claims. According to Galen, Chrysippus' theory represents an extreme expression of a cognitivist or intellectualist conception of emotions. It went further than Zeno in this respect and was largely rejected by the later Stoic Posidonius, who adopted a version of Plato's tripartite psychology. Tieleman is sceptical that there was any real difference between Zeno and Chrysippus; Galen's claims on this point seem to be based on earlier doxographical statements rather than first-hand scrutiny of Zeno's treatise (pp. 85–6). As regards Posidonius, T. argues that Galen has completely misrepresented his views. What Galen presents as the full-scale critique and rejection of Chrysippus' ideas is better understood as an extension of Chrysippus' own work (in Book 2 of *peri pathôn*) in exploring—and then resolving—problems raised by his theory. Even what has previously been taken to be Posidonius' main innovation, the idea of 'affective movements', can be taken as simply supplementing Chrysippus' own thinking on the psychological inertia (which he compared to 'running legs') involved in affections or passions. What Galen presents as the adoption of Platonic psychology is better regarded as commentary on Plato's ideas, made from an explicitly Stoic standpoint, of a type that (as other scholars have recently stressed) seems to emerge as a new feature of the later Hellenistic period.

T. also offers a fresh interpretation of what is distinctive and new in Chrysippus' theory of the affections—that is to say, in the Stoic theory in general. He disputes Galen's claim that Chrysippus' account of human psychology is narrowly intellectualist; rather it is presented as unified or holistic, giving a coherent rôle both to beliefs and psychophysical reactions. Through comparison with the Stoic theory of determinism, T. shows how emotions are explained by reference to long-term dispositions and localized responses to situations. T. also stresses the strong physiological or quasi-medical strand in the Stoic theory (understated both by Galen in *PHP* and Cicero in *Tusc.* 3–4). This anticipates Galen's own approach, as Galen himself acknowledges in *Quod Animi Mores*, Chapter 4, which is in sharp contrast to his negative and contentious treatment in *PHP*.

As I have stressed, this is a highly innovative study, whose conclusions run counter to much previous scholarship, especially on Posidonius. Personally, I found Tieleman's thorough treatment of source-criticism and his analysis of the Stoic theory very convincing, though, of course, one might want to argue about detailed points. Other scholars may find more to disagree with. But, by any standards, this seems to me to be a major contribution to research in this area, with far-reaching implications for our understanding of the nature and history of Stoic thinking on psychology.

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FROM ARCHIMEDES TO OMAR

R. NETZ: *The Transformation of Mathematics in the Early Mediterranean World: From Problems to Equations*. Pp. x + 198, figs. Cambridge: Cambridge University Press, 2004. Cased, £45, US$70. ISBN: 0-521-82996-8.

The subtitle of this excellent monograph identifies the precise character of the transformation that takes place in the history of mathematics between the Greek and Arabic traditions. Reviel Netz adopts an original approach to the current debate as to

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whether mathematics even has a history that can throw any light on the nature of the discipline itself. The traditional view (ahistoricism) is that the nature of mathematics has always been the same, though it has grown exponentially in bulk since antiquity. The historicist approach, by contrast, emphasizes the radical difference between ancient and modern mathematics. N. cleverly uses the treatment of a single problem by ancient Greek and medieval Arabic mathematicians as a way of showing the historical transformation that led from ancient to modern mathematics. He thereby establishes the importance of the history of mathematical practices, while also bridging the great divide posited by historicists between ancient and modern mathematics. In the end, he takes up a quite nuanced middle position between extreme historicism and ahistoricism.

For a historian of Greek mathematics, an attractive feature of N.'s book is that he cashes out his general claims in admirable technical detail by reconstructing the problem as it was resolved by Archimedes and later mathematicians. On this solid technical basis he then considers whether the treatment was purely geometrical or whether it contained the seeds of an algebraic treatment. By way of addressing this question, N. first sketches the line of reasoning that Archimedes used for his solution and then contrasts this sketch with the standard ahistoricist account of the solution given by Heath. N. claims that such an ahistoricist approach not only obscures Archimedes' line of reasoning but is also mathematically false. In short, N. argues that mathematics has a history and that its objects have different meanings according to the different practices to which they belong.

In Chapter 1, N. tries to give an historical account of the difference between problems and equations with reference to later Hellenistic attempts to solve the Archimedean problem in various ways by mathematicians, such as Dionysodorus and Diocles, who wanted to stake a claim to originality. N. suggests that each of these different treatments of the same problem is geometrical rather than algebraic, since they pursue problems that are not amenable to solution through equations. Yet, on the other hand, none of the mathematicians operate under any constraints that would prevent a quasi-algebraic approach, and so N. (p. 34) rejects Klein's thesis about a conceptual divide between ancient and modern mathematicians. He thinks that the Greeks were perfectly capable of giving a quasi-algebraic treatment but that they happened to minimize it in practice.

The ancient source for the mathematical treatments of the same problem by Archimedes, Dionysodorus and Diocles is the sixth-century A.D. scholar, Eutocius of Ascalon, who wrote a series of mathematical commentaries. Thus, in his second chapter, N. considers the significance for the history of mathematics of the differences between the original mathematical work of Archimedes and the commentaries of Eutocius. He suggests that the major difference lies not in theory but rather in practice, and that this facilitated the historical transition from problems to equations. Given that Eutocius worked primarily as a commentator, whose texts depended on previous authors, N. (p. 65) calls him a 'deuteronomic' author. This fact reflects a transformation in the practice of mathematics which, in turn, changed the nature of mathematics itself. For this reason, N.'s general strategy in this chapter is to compare the mathematical practices reflected in the texts of Archimedes and Eutocius, respectively, so as to assess the subtle changes that had taken place in mathematics. For example, N. focuses on two innovations by Eutocius that approximate to the modern ideas of functional relation and of algebraic magnitude.

In order to examine the fate of Archimedes' problem in medieval Arab mathematics, N. concentrates in his final chapter on Omar Khayyam who completed

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the development from problems to equations. N.'s purpose is to show that Khayyam's mathematics differs essentially from that of Archimedes, reflecting the deep conceptual divide between ancient and modern mathematics that was suggested by Klein and Unguru. But N. also wants to show that the historical basis for this divide rests on changes in the practice of mathematics from the world of Archimedes to that of Khayyam. As indicated in his previous chapter, N. finds much continuity between Eutocius and Khayyam, although the Arab transformation of mathematics leads to a new kind of science called algebra.

While giving a general overview of Khayyam's Algebra, N. notes the following significant features. The first is the inter-penetration of the introduction and the treatise proper, which is both a treatise *in* algebra and *about* algebra. Thus Khayyam's treatise is characterized by a seamless transition from general contextual comments to the mathematical results themselves. The second related feature of the treatise is its strongly articulated and systematic nature, i.e. it constantly arranges itself in various divisions and lists. Khayyam is interested in articulating divisions, dividing them, and organizing them according to some overarching principles.

One major difference between Khayyam and Archimedes has to do with the technical tools used to achieve the different aims of the proofs, especially the use of ratios and proportions. In N.'s (p. 169) terms, Archimedes 'foregrounds' proportions, while Khayyam 'foregrounds' equalities. For Archimedes equalities are ways of getting at proportions, while for Khayyam proportions are ways of getting to equalities. The reason for this, according to N., is that the way in which the goal is obtained is determined by the goal itself. It is this inverse ordering of foreground and background that makes the proofs so different. Khayyam's mathematical materials are the same as in Greek mathematics, but they are arranged in a completely new structure. For N., it is at this structural level that Khayyam's originality must be understood.

But there is at least some tension between N.'s claims about the relationship between mathematical practice and conceptual development in the history of mathematics. On the one hand, he claims that there is no conceptual obstacle to algebra in ancient Greek mathematics, though its practice is predominantly geometrical. Thus, for instance, N. (p. 96) arrives at the rather strange conclusion that both Diocles and Eutocius made only minimal conceptual progress beyond Archimedes, yet that they unintentionally stumbled across the idea of the function. I find this to be a rather dubious line of argument. Is it possible for one to stumble across a concept without realizing it, or is this merely historical retrospection on our part? On the other hand, N. shows that the 'deuteronomic' practices of Arabic mathematics led directly to the conceptual development called algebra. Clearly N. regards practices as the engine of conceptual change in mathematics, but it is unclear how this can be consistent with what he says about Greek mathematics. In general, he tends to overlook the messiness in the history of practices, so as to achieve the formal beauty of a mathematical proof in his own historical account of the development of algebra. For instance, N. claims (p. 61) that Greek mathematicians were typically in competition with each other rather than cooperating, so that their polemical communication was not conducive to generating a field of joint endeavour. But the same could be said of Renaissance mathematicians like Tartaglia and Cardano, although algebra flourished with them. Thus it is not helpful for explaining progress to talk about cooperation rather than competition between mathematicians. However, one has to admit that N. has reconstructed a very

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plausible trajectory of historical progress from problems to equations, even if it appears too neat in many places.

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MENANDER AND DEMOCRACY

S. LAPE: *Reproducing Athens. Menander's Comedy, Democratic Culture, and the Hellenistic City*. Pp. xvi + 294. Princeton and Oxford: Princeton University Press, 2004. Cased, £26.95. ISBN: 0-691-11583-4.

The contexts and causes of Pericles' citizenship law have always occasioned plenty of comment; few works make as much of its impact as this. For Susan Lape, the restriction of citizenship to those born of the formal union of two Athenian parents was essential to the replication of democratic ideology, 'the set of beliefs and practices that sustained the identity of Athenian citizens as specifically democratic citizens' (p. 3). This, in turn, played a central part a century and a half later, in the comedies of Menander. His plays assert the ideology of the democracy in a period marked by oligarchy, despotism and foreign domination, but also by democratic resistance and renewal; their failure to mention Macedonian rule is not escapism or acquiescence but performative, a denial of Athens' subordination. At the same time, however, 'comedy's family romances are often subversive of the democratic cultural order they instantiate' (p. 12). Far from apolitical, Menander's marriage plots not only reflect the new realities of the early Hellenistic period but shape responses to them in this time of transition. Some plays (*Aspis*, *Dys.*, *Epit.*, *Sam.*, *Sik.*) reward suitors and other lovers who demonstrate the egalitarian attitude this ideology demanded, others (*Mis.*, *Pk.*) mix in such stock figures as the braggart mercenary in order to exalt the civic virtues of the *polis* in a world of transnational monarchies. Throughout, slaves, prostitutes, foreigners, and women turn out to share in the moral qualities once thought male citizens' alone. So in *Sik.*, the democratic Stratophanes prevails over a white-skinned oligarchic rival who tries to take the girl for himself. *Samia*'s Demeas, the only sexually successful *senex* in New Comedy, earns the *hetaira* he lives with (another exception) only by displaying his civic credentials when he rejects her in favour of his son. The soldiers of *Mis.* and *Pk.* stand in for the Hellenistic monarchs who hired them, and their taming within the conventions of citizen marriage acts as an analogy for the way their masters ought to respect the traditions of the *poleis* they have overpowered. Young men fall in love at first sight and always choose a citizen girl (even when her identity is unknown). This naturalization of Pericles' law not only neutralizes the normal hierarchy of status reinforced by the dowry but ascribes to women a certain passive power. But Menander's women can also act outside their normal social constraints—most strikingly in the case of the *hetairai* Chrysis and Habrotonon—and this calls into question distinctions of gender no less than those of class and citizenship.

Bits of this will be hard going for those who think of Balibar (pp. 98–9) as a well-dressed elephant king, and some sentences cry out for commutation. ('That the play authorizes Glykera to act in advance of her cultural possibilities results in a certain underdetermination on the level of narrative logic' [p. 178].) In general, however, L. is a most considerate guide, supplying frequent summaries of the

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