Principles and Practices in Ancient Greek and Chinese Science by G. E. R. Lloyd

Aldershot, UK/Burlington, VT: Ashgate, 2006. Pp. xvi + 302. ISBN 0–86078–993–4. Cloth $114.95

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Since the early 1960's, G. E. R. Lloyd has been a leading figure in advancing the study and understanding of the history of Greek science, in large part effecting the metamorphosis of the discipline from the fragmented and narrow focus on modern categories of 'science' to a holistic investigation of inquiry into the natural world within the cultural, social, economic, and political *milieu*: compare Cohen and Drabkin [1948], Sarton [1952], and Clagett [1957] who excluded fertile but 'non-rational' fields of study, including astrology—based, in Mediterranean antiquity, on rigorous rules of mathematical astronomy—and alchemy, whence the modern discipline of chemistry. In recent years, Lloyd, casting his intellectual net even more broadly, has undertaken comparative studies of scientific approaches, particularly Greek and Chinese, in various foci of intellectual inquiry, especially mathematics and medicine [see Lloyd 2004].

For *Principles and Practices in Ancient Greek and Chinese Science*, Lloyd undertook the daunting task of choosing 15 of the most important or influential articles from the approximately 90 articles which he has penned over the last 20 years. These 15 articles (dating from 1987 to 2003) are now conveniently collected and easily accessible to students of Greco-Roman antiquity and the history of science. *Principles and Practices* falls into three parts. Part 1 includes five articles exploring the interpretation of Greek medicine. Part 2 includes six articles exploring technical questions in Greek science and philosophy. In Part 3 (four articles), Lloyd uses comparativist approaches to inquire into issues that may not occur to the specialist in a single area [ix]. Lloyd's comparativist studies succeed not only in emphasizing the themes developed in the first two sections of the

ISSN 1549–4497 (online) ISSN 1549–4470 (print) ISSN 1549–4489 (CD-ROM)
Aestimatio 4 (2007) 13–28

volume (and throughout his publishing career) but also in revealing new questions. Several of the articles were originally delivered orally [I, XI, XIII, XV], and this collection generally exudes a readable and intimate conversational quality. The articles are presented here as originally published (including the original pagination); a dagger (†) appears in the margin where Lloyd has altered or augmented his text. The author provides a supplementary bibliography of recent publications at the end of each section, *per se* a valuable tool. Each article is numbered sequentially [I–XV], with that number reproduced on each page. Citations to the volume in this review include this Roman article number and an Arabic page number.

Principles and Practices is underpinned by three major themes [ix–x]:

- a continuing preoccupation with disciplinary boundaries and how that fixation hinders rather than furthers exploration, interpretation, and understanding [XV.197];
- the polemical nature of Hellenic society which prejudiced Greek investigations into the natural world and shaped the interrelationships between teacher and student as well as between competing schools; and
- the open-endedness and unpredictability of scientific research.

Complex intellectual and institutional factors contributed to the development of rational interpretations of the natural world. Close textual readings show that divergent approaches and conflicting results occurred not only between cultures (Chinese and Greek), but also within cultures[1] and even within philosophical frameworks.[2] There is nothing predictable or inevitable about how an institution or discipline develops, and full appreciation can be gained only through combining social, cultural, political and abstract considerations [I.118, XI.1, XII–XV]. It is from this holistic approach to the philosophy and history of science that the collected articles derive their thematic cohesion. Interpretations based on modern values and expectations reveal only the biases of the interpreter and lead to no true

[1] For example, competing Greek explanations of the physical nature of the cosmos such as the Stoic *plenum* theory *v.* Epicurean 'atomic' theory.

[2] Disagreements about causes and different interpretations are noted *within* both the Hippocratic [I.117] and the Herophilean medical traditions [von Staden 1989].

understanding. Lloyd's approach to such an ambitious program is far-reaching, but his method is always cautious, detailed, and meticulous; and he is the first to admit to conjecture [e.g., VII.178, VIII.171]. He draws extensively from the sources, both ancient and modern, and his arguments never fail to be axiomatic, deductive, and rational, with Euclidean precision.

In the first article, 'The Transformations of Ancient Medicine', Lloyd explores the changes in our perception of ancient medicine and shows how the shifting post-antique reception of Greek medicine in fact parallels ancient approaches: even in antiquity there was a selection and distortion of medical texts. Lloyd traces the history of the modern reception of ancient Greek medicine from the persistence of the canonical authority of Hippocrates,[3] Aretaus, Galen, and Celsus well after challenges to their expertise in anatomy, physiology, and pathology had been successfully mounted [I.114], to the debunking of that authority, and, finally, to a shift in recent inquiry regarding what cultural insights can be gleaned from the study of Greek medicine with an aim to restoring 'the wholeness and complexity of Greek medicine' [I.130]. Drawing from a wide range of medical and philosophical evidence, Lloyd illustrates the heterogeneous scope and aims of Greek 'scientific' (e.g., non-magical, non-ritualized) medicine. Medicine in antiquity was not institutionalized and medical 'schools' in the modern sense were lacking. There was no unified approach, theory, or understanding of the fundamentals or of the details within the medical sects, much less between them: consider the conflicting Hippocratic theories of humors [I.126] and the Herophilean articulations of pulse theory [von Staden 1989]. Rational disciplines in Hellenic Greece—and medicine was no exception—were influenced by the paradigm of rhetoric and the ideal of citizen participation in government and politics. Plato had the sophist Gorgias [*Gorgias* 456b ff; Lloyd 1979, 254; I.128] pride himself on his rhetorical skills which rendered him more persuasive on medical issues than even his brother, a trained and practicing physician. Even Hippocratic treatises, including *Precepts*, *Decorum*, and *On Diseases*, advise practitioners on how to debate with a patient, family member, or fellow-physician [I.128]. A physician's success was measured by his ability to con-

[3] Littré [1839–1861] was motivated by his own conviction of the contemporary value of the Hippocratic corpus [I.114].

vince patients and peers of his authority and of his claim to the right answers *via* debate and dialogue [I.129–131].

Lloyd, who has long been interested in articulating the scope of science in general and natural philosophy in particular [XV.195: cf. Lloyd 2004, 33], takes up an ancient Greek debate on the precise parameters of 'medicine', the investigation of which can do much to elucidate how the original thinkers perceived and understood the issues. The polemical nature of Greek intellectualism and the plurality of medical traditions gave rise to debates over the definition of medicine, whether medicine constituted a rational discipline (skill or τέχνη as opposed to luck, experience, or knack [II.259]), and who had the authority to practice the medical τέχνη. These questions are explored in the second article, 'Definition, Status, and Methods of the Medical *Techne* in the Fifth and Fourth Centuries'. It was the answers to these questions which distinguished physicians (ἰατροί) from imposters, laymen, and midwives, who nonetheless served important functions.[4] Lloyd's scrutiny of three Hippocratic treatises (*On the Art*, *On Regimen in Acute Diseases*, and *On Ancient Medicine*) reveals wide-ranging and conflicting views of the definition, aims, scope, methodology, and limits of medicine and medical practitioners. The author of *On the Art* expansively defines medicine as the complete removal of suffering from illness and the 'alleviation of violences of diseases', but nonetheless allows the physician to refuse to treat a patient 'where the disease has already won the mastery' [I.253].[5] To the author of *On the Art*, medical τέχνη involves *doing* or *not doing* something to effect a cure, even if a patient cures himself without consulting an expert. The author of *On Regimen in Acute Diseases* suggests that the debate is waged because of the incompetence of some practitioners and disagreement among others [II.254–245].[6] *On Ancient Medicine* attests the conservative and traditional nature of the discipline. Its author attacks those who tried to apply 'the new-

[4] Although male physicians did oversee normal and abnormal births [[Hippocrates], *De nat. mul.* 1.34, *De nat. puer.* 30], a midwife was more likely than a ἰατρός to attend at a birth [Dean-Jones 1994, 34–35, 212–213: cf. Euripides *Hipp.* 293–296].

[5] τέχνη cannot in all cases be expected to secure a cure; success proves the power of the τέχνη, but failure does not belie its authority.

[6] Interestingly, Lloyd points out the frustration noted even in the primary sources over Greek medical pluralism.

fangled method of postulates (ὑποθέσεις)' to medical diagnosis as if they were undermining the status of medicine as a τέχνη 'since there is no criterion to which one should refer to obtain clear knowledge' [II.256], thereby oversimplifying the questions [IX.263] and reducing the art to chance.

In article III, 'Scholarship, Authority, and Argument in Galen's *Quod Animi Mores*', Lloyd further explores the primary themes of the first two articles: the effect of rhetoric in medicine and the aims and definition of the art. In *Quod animi mores*, Galen inverted Gorgias' argument to claim that a physician is in a better position than a philosopher to make patients better and more intelligent: since the soul follows the body, the physician can suggest changes in diet and regimen to improve a patient's character and intelligence—'the best doctor is also a philosopher' [IX.260: Kühn 1821, 1.53–63].[7] Galen drew extensively, but selectively, from medical, philosophical, and poetic sources. He simplified Plato's arguments in support of his own thesis on, for example, the nature of the soul and immortality [III.19]; and he also misinterpreted or misapplied Aristotle on, e.g., the correlation between physical features and character or intelligence [III.25–26]. Galen's purpose in *Quod animi mores*, as was the aim of the protreptic and apologetic Hippocratic treatises evaluated in article II, was to advocate the importance and prestige of the medical art as a τέχνη. Lloyd shows how Galen's judicious and sometimes distorted use of sources attests to the perceived and real connections between the medical τέχνη, rhetoric, and philosophy.

Philosophy, modern as well as ancient, shares with medicine a plurality of approaches and interests as well as a lack of consensus on its definition, scope, and aims: definitions and understandings of terminology were far from concrete [IV.262, IX.261, X.1]. Philosophers were admired by some, but reviled by others, e.g., the author of *On Ancient Medicine* [X.3]. Medicine and philosophy, with their own theoretical and practical agendas, developed sometimes conflicting, sometimes harmonious, epistemological models. Lloyd scrutinizes the interrelations and rivalries between medicine and philosophy more broadly in articles IX ('Philosophy and Medicine in Ancient Greece') and X ('Pluralism of Intellectual Life Before Plato').

[7] See also van der Eijk 2005 for the circumvolutions of philosophy and medicine.

As Galen relied upon the authority of Hippocrates of Cos, so too did Plato have Socrates enlist Hippocrates as an ally [*Phaedrus* 270c] on the connection between ethics, morality, and the study of nature and the human body. Lloyd rightly points out the ambiguity in Plato's text: What precisely is meant by the study of 'the whole nature' [IX.258]? Like Lloyd, ancient thinkers pursued wide-ranging interests. Plato drew analogies between justice and health in opposition to disorder and disease [*Gorgias* 504b–d: cf. *Republic* 564b–c], as Aristotle sketched analogies between health and morality [IX.259]; and Galen argued that the 'philosopher-doctor' was in the best position to help his patients physically, intellectually, and morally. Medical texts are replete with discussions of language, nature, convention, cosmology, and elemental theories: the author of *Airs, Waters, Places* even includes an ethnographic survey [X.5–6: cf. Herodotus, *Hist.* 3.106; Strabo, *Geog.* 6.4.1]. Among the Greeks, specialists were rare, excepting Euclid, Euctemon probably, and Meton; and epistemological approaches and explanations in all rational disciplines were pluralistic and heterogeneous [XV.199].[8] Lloyd, while sceptically attempting to define what constitutes philosophy before Plato, emphasizes that Presocratic philosophers cannot be made to fit into artificial modern categories, that those thinkers whom we thus categorize hardly shared a methodology or an interest in all the points which might constitute philosophy (e.g., cosmology, the relationship between language and reality) [X.10], and that insight can be gained only through caution and an appreciation for the complexity of their polymathic interests [X.12].

The criticism of the application of ὑποθέσεις to medicine meted by the author of the Hippocratic *On Ancient Medicine* [II.256] points to an early connection between medicine and mathematics, and Lloyd scrutinizes this link specifically in two articles chosen for *Principles and Practices*. Galen prided himself on his mathematical training and applied its principals to his medical philosophy [IV–V]. In article IV, 'Theories and Practices of Demonstration in Galen', Lloyd explores Galen's application of axiomatic-deductive reasoning to demonstrations in medicine. The strengths of such an approach are self-evident: it is orderly, systematic, and methodical; a clear logical

[8] For the extensive and flexible scope of Greek 'scientific' writers, see Rihll 1999, esp. 7, 89–90.

structure is demanded; and refutation must be guided by the application of logical analysis. This approach, however, is overly idealistic [IV.264] and inappropriate to medicine [IV.276], which is hardly an exact science. Galen certainly made no claim to conclusive knowledge, yet he repeatedly claimed that parts of medicine could be made the subject of rigorous geometrical-style demonstrations [IV.274]. Galen recast empirical observations in a geometrical mold 'with deductions stemming from starting points for which axiomatic indemonstrable status is claimed' [IV.277]. Galen's application of axiomatic-deductive reasoning was contentious and rhetorical; by appealing to the prestige and incontrovertibility of his method, Galen sought to establish his own authority [IV.273–274].

In articles V ('Mathematics as a Model of Method in Galen') and VII ('The *Meno* and the Mysteries of Mathematics'), Lloyd considers the status of mathematics, its connections to other rational fields of inquiry, and how Galen [V] and Plato [VII] invoked mathematics to establish their *éclat* and persuade the audience of the truth of their opinions, theories, and conclusions. Despite the difficulty and unpopularity of mathematics amongst physicians,[9] Galen valued the prestige and exactitude afforded by mathematically linked examples[10] and demonstrations, and so he used mathematics to persuade his readers of his own expertise and incontestability. Like Galen, Plato may have used mathematics for its prestige without fully understanding its complex nuances in *Meno* 86e–87b [VII].[11] As the use of mathematics in Galen may have served a non-mathematical purpose (to establish irrefutability), so Plato's aim may have been one of investiture. Plato under-described his hypothesis regarding whether an 'area can be stretched out as a triangle in this circle', thus making it unnecessarily obscure [VII.177–178] by withholding essential information [VII.180], in antithesis with orthodox Greek mathematical practice wherein the teacher would logically and methodically lead the student step-by-step through a proof until arriving at the con-

[9] According to Galen, his readership considered mathematical explanations obscure and unduly lengthy [V.113].

[10] E.g., the geometrically informed explanation of the cone of vision: see *On the Usefulness of the Parts* 10.12: V.124–125.

[11] Gregory 2000 does not address this passage and assesses Plato's geometry only in the context of his astronomy, atomism, and ideals of philosophical education.

clusion by whose indisputability the student would be overwhelmed [XIV.136]. Lloyd suggests that Plato's geometrical obliquity may have served a non-mathematical purpose, that of initiation: a guide (Plato's Socrates) attempts to facilitate a student's (Meno's) exploration of various possibilities of the problem's resolution [VII.180]. Lloyd guardedly suggests that the obscurities of the mathematical problem point to 'the need of initiation—not, of course, into the method but in the fields to which it is applied' [VII.181]. The deliberate obscurity and Lloyd's cautious suggestion of a context of initiation bring to mind Pythagoreanism which has been connected to Orphism, which was itself characterized by mystery and initiation rites [Kerényi 1950; Kahn 2001, 19–22; Assmann 2002]. De Zwarte [2004] argues intriguingly that in the Heraeum at Paestum, a temple possibly created by the Pythagorean community and wherein there seems to be embedded much mathematical knowledge, the placement of at least three columns of the *naos* may have been selected for the sake of (perhaps secret) mathematical wisdom, to which only members of the community would have had easy access. That is, the columns may have been so placed for reasons other than aesthetics. Worshippers of Hera at Paestum may have understood the mathematical implications of the temple under guidance similar to that which Socrates attempts to proffer to the intractable Meno. Plato's partially presented mathematical problem further bears some interesting resemblance to Chinese educational dynamic (as well as Druidical, if Caesar is to be believed: see *Bell. gall.* 6.14), wherein the student is expected to memorize and internalize texts (often marked by rituals of initiation in Chinese culture [XIV.136]) before coming to understand them, and then to conserve and transmit the corpus [XIII.162].

In article VI, 'The Alleged Fallacy of Hippocrates of Chios', Lloyd evaluates an ancient debate about whether Hippocrates of Chios engaged in paralogism in his quadrature of lunes. The debate underscores one of Lloyd's underpinning themes: the desire to establish incontrovertibility and to challenge the credibility of a rival. As in article I [117–118], the question remains, 'Who has the right to speak with authority about "science"?' Hippocrates' original text is long lost, and the argument and proof have been mediated through Aristotle, Themistius, Eutocius, Eudemus, Alexander of Aphrodisias, and Simplicius. Simplicius, Lloyd suggests, used the issue to undermine the credibility of his rival Alexander of Aphrodisias by represent-

ing him as having attributed a fallacy to the esteemed Hippocrates [VI.12]. Lloyd's methodically crafted examination of the language in the extant evidence shows that Hippocrates must have made some unreconstructable rhetorical remark about his quadrature of the lunes which subsequently misled Aristotle. Lloyd asks an important question on VI.118: To what extent does Simplicius offer 'verbatim quotations from Eudemus'? This query raises a fundamental issue regarding the survival of scientific texts, here hinted at but not fully explored. In essence, Lloyd asks, How reliably has Simplicius represented Eudemus' original ideas? Although some scientific treatises have been transmitted intact, many are distilled only through later commentators and encyclopedists (e.g., Iamblichus and Simplicius). The modern scholar is handicapped in working with later interpretations of scientific ideas rather than with the original formulations of those ideas.[12] Simplicius' presentation, eclectically compiled from remote sources, drew upon the authority of one source (Eudemus) to undercut the influence of another (Alexander). Likewise, Galen selectively relied upon the authority of Hippocrates of Cos, Plato, and

[12] The problem arose early in the transmission of the texts: Plato and Aristotle (both valuable sources for extracts and *testimonia* of earlier philosophers) engaged in the exegesis of earlier natural philosophers, and Galen's compendious corpus is an invaluable but selective and biased source of earlier medical theory and practice. Galen, for example, levels vicious attacks against the Methodists, claiming that he had succeeded where they had failed, taking over their cases and exposing their murderous ignorance [*De meth. med.* 10.31–38, 162–173, 204–205, 316–357, 390–391]. Galen, furthermore, had only secondhand access to many texts through Andromachus, Asclepiades, Criton, and others. The fragmentary and piecemeal nature of scientific texts brings to the fore even deeper problems , as Lloyd palpably demonstrates in his cautious attempts at reconstructing the argument. Lack of textual context and continuity (just as a lack of cultural and social context) lead to tentative resolutions of philosophical problems, especially as regards the particularly fragmentary survival of Presocratic texts whose disputed details stimulate debate rather than engender resolution: this issue is particularly brought to bear on Lloyd's discussion of Empedocles' 'theory of evolution' [XI.6–7]. Interestingly, though hardly surprisingly, the same problems are noted in other traditions, including Chinese. In his investigation into the cosmological and heterogeneously compiled *Huainanzi* [XXX.148–149, 153], Lloyd raises precisely the same problems noted in his discussion of the 'Presocratic' philosophers and the transmission of Hipparchus' claim regarding the quadrature of lunes.

Aristotle, although passages he cited from these authors and others 'for support of his general thesis [did] not do so to the full extent he requires nor in quite the way he represents' [III.12, 18–31].

In Article VIII, 'Plato and Archytas in the Seventh Letter', Lloyd delves into the debate of the authorship of that letter. Of the letters attributed to Plato, the seventh is the most substantial and most philosophical [VIII.159]; and, although inconsistencies and un-Platonic statements are evident [VIII.60], Platonic authorship should not be discounted [VIII.171]. Lloyd conjecturally posits that a careful reading of the seventh letter reveals subtle criticisms of Archytas as a mediator or interpreter of Plato's philosophy to Dionysius II. A close reading of the letter also undercuts the king's claim to understand 'the most important things' (*τὰ μέγιστα*) [VIII.164, 168–169]. Despite (or perhaps because of) his professed enthusiasm for mathematics, Pythagoras, and Archytas, Plato may have viewed Archytas as a rival, and so, eschewing the heavy-handed tactics observed in Lloyd's assessment of the use of the rhetorical arts by the medical writers, he (if Plato is the author of *Epist.* 7) may have applied subtle but persuasive language to secure 'the independence and originality' of his philosophy, thereby elevating his own status and weakening a potential rival [VIII.172].

The need to understand ancient texts within their cultural context has remained one of the core themes in Lloyd's considerable scholarly corpus, and he commends, on the side of Hellenic studies, recently fashionable scholarship on attitudes to and beliefs about the human body (Greek assumptions are not the same as our own): 'attitudes to the body often provide a key to much else in the belief systems, the values, the cosmology, of the society in question' [I.118]. Aristotle's explanation of the existence and function of females—that females are failed males because of their inability to concoct blood [I.124: Lloyd 1983, 94–105, esp. 95n139]—brings to the fore Aristotelean (and Hellenic) gender biases. The cultural *milieu* is especially important in the question of Greek theories of evolution, the topic of article XI, 'The Evolution of Evolution: Greco-Roman Antiquity and the Origin of Species'. Lloyd sets the debate securely in the ancient world, surveying the documentary evidence within the larger

philosophical dialogue about, e.g., coming-to-be and passing-away,[13] teleology,[14] and popular and traditional beliefs such as that in the Minotaur. Xenophanes recognized substantial changes in the configuration of land and sea [Kirk, Raven, and Schofield 1983, §184], but the extant fragments of his writings suggest no theory of the extinction of species or changes ('evolution') in species. Aristotle, in fact, rejected the notion of the evolution of species [XI.11]. Investigations into the natural world of animals and animal species were fueled not exclusively by zoological interest but also by philosophical and moral interests (especially in cases of Epicurus and Lucretius). The ancient discussion was 'not in anticipation of modern ideas' [XI.1] but was far different in scope, purpose, and resonance. The Greeks adhered to no cosmological dogma (in contrast with the modern cultural backdrop of continuing debates on the merits of Darwinism) but looked to the animal world for ethical and moral *exempla*. Lacking in Greek antiquity were explosive population growth, the dogmatic theory of creationism, and new information about the dissimilarities between species and varieties which informed Darwin's work [XI.14]. As tempting as it may be to interpret the charming tales in Xenophanes and Empedocles through a 21st-century filter, the conclusions reached would reveal more about the intellectual biases of the modern scholar than the philosophy of species developed by ancient thinkers.

Over the span of the past two decades, Lloyd has devoted much of his substantial intellectual energy to questioning the comparisons between scientific traditions, recognizing that no cross-cultural universals (or even scientific universals) exist. In the three comparative articles [XII–XIV] chosen for the Ashgate collection, Lloyd applies a multidisciplinary approach to explore the nexus between science, philosophy, tradition, and mythology, advancing his earlier researches [Lloyd 1979, 1983, 1987]. He delves into variant aspects of intellectual approaches to unravel and note important cultural diversity in the expectations about the nature of wisdom, the purpose of scientific texts, how cultures thought about science and philosophy and used

[13] Even among proponents of an eternal *versus* a created cosmos there was a wide acceptance of large scale cyclical change [XI.3].

[14] Advanced by Aristotle, but denied by Epicurus as producing animals useless and hostile to humans [XI.8–12].

various categories, and the very purpose of the act of philosophizing within distinct cultures.

Lloyd explores how social and political constructs shape intellectual approaches in article XII, 'Appearance *vs* Reality: Greek and Chinese Comparisons and Contrasts'. All cultures recognize hidden realities, but for the Greeks the question of seeming *v.* being played a crucial role in the development of Greek philosophical thought [XII.306–310]. An essential component of the Greek discussion was the debate regarding change, that is, whether change—coming-to-be or passing-away—is possible. Divergent conclusions of competing schools and thinkers, working within the framework of the debate defined by the dichotomy between the intelligible and the perceptible, were often agonistically motivated in the competition for prestige and in attempts to persuade peers and students. Such pressures did not exist within Chinese intellectual society, where the role of the philosopher was to transmit (not alter) the canon and the goal was to advise benign rulers who provided the primary source of employment and patronage [XII.314, XIV.133], which was antithetical to the independent and self-sustaining existence of the Hellenic Greek philosopher. Within this social framework, Chinese philosophers, since their work was addressed not to peers or potential students but rather to the benign patron-ruler, felt no pressure to engage in polemic; and, although they questioned the difference between appearance and reality and acknowledged hidden forces [XII.311], Chinese scholars recognized no fundamental ontological dichotomy and posited no ultimate truth that was acquired only through reason. The Chinese explained physical, social, and moral change [eventually, XII.312], through the workings of *yin yang* and they accounted for the five phases (*wu xing*) as governing cycles of mutual change not dependent upon the sharp contrast between reality and appearance [XII.315].

Likewise, as Lloyd shows in article XIII, 'Mythology: Reflections from a Chinese Perspective', the same cultural and political phenomena—the Greek love of rhetoric and the competition for prestige, the Chinese favor of consensus and disdain for debate—explain the absence of the dichotomy between mythic and rational accounts (*μύθος v. λόγος*), so prevalent in Greek rational thought, in the Chinese understanding of cosmology. The cosmological *Huainanzi* includes etiological, empirical, mythical, and rational elements—'an extraordinary variety of material handled in a striking diversity of

ways' [XIII.151–152] yielding a text which cannot be demarcated into μύθος and λόγος but instead 'quite simply presents itself as a seamless whole' [XIII.153]. Lloyd analyzes the Greek and Chinese use of language and rhetoric to conclude that diverse technologies of communication and linguistic idiosyncrasies themselves help to explain discrete intellectual approaches [XIV.133]. Similarly, cultural and political factors (expectations of citizen participation), combined with variant modes of writing and literacy (the Greek alphabetic script), in part account for disparate mathematical and medical approaches. The axiomatic-deductive paradigm of Greek mathematics begins with an indemonstrable premise, alphabetically building up a diagram, as the student is led through a sequence of incontrovertible steps, ending with an irrefutable conclusion [XIV.136]. The social and political factors, as they affect Chinese intellectual institutions, lack the dichotomy between perceptible and intelligible as well as between μύθος and λόγος, further explaining the Chinese approach to mathematics, which eschewed the axiomatic-deductive paradigm in favor of consent, unity, and loyalty within the intellectual lineage [XIV.136–138]. In China, 'the negative models' of 'rhetorical debates', so prevalent in Greek culture, were simply lacking [XIV.136].

In the last article of the collection (XV), 'Is there a Future for Ancient Science?"' (his valedictory lecture marking his retirement from teaching), Lloyd reflects on facets of both ancient and modern rational inquiry, including how the study of ancient Greek science has changed and how advances in modern science have been brought to bear on the history and philosophy of science. E. R. Dodds' seminal *The Greeks and the Irrational* [1951] shifted the emphasis in classical cultural studies away from 'the triumph of Greek rationality' and narrow inquiry, thereby encouraging the analysis of the whole culture. Lloyd emphasizes the importance of examining both the successes and failures of Greek science, philosophy, and culture as a means of restoring the 'the wholeness and complexity' of Greek scientific pursuit [I.130, XV.197]. Comparativist studies reveal universal questions raised by human thinkers (interest in the heavens, the nature and health of the human body), but endemic cultural investigations into these same questions are inspired by assorted motives and yield contrastive explanations. The comparativist approach poses significant demands, including the mastering of many (non-related) languages and cultures [XV.208]; but, Lloyd argues, such an approach will be

most fruitful, as indicated by recent scholarship at Cambridge (and elsewhere) in ancient science, which, though 'not explicitly comparativist, had been animated by an awareness of alternative traditions' [XV.208]. As Lloyd has rightly stated elsewhere [1991, 353], he reiterates the importance of inquiring into ancient science, the pursuit of which far exceeds the technical details of mathematical, medical, and philosophical explanations of the world: 'For science in antiquity, read the ancient understanding of the world—and that takes you straight to the heart of the values of the culture in question' [XV.207].

The articles which Lloyd selected for *Principles and Practices* focus tightly on ancient texts and issues, but his interest in modern relevance [especially Lloyd 2004] does peep through on occasion. Specifically, he suggests that the modern physician can learn much from the Hippocratic dialectical approach, which results in an open ended discussion between physician and patient about health and disease [I.32]. Epistemologically, Lloyd emphasizes that cognitive models vary within and between cultures [IX.271–272], and that the pluralism of intellectual approaches reflects nothing less than the diversity of human experience, as illustrated, for example, by anthropological studies into how human cultures classify animals, which habitat stratum they occupy (air, forest canopy, and so forth), whether they are domesticable, whether they are edible, and so on. [IX.266–268]. These queries have far-reaching implications for the philosophy of science as a whole in underscoring that there are no absolute answers [IX.268–269].

It is clear that differences between Hellenic and Chinese culture resulted in divergent rational explanations of the natural world. The same criteria of geographical location (e.g., Attica, and Ionia) and variant political systems (e.g., democracy and aristocracy) could perhaps be applied in scrutinizing differing Greek approaches to philosophy, mathematics, medicine, and other rational disciplines. Like Greek medicine, Greek cultural identity was hardly homogenous. The language, of course, was a unifying factor (although dialect and vocabulary varied regionally), and individual πόλεις worshipped many of the same gods and celebrated many of the same festivals (with local modifications). Nonetheless, there was no pan-Hellenic political or philosophical concord, not even after Alexander. It is agreed that certain social, cultural, and political factors were at work to spark

the scientific revolution in Ionia[15] Welcome would be a study of geographical trends in Greek medicine and/or mathematics to ascertain whether peculiar local factors (e.g., political, economic, intellectual) affected the trends in the development of rational fields of inquiry.

Principles and Practices in Ancient Greek and Chinese Science is not a monograph, and this fact results in some minor inconsistencies. While most are carefully and thoroughly annotated, article XI lacks citations (easily supplied by the advanced or talented intermediate student), and there are inevitable overlaps of evidence and examples: Gorgias' persuasiveness [I.128, II.252–253, X.7, XII.08, XIV.131]; Plato's attempt to educate Dionysius II [VIII.159–170, 172–173; XII.314; XIV.127]. Nonetheless, the volume is an invaluable collection, adhering to the mission of the Variorum Collected Studies Series to bring together a 'selection of articles by a leading authority on a particular subject' and to 'make available research that is scattered, even inaccessible in all but the largest and most specialized libraries'. The brief introduction is most helpful in establishing the cohesiveness of the collection, and each essay follows from its predecessor. Lloyd's treatment of manifold questions always engages the reader, and each article rewards with insight and elucidation. The anthology stands not only as a useful synopsis of recent trends and discoveries in the history of Greek (and Chinese) science but also as a testament to the continuing guidance and contributions to the history of science and ideas by the indefatigable Geoffrey Lloyd.

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[15] Graham 2006 is the most recent to affirm this.

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