicitly in his later writings. Recently, one of these extensions, known as frame theory and exemplified in the work of the cognitive psychologist Lawrence Barsalou, has dominated discussion in cognitive science; this is the approach used by ABC to ground their formalization.

According to Barsalou, conceptual structures are organized by frames, organized layers of nodes that include attributes at one level, with attribute values at a subordinate level. Inter-node relationships are included (for example, a value of one attribute may constrain the values of another attribute), as well as levels of nodes that are not attributes. For example, a blueberry is a ‘non-red fruit’, but one must then recognize that ‘blue’ and ‘non-red’ are possible values of ‘color’, with ‘blue’ being a subset of ‘non-red’. Thus ‘blue’ and ‘non-red’ cross conceptual boundaries, tying ‘blueberry’ to ‘color’ in a (nearly) unique fashion and constraining the possible attribute values. There is a dynamic aspect to Barsalou’s use of frames: what is activated in any single instance of a recalled concept will be affected by the context of its recall. Thus, the tie to the color of blueberries may be less active when the context involves discussion of the vitamin content of fruit, but more active in discussion of a graphic design for cereal boxes. Following Barsalou, ABC use a graphical way of describing frames; this permits an economy of description highlighting similarities and differences among multiple frame representations.

The presentation is initially organized in terms of the two briefer case histories, bird classification and nuclear fission. In each case,

frame representations are used to resolve historical puzzles and to exemplify the use of frames in historical cognitive analysis. Thus, 17th century taxonomies of birds divided them into two classes, water birds and land birds, the former having webbed feet and rounded beaks, the latter clawed feet and pointed beaks. By the early 19th century, many species had been found that did not fit these categories. Thus, South American Screamers had webbed feet but pointed beaks. These anomalies were accommodated in the 1830s by Carl Sundevall, who added a new category, Grallatores, for birds like the Screamers. He also replaced water birds by Natatores (Swimmers) and land birds by Gallinae (Chicken-like). All three categories were distinguished by anatomical attributes which preserved some of the distinctions of the old taxonomy, but added others. Thus, Natatores were still distinguished from the Gallinae by the presence of webbed or clawed feet (as in the old taxonomy), but absence of a fifth secondary feather (a feature present in both of the other two categories) was now required for the Grallatores, to distinguish them from the other two categories. Note that the new taxonomy is consistent with the old, in that while new attributes and values are added, the overall structure of the frame is unchanged.

The nuclear fission case invokes frame differences at a more complex level. The discovery of nuclear fission in 1939 is generally attributed to Lise Meitner and Otto Frisch, who argued that anomalous results first observed by Otto Hahn and Fritz Strassmann in 1938 were due to the splitting of a uranium atom into fragments that corresponded to lighter elements. The chemist Ida Noddack had argued essentially the same thing in 1934 following similar observations, although her discovery never generated discussion and was ignored by the scientific community. ABC argue that their cognitive account can explain 'why the same community that rejected fission in 1934 accepted it in 1939' [4]. The explanation rests on the fact that two different frame representations were involved, one, familiar to chemists and used by Noddack, was based on the dynamics of chemical elements. The other, accepted by most physicists, was based on nuclear disintegrations and made no reference to chemical processes. Physicists would have had to revise their entire conceptual structure dramatically to accept Noddack's account and there was simply no way for physicists to make sense of her proposal, given that the framework for nuclear disintegration allowed no room for

the chemical motivations that inspired Noddack's frame representation. By contrast, Hahn and Strassmann's finding [1938] that lighter elements seemed to be present as a result of uranium disintegration, provided a reason for attacking an otherwise acceptable attribute constraint without reworking the entire conceptual structure. Meitner and Frisch were then able to explain the changes in structure by using a theoretical model (the liquid drop model of the nucleus) which had developed in the meantime. From a cognitive point of view, it was the unique nature of Noddack's frame representation that allowed her to propose something which, however, physicists saw as incomprehensible because their frame for the same processes was structurally different. While a community can understand and accept additions to an older frame (as in the bird taxonomy example), adopting a new frame is much more difficult.

So far, there is not a huge difference between the frame analyses offered by ABC and a comparable analysis based solely on ideas laid out in Kuhn's later writings: 'The structures Kuhn described appear in real historical situations and operate in very much the manner he proposed' [41]. Specifically, Kuhn described concepts in terms of contrast sets in which similarities and dissimilarities constitute the objects of categorization (hence implying family resemblances among instances of the same concept). The newly discovered Screamer simply added to the set of such contrasts. In the case of nuclear fission, Noddack's proposal was in effect calling for

a revolutionary change in the paradigm without providing an anomaly competent to create a crisis state in which a new alternative could mature... Cases like these are evidence of the creation and elimination of opportunities to categorize entities that we have already suggested as the main characteristic of revolutionary change. [103]

With this grounding, and the demonstration that recent cognitive theories are roughly consistent with Kuhn's account of conceptual change (at least in some cases), ABC turn to a knottier issue, that of incommensurability among concepts. Using their formal frame analyses, they

draw out various conclusions that Kuhn suggested but did not elaborate, for example that incommensurability varies in

degree or importance and that the degree correlates with the position of a concept in a hierarchy. [104]

Here, the case study used is the Copernican revolution, ‘an episode that Kuhn never treated satisfactorily’ [104].

As is well known, Kuhn spent decades after the 1962 publication of *Structures* in modifying and changing his original statements about scientific change. In the cognitive domain, he dropped his initial reliance upon gestalt switches to account for such change in favor of more nuanced claims, ones that could bridge the gap between the social and the cognitive. By the end of his life, he adopted a language-based mechanism that could generate incommensurability among the scientific terms that designate ‘natural kinds’ (like ‘gold’ or ‘poison’). Such terms form natural hierarchies, with the lowest levels consisting of items that are described by learned similarity and difference relationships. For this reason, a change in one of the lowest level concepts could generate a ‘local’ incommensurability, and hence there could be partial or total failures of communication among scientific communities trying to talk about the subject matter. For changes at higher levels of the hierarchy, even broader problems of incommensurability could occur—hence his implied notion of ‘degrees of incommensurability’.

To contrast Kuhn’s account with their frame account, ABC use the example of the concept of physical object. Before Copernicus, the two natural kinds, celestial object and terrestrial object, differed in that the former were changeless and endowed with perfect circular motion. No such bifurcation was possible after Newton, however, for whom both natural kinds were now physical objects. Celestial objects were described by a frame in terms of orbit center (possible values: star, planet, other), orbit shape (ellipse, hyperbola, other), distance, luminance, size, and so on. By contrast, the equivalent pre-Copernican frame specifies attributes such as path (with possible values of daily, proper, and retrograde), distance, luminance, and size. There is no way to map the values of orbit center onto those of path; the structure of the frames is simply different. Thus, the frames for physical objects pre- and post- Copernicus were different in structure and, hence, incommensurable. So far this is not much different from Kuhn’s description. ABC note, however, that their frame account allows for more precise specification of where the problems arise. Kuhn’s degree of incommensurability now becomes a set of questions

about the nature of the structural difference: Is it among attribute values at a low level? Does it redistribute objects across category boundaries? Do the categories differ? At what level of the frame?

Much of chapter 5 of ABC's book is devoted to exploring such differences across various aspects of the Copernican episode. For example, before Kepler, most astronomical theory concentrated on a celestial object's angular position, in accord with the importance of the components of the path attribute of celestial objects (whether, in short, the path was a manifestation of daily, proper, or retrograde motion). After Kepler, angular position was no longer part of the frame; a Keplerian *orbit* (not an *orb*) was characterized by its shape and center, not its angular position in the sky. This generated incommensurability because it introduced new attributes *and* new values, rather than new attributes with the same set of values or new values for existing attributes. As a result, the Keplerian approach violated a fundamental principle, the 'no overlap principle', which states that no concepts divided by a superordinate in a hierarchy may overlap. The degree of incommensurability caused by such a change is measured by how high in the hierarchy it occurs. The incommensurability between Keplerian and pre-Copernican astronomy was, therefore, not so severe as that which occurred after Newton, which brought further change in the concept of physical object, a higher-level frame than that of orbit.

Chapter 6 explores the consequences of incommensurability within a single tradition. Here, ABC compare Ptolemaic conceptions with Copernican conceptions, with a focus upon the way equants were accommodated within each tradition. Ptolemy introduced epicycles and deferent points, primarily to account for retrograde motion while preserving perfect circular motion. Even so, the fit to the observed phenomena was not perfect; so he introduced equant points on a line connecting the Earth and the center of the deferent, and then postulated that the planets moved with changing velocity such that, as seen from the equant point, the motion appeared uniform. Equants had been a sticking point for Ptolemaic astronomers because, by positing a change in the angular velocity of a planet along a path, it proposed something that was increasingly seen as physically awkward. One advantage of the Copernican system was that it removed the necessity for equant points. Thus, by removing equants, Copernicus ironically made it easier to retain the Ptolemaic system—

Copernican astronomy is not incommensurable with either the conceptual structure favored by the Averroists or the Ptolemaic alternative apart from the difficulties with the equant, which the Ptolemaic astronomers regarded Copernicus as having resolved. [146]

From this perspective, Copernicus did not represent a revolutionary change from Ptolemaic astronomy. Instead of Copernicus, the real revolutionary change occurred as a result of Kepler's work,

the first sustained defense of Copernicanism in the modern sense: the sun played a real physical and geometrical role, and planets moved around it on paths that could be calculated from Kepler's new principles... the first major incommensurability with earlier astronomy. [162].

The authors note also that Kepler's concept of an orbit was an *event* concept, not an *object* concept, and that this also may mark a major incommensurability. Event concepts, so recent research in cognitive science suggests, are organized very differently than object concepts, since they embody values that can vary over time. This creates difficulties for the frame representation approach, since events seem to require multiple frames for each successive time interval. And, experimental evidence from the cognitive laboratory (partly due to Barsalou and his colleagues) suggests that different processes are involved when event concepts are memorized, retrieved, and communicated. ABC suggest that some cognitive scientists regard these as 'mental models', although the discussion of this alternate view from cognitive science is too brief to be of use to the reader.<sup>1</sup> For some reason, ABC do not discuss the excellent paper by the third author, Xiang Chen [2003]. He showed that John Herschel's partial understanding of the wave theory of light could be explained by the fact that Herschel had an object concept of waves, one that was incommensurable with the prevailing event concept of waves that emerged after the work of Fresnel and others. While the difference mattered little in how the wave account of refraction and reflection were understood by Herschel, his grasp of the theory of polarization, which required an event concept, was partially erroneous. This example, if included in the book, would have gone far to show the reader that

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<sup>1</sup> Those interested could start by reading the papers in Magnani and Nersessian 2002.

the frame theory approach can work as a cognitive historical explanation, even in an area where the cognitive processes involved are still not fully understood.

In the final, seventh, chapter, ABC provide a brief summary, followed by brief discussion of the implications of their approach for several controversial issues. In particular, they note that the problem of incommensurability has been softened or denied by realist philosophers of science such as Putnam. Under this view, incommensurability is not absolute, so long as referential stability is maintained. Roughly speaking, you and I do not have to have the same concept of cat to communicate about cats, as long as we agree on what specific instances correspond to the named term. In science, later theories can be better descriptions of entities, as long as the entities under discussion are the same. ABC, by contrast, argue that concepts refer to phenomenal realities, not to realities in the real world. While there are constraints on what concepts may be posited under their view, the constraints do not guarantee that there are corresponding entities in the world. Incommensurability can not always be resolved, nor can science be taken as resting on realist interpretations.

The issue is related to ABC's extended discussion of a proposal made by the sociologist of science David Bloor, whose famous manifesto for the 'Strong Programme' in the sociology of science dismissed the need for cognitive understandings of science. Instead, Bloor argued for a sociological approach to a causal theory of science. ABC argue that their approach refutes Bloor's thesis by showing that a cognitive account preserves all the requirements set by Bloor for an account of science, one that is truly causal, impartial, reflexive, and symmetric (i.e., with the same kinds of explanations accounting for both true and false beliefs). Further, their account, but not Bloor's, preserves a role for historicity in accounts of science. Thus, according to Bloor, ahistorical social factors ('interests', and the like) trump contextual factors—for him, history of science is a secondary part of a comprehensive theory of science, whereas, on the framework approach, it is only through the historical context that one can begin to understand the nature of conceptual change in science. In this way, the original intent of Kuhn is preserved and his relevance for the history of science can be re-established.

This is a short but very rich book, one that must be seen as a major contribution to historiography of science. Still, this reviewer

was left wishing for more substance on some issues, and for broader reviews of other work that has taken a cognitive historical view of the history of science (much of this work is cited but only briefly discussed, if at all). For example, Howard Margolis [2002] has used ‘habits of mind’ as a construct to explain aspects of the Copernican revolution. There should have been discussion of how his proposal differs from that of ABC. One of ABC’s occasional collaborators, Nancy Nersessian [2005] has explicitly used mental models to account for scientific change, and has related her work to Kuhn’s. Again, discussion and comparison would have been welcome.

In the first chapter, ABC note that Kuhn’s use of gestalt psychological principles to illustrate conceptual change was problematic. No number of ‘duck-rabbit’ perceptual reversals can actually bridge the gap between the cognitive and the social—conceptual change at the social level is not a matter of accumulating such instantaneous perceptual phenomena. Instead, it occurs across long periods of time and represents the outcome of extended processing within and among individuals. By rooting their approach in recent cognitive science work, ABC claim to have bridged this gap. That is, they argue that conceptual change at the frame level can be seen to occur among different individuals across long periods of time.

Still, a gap remains, but this time at a different level. All of the examples used in the book represent change at group levels, or, for individuals, as the result of analysis of finished work. Kepler, for example, changed his concept of orbit between writing the *Astronomia Nova* of 1609 and the *Epitome of Copernican Astronomy* of 1618–1622. The results of these changes are nicely described by ABC’s use of frame representations, but a full account would need to examine more closely the reasons why Kepler himself changed his views and the processes that led up to them. A complete cognitive account thus requires a more detailed analysis of the ‘microstructure’ of thinking. Barring such completeness for at least some cases, the gap between the cognitive and the social is still not resolved. Kuhn was sensitive to this need, especially in his last writings, and previous papers by the authors of the present book show similar sensitivity. Including discussion of this large issue in the present book would have strengthened it.

In the end, does the proposal for a newly cognitivized Kuhnian approach work? Can it offer the historian of science a useful set of

tools? For this reviewer (already among the ‘cognitively converted’) the answer is clearly ‘Yes’, though much remains to be done. Still, given its richness and the clarity with which the case is argued, this is a work which will have to be dealt with. Cognitive science does offer historians tools for a new approach to the history of science, one that would have pleased Kuhn himself.

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*A Brief History of Ancient Astrology* by Roger Beck

Malden, MA/Oxford: Blackwell, 2007. Pp. xiv+159, 10 figures+4 tables. ISBN 1-4051-1074-0. Paper \$21.95

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Until now, readers wishing to learn about Greco-Roman astrology had to make their way through the 627 pages of Auguste Bouché-Leclercq's magisterial discussion [1899] or otherwise rely on the much shorter, though methodologically more sophisticated, introduction by Tamsyn Barton [1994]. While both books will no doubt continue to be consulted as standard reference works, Roger Beck's eminently readable and indeed very brief *Brief History of Ancient Astrology* now presents the most convenient starting point for anybody who wants to understand how Greek and Roman astrologers constructed a horoscope and ascribed meaning to its individual features. Notwithstanding the book's title (no doubt imposed by the publisher), it is, as Beck himself avows, not in fact a history of ancient astrology, but rather a lucid account of how ancient astrology worked. The author has deliberately left aside such topics as the development of astrology throughout antiquity (which, owing to the fragmentary nature of our evidence and the inherent conservatism of the discipline, is hard to trace anyway), the history of astrological literature,<sup>1</sup> and the philosophical debates about the validity of astrology.<sup>2</sup> He also devotes little space (in chapter 8; see below) to the historical and political context of astrological practice, a topic treated at length by Cramer 1954 and given special emphasis in Barton 1994. The scope of the work is thus limited, but Beck's narrow focus on the technical aspects of his subject matter has resulted in a book that does an excellent job at enabling non-specialists (such as classicists and ancient

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<sup>1</sup> On which see Gundel and Gundel 1966.

<sup>2</sup> Conveniently summarized in Long 1982.

historians) to grasp both the science that underlies ancient astrology and the mentality that drove it.

The book is divided into nine short chapters, beginning with an introduction (chapter 1) on the definition of astrology. Beck shows (with reference to Ptolemy) that while the ancients distinguished what we call astronomy from what we call astrology, they regarded them as related sciences: the first was concerned with predicting the movements of the heavenly bodies, the second with determining the influences of these movements on earthly events. Chapter 2 deals with the origin of astrology in Mesopotamia and its transfer *via* Egypt to Greece and Rome, drawing special attention to ancient constructions of this history as involving fantastically long time-spans and recourse to ‘alien wisdom’, that is, arcane knowledge associated with foreign countries of high intellectual prestige.

In chapter 3, Beck presents the basic elements of a horoscope, including the signs of the zodiac and their aspects; the planets and their position in the zodiac; and the movement of zodiac and planets through the fixed circle of the four centers (ascendant or *horoscopos*, midheaven, descendant, and lower midheaven). To clarify the subject, he uses the felicitous image of the zodiac as a clock-face, with the planets as seven dials moving at different speeds while the clock rotates steadily in the opposite direction (a modern version of Vitruvius’ visualization of the same phenomenon as seven ants moving in circles on a spinning potter’s wheel [*De arch.* 9.1.15]).

Chapters 4–6 are concerned with ‘Structure and Meaning in the Horoscope’. Chapter 4 returns to the aspects and also introduces the *dodecatropos* of twelve ‘places’ (the modern ‘houses’); chapter 5 discusses the signs of the zodiac, ways of grouping them, and methods of defining their (often hostile) relationships to one another; and chapter 6 treats the planets, their characteristics, and their effects.

In chapter 7, Beck turns to the interpretation of horoscopes. Surviving horoscopes from antiquity typically present only factual information on the position of signs and planets at the moment in question, without providing any exegesis as to the chart’s meaning. For interpretations, we have to rely on the discussion of horoscopes in the astrological literature, where the author’s interpretative skills are usually applied to the birth charts of conveniently already deceased

natives. Beck presents a number of examples, including the horoscope of Ceionius Rufius Albinus [Firmicus Maternus, *Math.* 2.29.10–20]; Vettius Valens' comparison of the horoscopes of six men who survived one and the same shipwreck [*Anthol.* 7.6]; and the Byzantine horoscope of Islam [L621 in Neugebauer and van Hoesen 1959].

Chapter 8 is concerned with astrology's dangerous claims to be able to predict the length of the native's life and to spot a person's predestination to become emperor—the horoscope of Hadrian reported by Hephaestion of Thebes [L76 in Neugebauer and van Hoesen 1959] serves as an example of the latter. In this context, Beck briefly discusses the Roman emperors' uneasy relationship with astrology, a practice they themselves employed for their own purposes but whose use by others they regarded with deep suspicion. Chapter 9 presents a short conclusion.

Written in a charming colloquial style in which the personal voice of the author is present throughout, full of well-explained examples from ancient sources, and furnished with useful diagrams, Beck's book is extremely user-friendly. Unlike Barton, who in her 1984 book made a number of important general points about the political function of astrology and about the ways the discipline was practiced (stressing in particular the connection between the fall of the Roman Republic and the rise of astrology, as well as the divide between the orally imparted expertise of actual astrologers and the purely epideictic nature of astrological treatises, which are 'useless' in practical terms), Beck does not endeavor to say anything new, but simply attempts to give a succinct summary of his subject, an undertaking in which he succeeds admirably. He does, however, appear to have the larger agenda of getting his readers to respect ancient astrology. Sounding at times even a tad defensive, Beck admits that the predictions furnished by astrology are unscientific, but stresses repeatedly that the features of a birth chart themselves are mere astronomical facts. Seeking in no way to vindicate astrology as a form of divination, Beck is nevertheless fascinated by astrology as a system of signification, a veritable language by means of which sets of astronomical phenomena can be experienced as deeply meaningful.

Thanks to Beck's book, readers are now able to listen to this kind of 'star-talk' with new appreciation.

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*The Fragments of Anaxagoras: Introduction, Text, and Commentary*  
by David Sider

2nd edn. Sankt Augustin: Academia Verlag, 2005. Pp. x + 204. ISBN  
3-89665-293-1. Paper € 34.50

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David Sider's fine edition of Anaxagoras (originally published in 1981 by Verlag Anton Hain) has been reissued in a second edition by Academia Verlag in their International Pre-Platonic Studies series. The first edition was a major contribution, but suffered from some flaws. It was a photographic reproduction of a typescript, ugly and difficult to read, from before the days of computerized typesetting. There were some words left out of the translations [B1, B4a]; some errors of translation ('force produces speed' instead of 'speed produces force' in B9; 'earth is separated out of clouds' instead of 'water. . .' in B16); and a typo or two in the Greek. The new edition is typeset and easy to read. New sections have been added to the introduction—'Diagrams', 'Style', and 'Allegory'—and the bibliography has been brought up to date. Overall the text has not changed much since the first edition, though there are some additions. Nevertheless, since the first edition has been out of print and is virtually impossible to get, even used, this new edition is welcome simply for making the work available again in an improved version.

Sider provides a thorough, scholarly edition of the Greek text, following the order and numbering of Diels' B-fragments. His text is based on a new examination of microfilms of the MSS (including a number not collated by Diels) of Simplicius, who preserves most of the fragments. Sider corrects some errors in the previous texts, perhaps most notably pointing out that ἡ γῆ in B15 was not an emendation of the text by Diels, but was in the MSS (the article, however, was omitted in most of them). He defends the reading of F for B2, ἀπὸ τοῦ πύλου τοῦ περιέχοντος (other MSS have πολλοῦ), translating 'out of the vault of the surrounding matter'. He points

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out that at this early period *πόλος* typically means ‘celestial sphere’ rather than ‘pole’, and makes perfectly good sense. This provides an attractive reading of a difficult passage—although perhaps *πόλος* is too precise a term for what was present in the early stages of the cosmogony. Sider gives evidence for rejecting B20 as a fragment of Anaxagoras (it is now recognized as referring to Hesiod).

Sider diligently sifts through ancient readings and commentaries as well as modern interpretations to provide a balanced view of the fragments and the theory they express. He is careful in his treatment of problems, thorough in his review of scholarship, and judicious in his interpretations.

It would be nice if Sider had expanded the edition to include testimonies—which are referred to in many cases, but not reproduced systematically. Since a good deal of Anaxagoras’ theory, especially his cosmology, appears only in testimonies, a treatment of the fragments alone leaves us without a complete account of his theory. Sider’s 66-page introduction gives a good overview of Anaxagoras’ life, works, and style, as well as an account of the text and its transmission. But there is little there about content. Sider does address questions of philosophical interpretation in the commentary, and sums up in a seven-page conclusion dealing with Anaxagoras’ theories. There is not, however, a detailed analysis of Anaxagoras’ philosophical system in Sider’s book. Sider subscribes to the widely-held view that the elemental stuffs are composed from contrary qualities, e.g., gold is composed of hot and cold, wet and dry, light and dark, and so forth, in certain proportions. Though this view solves some theoretical problems, it does not adequately account for Anaxagoras’ failure to make a formal distinction between contraries and stuffs; and in general it turns his theory into something quite different from the lavish ontology it appears to be [see Graham 2004].

Sider argues that Anaxagoras had a theory of perspective that allowed him to say that the large and small have the same number of parts. His attention to some previously overlooked reports on this subject is an important contribution. He also accepts reports that Anaxagoras provided allegorical interpretations of Homeric passages and provides plausible evidence for this. His exposition of Anaxagoras’ style in a new section of the introduction provides an intelligent and valuable analysis of what seem to modern readers to be a convoluted way of expressing oneself.

While Sider's philological analyses are in general excellent, I have a couple of bones to pick. In dealing with the verb διακρίνεσθαι, he says,

While ἀπόκρισις describes the separation of simples (δυνάμεις or seeds) from the περιέχον or from each other, resulting in the predominance of some new substance, διάκρισις, on the other hand, is limited to the breaking-up process, i.e. the disarranging, as in B 17, where it = ἀπόλλυσθαι. The following formula is suggested: ἀπόκρισις = διάκρισις + σύμμιξις. [109]

In accordance with this interesting analysis, Sider translates διακρίνεσθαι by 'to break up'. But the evidence for this reading seems less than obvious to me. Several times [e.g., B12.16, 26] Anaxagoras pairs διακρίνεσθαι and ἀποκρίνεσθαι as synonyms. No doubt the terms have different nuances, but I do not see how the dissolution implied by the former term in B17 is very different from the separation of parts implied by the latter term.

As I have noted, most of the problems of translation in the first edition are fixed in the second, but there is one place where the second edition is inferior. In B11 (second edition) Sider renders ἐν παντί παντὸς μοῖρα ἔνεστιν πλὴν νοῦ, ἔστιν οἷσι δὲ καὶ νοῦς ἔνι by 'In everything *but Nous* there is a share of everything, but there are some things in which *Nous* too is present' [123, emphasis added]. That the first νοῦς goes with μοῖρα is clear both from its position and from the second clause, in which it is the subject. The correct translation is surely that of the first edition: 'In everything there is a share of everything *but Nous*. . .'. The erroneous translation is presented without any change in the commentary accompanying it to explain the alteration (one new comment is added, which does not concern the first clause). Sider leaves '*Nous*' transliterated because 'there can be no exact equivalent'. Still, the same could be said of διακρίνεσθαι and most of the substantive terms Anaxagoras uses; translators should translate, not transliterate.

One last problem of translation I worry about is Sider's treatment of ἄπειρος, which he consistently translates as 'infinite'. He holds that Anaxagoras has a fairly sophisticated view of numbers, including concepts of the infinitely large and infinitely small [86–88]. But there is a gap between Anaximander's boundless (ἄπειρον) and

Aristotle's concept of infinity [*Physics* 3], and it is not clear to me that Anaxagoras is near Aristotle. The things 'boundless in multitude and smallness' that were together in the primeval chaos [B1] may just be uncountably large in number and immeasurably small. The fact that later commentators understand Anaxagoras' elements to be infinite may say more about their use of the term ἄπειρος than about Anaxagoras' meaning. There is no question that Anaxagoras thinks that division can go on without end [B3], but whether he thinks the basic realities are infinite is not so obvious. Furthermore, even if the things (χρόματα) are infinite in number, it is not immediately clear whether the elements are infinite in number; the things in question may be 'seeds', that is, on Sider's plausible reading [94–95], small concentrations of some character, e.g., earth or water, in which case a finite number of elemental stuffs could be present in an infinite number of particles. Indeed, why did Anaxagoras speak of the smallness of the things if he was not thinking of particles? In any case, more needs to be said about Anaxagoras' ἄπειρα.<sup>1</sup>

All in all this is a first-rate edition of the fragments of Anaxagoras. It sets a high standard of scholarship and can be used as the definitive edition of the philosopher. It does not provide a full-blown philosophical study of Anaxagoras with testimonies. For that we can look forward to the forthcoming book by Patricia Curd in the Phoenix series of the University of Toronto Press. But Curd's work could not be what it is without Sider's edition. And we can be grateful to Academia Verlag for making Sider's study available.

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<sup>1</sup> One small complaint about references in the apparatus. Sider frequently cites β among the MSS. This reference is easily found in the *conspectus siglorum* of the first edition (it refers to common readings of MSS Δ and Θ); and the same conventions are used in the second edition. But, since 'β' does not appear in the *conspectus* of the second edition, it is almost impossible to discover in this edition what it stands for. The diligent reader can find the answer in a parenthesis on page 58, though it appears in this form, 'b: agreement of D and Q', where the desired Greek letters have been set in a roman typeface.

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*Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600–1800* by Larrie D. Ferreiro

Transformations: Studies in the History of Science and Technology.  
Cambridge, MA: MIT Press, 2007. Pp. xxvi + 441, 92 illustrations.  
ISBN 0–262–06259–3. Cloth \$45.00

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In the interest of full disclosure, I should mention that I once sent the author of this book a copy of my Master's thesis, entitled 'Ships and Science'. In it I focused on the use of plan drawings in British naval architecture between 1580 and 1715, briefly arguing that scientific theory was of little use in early shipbuilding because it could not be used to make changes to the design drawings. I developed this argument more fully in my subsequent work having to do with stability theory in the 19th century, which I also made available to the author.

It was, therefore, with considerable interest that I noted the title of this book. It was with considerable surprise that I read the preface, in which the author defines naval architecture as the application of scientific theory to ship design. This view is logically, historically, and historiographically mistaken.

According to the dictionary, the term 'naval architecture' refers to both the design of ships and the superintendence of their construction. To equate naval architecture with theory alone is to confuse a small part with the whole. As for history, the phrase 'naval architecture' came into use in the late 16th century to describe a new approach to the design and construction of warships, organized around the use of measured, three-view, architectural-style drawings. Naval architecture was, in other words, already 'born' before this book begins. Originally, it had no connection to scientific theory whatsoever.

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<sup>1</sup> Ed.: For a response to this review, see L. D. Ferreiro, *Aestimatio* 4 (2007) 8–12.

Historians might recognize the methodological error. It is the common one of trying to impose modern categories on a historical subject instead of trying to understand how the historical actors understood the matter. But here the attempted imposition leads to a rather serious problem. The author is eventually forced to admit that 18th-century theories relating to the behavior of ships were, indeed, quite useless and rarely, if ever, applied to actual ship design—and that means that there was no ‘birth of naval architecture’ in the period 1600–1800 according to the author’s *own* definition.

To put it more bluntly, the title of this book is misleading because naval architecture was not born in the period 1600–1800. Further, it is not surprising that, since there is no carefully chosen, logically defined, historical subject, there is no clear, logical order to the book’s contents. On the contrary, there is a constant mismatch between what the reader expects and what the author provides. For example, given the author’s equation of naval architecture with scientific theory, readers might reasonably assume that the subject of the book would be the work of a group of European savants who sought to understand the physical laws governing the behavior of ships at sea. Many famous scientists of the 18th century were involved to one degree or another, including Newton, several Bernoullis, Euler, Condorcet, D’Alembert, and a host of lesser lights. The results of their work came to be known in England as ‘naval science’.

Again, assuming this to be a book about naval science, readers might reasonably expect the prologue (following the preface) to address the relevant scientific and technical issues. Instead, it contains a detailed account of the life of French savant Pierre Bouguer up to 1744, when Bouguer is described as ‘ready to bring the laws of naval architecture down from the mountain’ [22]. This leads the reader to expect an intellectual biography of Bouguer, detailing his theoretical contributions to naval science. No such biography ensues until the epilogue. Instead, what follows is an introductory chapter (following the preface and prologue) entitled ‘Mere Carpenters’. From this one might expect to read about the problems of ship design that naval science was supposed to solve according to the rhetorical attacks of savants on actual shipbuilders. At the very least, having gone to the trouble of equating naval architecture with theory, one would expect the author to provide an introductory discussion of theory here, at last. Instead, this chapter contains a hodge-podge of

oddly-interpreted information concerning the number of ships in various navies, the use of cannon, the line of battle, ship models, a few words about the use of plans, a few words about early treatises on naval architecture and so on. It is not that the material is completely irrelevant. It is rather that, in the absence of a clearly defined subject, readers are left to wonder why they are reading this particular material at this particular time.

Naval science is, in fact, the focus of the book's three main chapters. The first, chapter 2, deals with the maneuver and masting of ships, neither of which are normally considered part of naval science, or naval architecture. Their inclusion does, however, draw attention to conceptual relationships between maneuver and masting and the more traditional topics of ship stability and resistance. The chapter is marred, however, by a strange organization leading to the inclusion of a great deal extraneous material. One might think, for example, that a chapter on maneuver should start with a discussion of maneuver. It starts instead with a history of the Jesuits, moves on to a history of European academies, printing, book publishing, and more.

Resistance is the subject of chapter 3, entitled 'A Shock to the System'. It is never explained whether the cute title is supposed to refer to Newton's account of resistance in terms of the impact of particles on a ship's bow, or to the shock of savants working on theories of resistance in the Great Age of Newton when they discovered that the great man's theories were wrong. This chapter also includes a great deal of extraneous material, ranging from a completely unnecessary discussion of Cartesian vortices, never referred to again, to an analysis of a modern study of the relative number of ships captured by French and English navies during their many wars.

Stability theory is covered in chapter 4, where readers will again have to scratch their heads as to organization. The first two paragraphs of the chapter say that stability theory was not developed as a response to stability accidents. The very next section is entitled 'Stability Accidents'. This is followed by a lengthy discussion of tonnage calculations, displacement, then tonnage again; but it is not explained to the reader that the measurement of displacement is relevant to calculations of stability. The chapter ends with 20 more pages of marginally relevant information, including a tacked on account of rolling and pitching, which was very poorly understood in the 18th century and not very well explained here either.

Nowhere is the organizational oddity of the book more apparent than in the fifth chapter. It simply lists the tables of contents from what the author identifies as the ‘Great Works’ of naval architecture. If not wholly irrelevant, this material should surely have been integrated into the text, where the books in question are discussed more than once. A sixth chapter has the misleading title ‘Genius and Engineering’. It contains potted accounts of the professionalization of naval architecture in various European countries. The book ends with a brief epilogue that concludes the biography of Bouguer abandoned in the prologue.

When all is said and done, it is clear the author has done a great deal of research. Alas, he does not seem to have been able to bring himself to leave any of it out, perhaps under the impression that masses of marginally related material constitutes ‘context’. The unfortunate result is that not enough time or space is devoted to a careful consideration of the actual science. Recourse to the calculus is far too quick. Too little attention is paid to explaining the underlying concepts.

This is a great shame because naval science has not received much attention in the English speaking world since the excellent introduction to John Fincham’s *History of the Naval Architecture* of 1852, and Edward Reed’s wonderful *Treatise on Stability of Ships* of 1885 (if you want clear explanations of the theory of stability and its historical development, read this). But naval science is a subject that deserves study. Sailing ships, as frequently stated in the 18th century, were the most complicated machines of their time, composed of thousands of parts, operating in the most complicated physical environment known to man. Naval scientists were engaged in the reduction of the extremely complicated behavior of these machines to the consideration of a few abstractions, expressed in the new language of the calculus. According to stability theory, for example, the behavior of a ship could be interpreted in terms of the movements of the centers of gravity and center of buoyancy—two abstract points that do not really exist. How and why savants came to think about the behavior of whole ships in this way deserves a proper explanation. It eventually led to an engineering revolution.

There is, however, an even bigger mystery. As noted above, the naval science of the 18th century was basically useless. It would not

even begin to be applied in a meaningful way until 1870. Why then did so many famous scientists continue to work on more or less useless theories for more than a century and a half? The author invokes a few clichés about the interest of the state in ‘rationalization’ and ‘standardization’, but it is not at all clear how theories of admittedly little practical utility could ‘rationalize’ anything. The author spends almost no time analyzing what the naval scientists had to say about why they were doing what they were doing.

To sum up, the author of this book equates naval architecture with the application of scientific theory to ship design. Mistaken or not, the equation leads the reader to expect a history of that activity. One would expect such a history to begin with a historical description of the nature and process of ship design. One would expect it to include an assessment of the problems resulting from the design process. One would also expect it to include an explanation as to how theory was supposed to correct these problems. One would then expect a careful historical description of the theory itself, along with an explanation of the motives of those who worked on it, particularly given the limited utility of their work.

This book never clearly identifies or addresses these issues. The reason seems to be that there is no clearly defined subject from which the necessary order could be deduced. A book about a conceptual revolution needs a better conceptual foundation than that.

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*Hippocrates in Context: Papers Read at the XIth International Hippocrates Colloquium, University of Newcastle upon Tyne, 27–31 August 2002* edited by Philip J. van der Eijk

Studies in Ancient Medicine 31. Leiden/Boston: Brill 2005. Pp. xvi + 521. ISBN 90–04–14430–7. Cloth \$205.00/€ 159.00

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This volume brings together 29 studies concerned with the Hippocratic Corpus that were originally presented at the conference mentioned in its title. The notion of context, to be sure, is a highly flexible one and applicable in about as many different ways as there are perspectives from which the Hippocratic treatises can be studied. But what most of these studies have in common is that they illustrate the tendency in present-day Hippocratic studies to transcend the boundaries of the historiography of medicine in the strict sense and focus on what we may learn from these treatises about the civilization in which they were written and functioned. But if the treatises reflect aspects of Greek society and mentality, the converse process will also have occurred, viz. they will also have influenced other disciplines and other areas of culture. In his introduction, the editor speaks of an interdisciplinary approach needed to study these interactions [xi].

The volume divides into sections corresponding to five main kinds of context:

1. The Epistemological Context of Hippocratic Medicine
2. The Social Context of Hippocratic Medicine
3. ‘Hippocratic’ and ‘Non-Hippocratic’ Medicine
4. The Hippocratic Medical Discourse in its Linguistic and Rhetorical Context
5. The Impact and Later Reception of Hippocratic Medicine.

As such, clearly, the volume caters for various tastes, ranging from the archaeology of Attic cult centers to the  $\epsilon\upsilon$ -/ $\delta\upsilon$ - prefixes of

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Greek vocabulary, though it is weighted in favour of the intellectual context—there are no less than three studies of *On Ancient Medicine* (by Barton, Dunn, and Schiefsky) as well as studies of its impact in later periods, which after all constitute a context as well.

One of the questions arising from this interest in context is the obvious one of identifying a relevant context for each treatise under scrutiny. In a number of cases, scholars have rashly assumed a Hippocratic context for what they had found in other, non-Hippocratic texts. Thus, Jacques Jouanna, one of the founding fathers of the modern Hippocrates industry, effectively questions the influence—which has often been too easily accepted—of key Hippocratic notions such as the precipitating cause and the crisis on the thought of the great historians Herodotus and Thucydides, providing a few useful lessons in methodology in the process. Likewise, but from a diachronic perspective, Véronique Boudon shows that the technical notion of medicine as a stochastic art has been unjustifiably traced back to the Hippocratic corpus on the basis of its mere use of the term *στοχάσασθαι* ('estimating the right measure').

This volume brings together contributions from scholars of different generations. On the Hippocratic stage there has always been a strong Mediterranean presence, i.e., work by French, Spanish and Italian scholars (some of whose contributions have here been translated into English) but a number of American and British scholars are here present as well. The age of some of them suggests that Hippocratic studies have a future in their part of the world as well. The whole book thus attests to the health and vigor of this branch of the historiography of Graeco-Roman science. The quality of scholarship is on the whole very good. One welcomes the useful indexes appended at the end.

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*Early Christian Literature: Christ and Culture in the Second and Third Centuries—The Apologies, Apocryphal Acts and Martyr Acts*  
by Helen Rhee

London/New York: Routledge, 2005. Pp. xvi+266. ISBN 0-415-35488-9. Paper \$39.95

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Studies of early Christian literature typically focus on a modest subsection of the available evidence. Helen Rhee seeks to break through this compartmentalizing approach in this succinct book, a revised version of her dissertation at Fuller Theological Seminary. *Early Christian Literature* systematically compares the thematic content of three major genres of the early Church: the apologies, the *Apocryphal Acts*, and pre-Decian martyr literature. The result is an engaging, thought-provoking study that documents both the diversity and common threads of early Christian literature.

The central texts for Rhee's analysis were all written between the mid-second and early third centuries. Yet these texts, composed in the Greek East, Rome, or Latin North Africa, present 'radically different, if not contradictory, Christian self-portraits' [4]. The book's first chapter ('Second-Century Christian Literature in its Historical-Social Context') concisely orients readers in the thicket of modern scholarship that has developed around each genre. Building on the work of Robert Grant and A. J. Guerra (among others), Rhee highlights the debt of the 'apologists'—Justin Martyr, Athenagoras, Tatian, and a half-dozen others—to the protreptic tradition of ancient rhetoric and philosophy. While attacking the errors of paganism, the apologists also sought to 'defend, propagate, and explain' Christian doctrine in Greco-Roman terms [29]. By contrast, the *Apocryphal Acts of the Apostles* (John, Paul, Andrew, Peter, and Thomas) and the earliest martyr literature (the *Acts* of Polycarp, the martyrs of Lyon, Perpetua, Felicitas, and others) present an unrelentingly hostile portrait of Greco-Roman society. Later Christian orthodoxy embraced the

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apologists and the martyr literature, but usually rejected the non-canonical *Apocryphal Acts* as fraudulent and heretical. The three genres thus stand in a 'triangular relationship' [47], united by shared goals and assumptions, but strongly divergent in their views of Greco-Roman society and their relationship to later Church authority.

Chapters 2–4 each examine a pivotal theme in Christian self-presentation during the second and third centuries. Early Christian writers all proclaim the superiority of Christian monotheism [chap. 2], but do so in profoundly different ways. The apologists are the most deeply indebted to Platonic models. Most present themselves as operating *within* the Hellenic intellectual tradition. Justin in Rome and Tatian in Syria, while 'poles apart' in their attitude toward Greek philosophy, agree with Clement of Alexandria that Christianity represents the true form of philosophy [70]. Nearly all of the apologists identify Christ as the Logos, 'emphasizing the divine and cosmological nature of the Son' [103]. The *Apocryphal Acts*, by contrast, focus on demonstrations of Christ's power in action. Their narratives abound with exorcisms, healings, and resurrections performed in the name of 'Jesus Christ' or the 'Lord Jesus'. While the *Apocryphal Acts* share the apologists' conception of God as unbegotten and unchangeable, they present Christ, God's Son, as the twin of the apostles, even blurring the distinction between the divine Christ and his closest disciples. The men and women who accept the apostles' teachings are, in turn, sometimes able to perceive Christ themselves. One believer sees Him as a child, another as an old man with a flowing beard. Since His human appearance is only an illusion, Christ is 'not confined to any single illusory form on earth' [83]. Finally, the martyr acts present Christian monotheism as 'true piety', drawing upon the Greco-Roman vocabulary of sacrifice [88]. As sacrificial victims, the martyrs imitate Christ and become mediators between Christ and His followers. But they do not become Christ. The martyr acts, Rhee argues, maintain a more careful demarcation between the human and the divine than do the *Apocryphal Acts*. Instead of 'divine men taking over Christ', the martyrs remain 'disciples and imitators of Christ' [102].

Christian writers in all of these genres emphasize the superiority of Christian sexual morality [chap. 3]. The apologists keenly defend the 'rigor and stringency of the Christian sexual codes', which they

contrast with Greco-Roman practices of prostitution, homosexuality, adultery, abortion, and infanticide [117]. Some apologists, such as Clement of Alexandria, highlight Christians' respect for marriage, echoing Stoic ideals that were widely admired by Greco-Roman aristocrats. At the other end of the spectrum, Tatian insists upon chastity as the true mark of Christian sexual piety, even linking marriage in one passage [*Oration* 8.1] to pederasty and adultery. His strident rejection of human sexuality made him a 'heretic' in the eyes of most patristic writers [124]. Yet, all five of the *Apocryphal Acts* convey a comparable hostility toward marriage and sexual intercourse. Time and again in these narratives, apostolic preaching precipitates the dissolution of traditional political and family bonds. The *Apocryphal Acts* frequently depict distraught male rulers who exhibit 'increasingly "womanish" or "female" attributes, while the continent heroines display increasingly "manly" or "male" qualities' [138]. Thecla, the heroine of the *Acts of Paul*, Maximilla, the wife of the Roman proconsul of Achaëa in the *Acts of Andrew*, and the Indian noblewoman Mygdonia in the *Acts of Thomas* all fit comfortably into this narrative pattern that celebrates the disruption of normative marital bonds. The martyr literature similarly features numerous stories of Christian women whose commitment to Christ—expressed in many cases through their chastity—leads them into bitter conflict with their non-Christian husbands and fathers. Perpetua's rejection of her father's tearful pleas exemplifies this narrative pattern. Indeed, the only legitimate form of paternity in the early martyr literature is that of God the Father [122].

Finally, chapter 4 investigates Christian attitudes toward the Roman Empire. The apologists forcefully assert Christians' loyalty to the emperor, drawing a 'critical distinction between worship of the emperor and honor paid to him' [166]. Tertullian offers the most precise formulation of this distinction, defending Christians' refusal to swear by the *genius* of the emperor, while affirming their willingness to swear by his health (*salutem*). His endorsement of imperial authority stands in sharp relief to the rhetoric of the *Apocryphal Acts* in which the apostles repeatedly flout and disrupt various forms of non-Christian government (often, but not exclusively, Roman). In these narratives, there appears to be 'no common ground between Christianity and the Empire' [187]. Hostility to Roman authority is, in fact, the central leitmotif of the martyr literature. As Rhee

observes, the martyrs' words and actions emphatically demonstrate 'their contempt for and renunciation of the entire Roman system of power' [186].

In sum, Rhee makes a strong case for a more integrated approach to early Christian literature. While few of the book's individual arguments break new ground, the whole is greater than its parts. By slicing across the traditional divisions in the historiography, *Early Christian Literature* highlights both the shared features and remarkable diversity of early Christian literature. Inevitably, given the range of material the book embraces, there are holes in its bibliography, especially in German scholarship. But its 31-page bibliography and more than 1100 endnotes provide a valuable introduction to each of the subfields it considers.

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*Plato's Cosmology and its Ethical Dimensions* by Gabriela Roxanna Carone

New York: Cambridge University Press, 2005. Pp. xii + 320. ISBN 0-521-84560-2. Cloth \$70.00

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The thesis of this provocative book is that the cosmological doctrines of the late dialogues are immensely relevant to the development of Plato's ethical views. The universe at large is a divine rational and teleological agent that serves as a model for emulation, and it is through their emulation of it that humans may become virtuous and happy. As a model, the universe is available to all humans, and so Platonic happiness is no longer confined to the philosophically educated or those under the rule of philosophers—all humans are citizens of the cosmos and capable in various degrees of understanding its order and purposes, and so the ethics of Plato's late period is truly cosmopolitan.

After a helpful introductory chapter, Carone devotes two chapters each to the *Timaeus*, *Philebus*, and *Politicus*. In the first of the doublet chapters, she presents an account of the dialogue's cosmology; and in the second, she works out the implications of that cosmology for human moral progress. There is one chapter on the *Laws*, and a final chapter summarizes the book and reflects on the implications of its argument.

As Carone notes in her introductory chapter, studies of Plato's ethics and of his cosmology have proceeded almost entirely independently of each other.<sup>1</sup> One of the consequences of the failure to connect the two is that students of Plato's philosophy have not been in a position to fully appreciate Plato's place in the history of ethics:

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<sup>1</sup> An important recent exception is Johansen 2004, which appeared too late to be considered fully in Carone's book, but whose relevance she underrates [197n4].

not only for post-Platonic Greek philosophers but indeed for Plato himself nature is normative for human aspirations and conduct. The familiar Platonic ideal of ‘assimilation to god’ has traditionally been construed as requiring a divine reality *beyond* nature as the source of ethical normativity; by contrast, it is one of Carone’s central aims to ‘naturalize’ god. If god can be shown to be a rational entity or principle immanent in the cosmos, then Plato’s late ethics may clearly be viewed as a precursor of ethical systems like that of the Stoics.

The story Carone tells of the cosmology and its ethical relevance is complex, and no summary of it will do justice to its scholarly depth. This review will commence in the case of each dialogue with a brief account of its cosmology as Carone interprets it, followed by a summation of its ethical relevance.

The creation myth of the *Timaeus* [ch. 2–3] shows the universe to be the effect of a primary cause, the rational and purposive Demiurge. The Demiurge represents Intellect (νοῦς) but should not be understood to represent a transcendent deity, a divine soulless—even bodiless—entity. Carone argues (see further below) that the Demiurge is nothing other than the world soul, an intellect that is embodied in the universe. According to this understanding of the cosmology, the world soul is the purposive and beneficent mind that orders the entire universe. As an intelligent rational agent, the universe itself, under the aspect of its divine world soul, is a model for humans to emulate. Just as its reason overcame (or better: overcomes) the erratic impulses of necessity and harnesses those impulses to serve its rational purposes, so humans may look to the god that is the universe as a model to overcome the irrational disturbances in their own lives. The study of astronomy draws the motions of our own souls into conformity with the orderly motions of the universe, rendering us virtuous and happy. This happiness is not the exclusive preserve of philosophers who know the Forms, but is available to everyone under heaven. In this way the ethical elitism of the middle dialogues gives way to a universal inclusiveness.

That inclusiveness also characterizes the attainment of the best life, the competition for which—between knowledge and pleasure—constitutes the main topic of the *Philebus*, a work discussed in chapters 3 and 4. In that dialogue also, according to Carone, cosmology

provides a model for human moral success. The discursively presented *Philebus* cosmology complements that of the mythically related *Timaeus*: the ἄπειρον of the former corresponds to the ἀνάγκη of the latter, πέρρας to the function of the Forms in giving formal/mathematical determination to the undetermined, the mixture of the two to the ordered realities that result from the determination, and mind (as cause of the mixture) to the Demiurge understood as the world soul. Mind in the *Philebus* is (like the Demiurge on Carone's reading) immanent in the cosmos. So here again, the universe itself as macrocosm is an embodied teleological agent, ready to serve as a model for microcosmic rational human agents. This cosmology, Carone argues, is deeply relevant to the dialogue's ethical discussion of pleasure and its claim to a constitutive place in the best life. For, whereas the various kinds of 'false' pleasures are exhibits of ἄπειρον, the 'pure' pleasures—as well as some of the mixed pleasures—have proportion and thus are associated with πέρρας. These pleasures have a rightful claim to be in part constitutive of the good life. How, it may be asked, does this provide space for the modeling function of the divine universe? Carone argues provocatively [114–115] that pleasure is in fact a valuable component of the life of god. It goes without saying that knowledge is such a component as well, and that humans find happiness in emulating the divine reason of the universe by understanding its mathematical proportions, which draw them to goodness in their choices of pleasures. As microcosmic derivatives of the macrocosmic universe, they may reflect its rational and teleological life (provided that they overcome the effects of the ἄπειρον). Such understanding leads humans to self-knowledge. So again, happiness is available not just to the philosophically educated or the citizens of a philosophically ruled community, but to all citizens of the cosmos.

Carone finds cosmological relevance in the myth of the reversals of the cosmic periods propounded at *Politicus* 269e–274e, the subject of chapters 6 and 7. According to the traditional (though lately much disputed) reading of that myth, the cycle of our present age—in contrast to the earlier age of Cronus—is devoid of divine guidance. If this reading were to stand, the myth would contradict the divinized cosmologies of the *Timaeus* and the *Philebus*; and Carone argues persuasively that the traditional reading fails. This age is after all the age of Zeus and is as such under divine guidance; it is separated from the prior age of Cronus by an interval during which the world, bereft

of divine guidance, reversed its course and tended to descend toward utter chaos, from which the divinity represented by Zeus, reestablishing its original course, rescued it. Even so, there are crucially significant differences between these two divinely guided ages, and these differences are relevant to the political theme of the dialogue. Unlike the subjects under the direct and benevolent care of Cronus, we humans in the less than ideal age of Zeus contend with the lingering effects of the universe's chaotic past. In the absence of regional deities to guide us, we are on our own and must exercise greater autonomy. Among the crafts that we require to make do for ourselves is the political craft, and thus the need to be ruled by a wise ruler whose model is the cosmic god. Carone argues that while the mythic reversal of cosmic cycles should not be taken literally, the account places humans in a universe in which a drama between intelligent order and chaos is being played out. This drama recalls the opposition of rationality and necessity in the *Timaeus* and the tension between *πέρας* and *ἄπειρον* in the *Philebus*. While the rules of Cronus and Zeus are thus substantially different, they are both in different ways expressions of a single divine intellect that in the *Politicus*, as in the *Timaeus* and *Philebus*, serves as a model available to all humans to emulate.

*Laws* X (discussed in chapter 8) raises the 'problem of evil' in the context of the divine governance of the world. The ruling world soul (which according to Carone is not independent of its cosmic body) is divine and, hence, not responsible for evil in the world. Nor is there a rival cosmic 'evil soul'; evil in the cosmos is caused by the bad condition of self-determining human souls: humans are entirely responsible for all evil in the cosmos—not only moral evil but (surprisingly) natural evil as well. For humans are an integral part of an organically unified universe—in fact, in a limited sense, they are 'rulers' of it—and human decisions and actions have consequences that reverberate throughout the cosmos. Thus, evil in the human soul in the form of folly, injustice, arrogance, all rooted in greed (*πλεονεξία*), must be overcome if our co-rule of the universe under the rational rule of the divine world soul is to be in harmony with its purposes.

*En route* to establishing her main thesis, Carone visits many issues in the interpretation of these dialogues that have been and remain areas of scholarly controversy. The positions she defends on

those issues are often original, but her defense of them is not always cogent. Many scholars who read this book will be provoked by her arguments. In this review, I propose to take issue with her claim that in the *Timaeus* (at least) god is immanent, and that the Demiurge in that dialogue must be identified with the rational world soul.

The question of the ontological status of the Demiurge, the anthropomorphically represented god that is the primary, intelligent, and beneficent efficient cause of the visible universe is one of long-standing in the interpretation of the *Timaeus*. Given the apparently exhaustive ontological division between ‘what is’ and ‘what becomes’, what sort of entity is this god? Carone argues that it may and should be identified with the world soul, embodied in (material) space. Her argument appears to be the following:

1. The Demiurge ‘is or performs the function of a mind or *nous*’ [42: see 35–42].
2. There can be no motion without soul [43, with textual references there].
3. Mind is in (rotary) motion [44].
4. Therefore, soul is prior to mind and the mind that is (or is represented by) the Demiurge is ensouled.
5. ‘Motion presupposes space’ [44].
6. ‘Space implies body, since there is no void in Plato’s universe’ [45].
7. Therefore, ‘a spatial or material medium seems to be a necessary condition for the motion of [the demiurgic] *nous* itself’ [45].
8. Therefore, the Demiurge just is the world soul.<sup>2</sup>

This argument is directed against those who see the Demiurge as representing a transcendent god—transcending, that is, the whole realm of becoming (of which the world soul is a part).

This argument is open to challenge. Critics will charge that it conflates producing agent with product. The world soul is undeniably itself an artifact, a product of whatever mind it is that the Demiurge is or represents (*Timaeus* 35a–36d). Metaphor or not, the creation story of the *Timaeus* would be rendered grossly incoherent if this

<sup>2</sup> Strictly, the conclusion is that the Demiurge is the mind of the world soul, but since this soul—unlike the souls of humans—has no other parts, there is no conceptual space to distinguish the mind of the world soul from the world soul as such.

interpretation of the status of the Demiurge were to stand. But it does not stand. For, while (rotary) motion is indeed an attribute of the (mind of the) world soul—in the *Timaeus*, the rotary motion of the Circle of the Same around its polar axis—there is no evidence that this motion is an essential attribute of mind *per se*. Contexts in the *Timaeus* and elsewhere that describe mind as engaged in such motion can easily be read as referring to instances of mind embodied in the cosmos. Carone's contention that 'Plato's claims about the nature of intellect in the *Timaeus* concern intellect as such, that is, as a genus of which both human and divine intellect are kinds' is only partly borne out. For according to the *Timaeus*, divine intellect itself is of two kinds: there is the generating intellect represented by the Demiurge, and the generated intellect of the world soul distributed among heavenly bodies, the generated 'gods' to whom is assigned the task of generating mortal creatures (*Timaeus* 41a–d). Texts in the *Timaeus* and elsewhere that ascribe rotation to mind may easily be read as referring to this generated cosmic mind, not necessarily to mind *per se*. So premiss 3 above calls for qualification and once qualified is compatible with the existence of a transcendent mind, which neither rotates nor, for all we know, is ensouled.<sup>3</sup>

It is regrettable that Carone devotes such zeal to attempting to prove that the divine mind of Plato's cosmology must be immanent. For as long as there is a type of divine mind that is indeed the immanent organizing mind of the universe, ordering it in the pursuit of attaining good ends (and we have seen that the cosmic soul, personified by the generated gods, does indeed play such a role), the function of the universe as model for human beings who are exhorted to imitate the divine remains intact. Such imitation of the universe

<sup>3</sup> The statement at 30b that 'it is impossible for mind to come to be present (*παρὰγενέσθαι*) in anything apart from soul' has often been taken (as now also by Carone, [44]) to mean that mind *in general* cannot exist apart from soul. But it has long ago been pointed out (by Hackforth and others) that the choice of infinitive shows clearly that the context of application is *γένεσις*, i.e., the world of becoming. To that extent, it is true that the divine cosmic mind, itself a thing that has come to be (*γγόμενον*), must be ensouled (this is exactly the context in which the statement occurs). But that requirement does not necessarily apply to a transcendent divine mind, should there be any such.

is indeed the imitation of god—albeit a lesser god—and the characterization of late Plato as an ethical naturalist is not ruled out by this challenge to Carone’s claims about the status of the Demiurge.

Other controversial claims include the contention that in the dialogues discussed Plato gives up his earlier belief—if he ever held it—that soul is essentially independent of body. It sometimes seems that Carone is guided more by her own philosophical predilections than by a careful assessment of all the evidence. Nevertheless, she has succeeded in establishing her overall thesis: that there is an inextricable connection between Plato’s cosmology and his late ethics, and that it is only by modeling our own microcosmic natures and lives upon the larger, macrocosmic nature and life of the universe that we humans will find our own teleological fulfillment. To that extent, we are undeniably in her debt.

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