Introduction

> It is not the unanswered but the unasked questions that undermine discourse and give an unbalanced slant to an entire field.[1]

Any historian of ancient science and technology worth her salt should begin this book by trying to persuade the readers that her subject is indispensable to a true understanding of antiquity. For once, the claim is actually true. To state the obvious, one cannot really have an accurate picture of classical Athens without considering the role of *techne*[2] and technicians within it – especially given that they are so central to canonical authors like Plato or Aristophanes. And one cannot plausibly identify Romanization with the provision of infrastructures such as aqueducts or roads, and then declare that technical expertise was not essential to run the Roman Empire. Yet, stating the obvious appears necessary. Indeed, there are two surprising facts about ancient technology. One is how pervasive it was. *Techne*, and its Latin equivalent *ars*, covered an even wider spectrum than modern technologies. Both carpentry and medicine were *technai*; a rhetorician, capable of turning opinions around in the minds of his audience, and a sculptor, capable of turning a block of marble into the statue of a god, both qualified as technicians. Most of the remains, material or literary, that we have from the ancient world were the products of some form of technical knowledge. Once you start looking, there is no getting away from it: you find technology *everywhere* in the ancient world. All the more surprising, then, that the second surprising fact about ancient technology is how few people have been or are studying it.

At the time of writing, the history of ancient technology is still seen as a specialist subject – ironically, too 'technical' to fully enter the mainstream

[1] Mathews 1999: 121.

[2] Throughout the volume I have transliterated τέχνη and retained *ars*, rather than translating them, because the range of meanings covered by these words in Greek and Latin cannot be reproduced by any single modern equivalent, such as 'craft', 'art' or 'skill'. Cf. Meißner 1999: introduction; Balansard 2001: 13–17.

of classics, and too exotic to count as more than a luxury in history of science departments. This volume hopes partially to correct this situation, by showing that ancient technology can provide invaluable insights into ancient culture – indeed, that one cannot understand these two terms, ancient culture and ancient technology, in abstraction from each other. Moreover, I hope the insights we gain into ancient technology and culture may be useful for the historiography of science and technology of later time-periods as well.

Let me explain first of all how this book differs from the extant literature on the subject.[3] Most of the current histories of ancient technology deal chiefly with engineering, while my decision has been at least partly to embrace the ancient span of the terms *techne* and *ars*. This diversity has prevented a single definition of the topic under consideration. Indeed, the whole of the first chapter is devoted to showing how arduous a task that is, and how loaded definitions of *techne* were. *Not* providing a circumscribed, neat definition of *techne* is partly the point I want to make with that chapter and with this book.

Again, most of the extant accounts separate out a description of attitudes to technology from the main narrative.[4] Instead, my emphasis throughout the whole book is on how technical knowledge, activities and products were perceived and represented by the people involved (both practitioners and customers). This makes methodological sense: I do not think that one can separate what we know 'objectively' about ancient technology from ancient attitudes to technology. We might foster the illusion that we are in the presence of objective facts where archaeological evidence is available. Yet, if we want to say anything above and beyond a *prima facie* description of an artefact – be it a water pump, an aqueduct, or a blown-glass vase – we have to rely on *someone's* attitude, perception and representation, even if they are just our own. In fact, attitudes affect even *prima facie* descriptions, as demonstrated by the classification and re-classification of archaeological finds according to shifts in what is deemed interesting or significant about the ancient world. Yesterday's unidentified metal object, relegated for decades to a museum store, may become tomorrow's catapult frame, triumphantly displayed in the main gallery; someone's abacus table is someone else's game-board. As archaeologists know all too well, the

[3] E.g. Hill 1984; White 1984; Traina 1994; Landels 2000. I have derived much inspiration from Schürmann 1991; Greene 1994; DeLaine 1997 and 2000; Wilson 2002.

[4] This is the case for instance in Humphrey, Oleson, Sherwood 1998, an otherwise immensely valuable contribution.

evidence often says little by itself.[5] The same is true *a fortiori* in cases where little or no archaeological evidence is available and we have exclusively to rely on texts.

Thus, my emphasis on how technical knowledge, activities and products were perceived and represented by the people involved is grounded in the fact that, arguably, any evidence we have comes through the filter of perceptions and representations – attitudes – to technology.

Again, I have been perhaps more vocal than previous accounts in my criticism of two approaches which I think have marred the historiography of ancient technology, and are partly to blame for its current state of relative neglect. They are more common among non-specialists (historians of science and technology of other periods and classicists) than among historians of ancient technology of the last generation, as if debate on some issues had moved on within the field, but the message had failed to spread outside of it. I call these two approaches the *blocage* question and the 'mainstream view'.

The *blocage* question originated from a perceived discrepancy between the ancient potential for technological development and this development in actuality. Ancient technology has seemed quite 'advanced'. Archimedes built incredibly accurate catapults, and Hero of Alexandria described a device where boiling water, turning into steam, set a metal ball in motion. Modern observers have wondered why ancient technical knowledge stopped at the production of gadgets or, at most, engines of war, and was not taken further to what were seen as its natural consequences, i.e. the creation of a steam engine. This approach also postulated a certain connection between technology and economy. On the basis of the seemingly obvious equation 'better technology = better economy', and even without invoking the possibility of an industrial revolution, historians have wondered why the ancients seemed so little preoccupied with using or improving technology to increase productivity.

The discussion around these two related issues has been dominated by the notion that something 'blocked' the ancient mind and prevented it from making those connections between technology and economy, or technology and wider applications, that we take for granted. Reasons proposed for this *blocage* include the presence of slaves, a widespread scorn for work and practical applications in general, and the stigma attached to gaining money rather than inheriting landed property.[6]

[5] See Morton 2006, although the situation he describes is more complicated for ancient artefacts than he allows. I thank Tracey Rihll for this reference.

[6] The term *blocage* comes from early French discussions of the topic: e.g. Schuhl 1947; Greene 1994 for bibliography. The question is related to the debate between 'primitivists' and 'modernists' in ancient economy, see Finley 1965; Meißner 1999: 19–20; Greene 2000; Wilson 2002.

As has been pointed out by Kevin Greene,[7] the *blocage* question is badly posed. It rests on premises that we can simply reject: the assumption that technology goes or develops in one direction, thus possessing a context-independent potential that is destined to actualize itself unless something hinders it; the assumption that the relationship between technology and economy is straightforward and, again, pretty much context-independent, unchanged throughout human history – in particular, the assumption that technological progress leads to economic progress ('progress' here seen as susceptible of objective definition). Cast doubt on any of these notions, and the *blocage* question vanishes into thin air.

The second approach is more insidious, and more difficult to describe. By 'mainstream view' I mean the stubbornly common picture according to which ancient technology was marginal to society and economy, its practitioners were widely despised and its activities looked down upon. I call this view 'mainstream' both because a surprising number of people today hold it, and because its supporters maintain that this was the view of most ancient people, or of the people whose views mattered the most. In other words, 'mainstream' refers not just to the present popularity of a certain picture of ancient technology, but also to the fact that such a picture depends on an undemonstrated premise: that some views we can glean from the sources were the majority, the dominant, *the* ancient 'mainstream' attitude to technology.

Now, I think it is a completely open question to what extent technology was marginal in ancient society, and it is an even more widely open question to what extent we can identify a view in a society and call it 'dominant' – even opinion polls today cannot claim to do that. What has in fact happened is that modern historians have selected statements put forward by authors they consider significant (Plato, Aristotle, Xenophon, Seneca) and have held them up as the dominant view on the question of ancient technology, sometimes under cover of the excuse that there is not enough evidence to do otherwise.

A common statement in favour of this selection is that Plato, Aristotle and so on, represent the elite; thus, by definition, they represent the dominant group in society at the time. It is, however, yet another open question to what extent the ideology espoused by the elite is effectively dominant for the majority, even within an Orwellian society.[8] Most likely, there will be instead an on-going, dynamic negotiation between elite and

[7] E.g. Greene 1994.
[8] Debate on this is rife: one can start from Foucault 1975; Bourdieu 1977 [1972].

non-elite views – in other words, a complicated and recalcitrant entanglement of views. Historians who espouse the mainstream view pick out one thread or, if you prefer, one musical line in what is a cacophony of voices, and declare that it is the one worth writing about, or listening to. As I show throughout the book, this at best oversimplifies positions that are not homogenous, not even within one individual author, and, at worst, it privileges their authority over dissonant positions – an operation about which there is raised awareness in areas such as history of slavery or of women, and about which there should be awareness in the history of technology too.

In sum, the 'mainstream view' takes sides in what was effectively a conflict-rife, dialectic, polarized situation. I see nothing particularly wrong in taking sides – we all do – as long as we do not pretend otherwise, or, worse, pretend that there was only one side to the question in the first place.

Finally, many previous accounts opt for a chronologically rather loose but, within the limits indicated above (an emphasis on engineering), thematically comprehensive narrative. Instead, I have opted for case-studies, one for each chapter. Each episode deals with a different type of technology, a different time-period, and tries to experiment with slightly different historiographical techniques. Thus, chapter 1, on medicine, is set in classical Athens, and is a history-of-ideas piece; chapter 2, on military technology, spans the period from the fourth to the first century BC and could be called a historiographical survey. Chapters 3, on carpentry and concentrating on the first century of the Empire, and 4, on land-surveying in the century after that, are examples of what one could do with archaeological and epigraphical sources, respectively. Finally, chapter 5, on architecture, spans a vast expanse of time, from more or less the third to more or less the sixth century AD and is an embryonic attempt at a big-picture history of ancient technology based on the integration of textual and material evidence. I have tried to organize each chapter around a big question; the case-study provides a necessarily limited and qualified answer, but it also hopefully offers some insight into what could be a more general treatment of the issue. Also, I conceived each case-study as a sort of history writing exercise, almost an experiment about what can be gleaned by looking at, or looking for, particular types of sources, or approaching them in a certain way.

Some of these micro-histories will be genuinely micro. When I embarked upon the 'experiments' of chapters 3 and 4, for instance, I thought I'd be hard put to find enough evidence to write anything at all,

but ended up instead having to reduce my focus to the iconography of one technical instrument in chapter 3, and to a forty-year span in chapter 4. Being overwhelmed by the abundance of sources is not a frequent experience in ancient history, and one that deserves emphasis, almost celebration. Micro-histories, some of them with a narrow focus, also mean that each chapter has a lot of potential for expansion: I have suggested some ways of doing that in the conclusion.

The epilogue is also where I summarize my main positive conclusions on ancient technology. This is because they are in fact retrospective thoughts – one never knows what a book is about until after writing it (sometimes not even then). I was able to detect some general features by the end, but I did not have a master plan when I started – rather, I was driven by some unsatisfied curiosities and unsolved puzzles. One such was the mosaic on the front cover, and the connection it seemed to have with a twentieth-century Neapolitan poem on how death makes us all equal, some lines of which serve as epigraph to this book. I discuss the mosaic (not the poem) in chapter 3. Chapters 4 and 5 pretty much originated from wanting to find out more about – respectively – a group of inscriptions in Delphi, and a group of late ancient laws I had looked at for my Ph.D. thesis.

In other words, the whole enterprise has often been no more systematic than asking some unasked questions and seeing where that took me, and I would like to retain a flavour of that experimental approach. I hope the reader will find the resulting investigations intriguing enough to forgive the fact that some of those experiments remain undecided, and several of those questions are only partially answered.

CHAPTER 1

The definition of techne *in classical Athens*

Chained to a rock, the Titan Prometheus remembers how he helped humankind:

> they had eyes but could not see, and ears but couldn't hear. [. . .] They did not know how to build houses with bricks and facing the sun, nor to work with wood. They lived in sunless caves the way ants live in the ground [. . .]. They worked without useful calculations, until I showed them the risings and settings of stars [. . .]. I taught them numbers, the greatest stratagem, and writing, the mother of memory. I yoked beasts for them [. . .] and I harnessed horses to chariots and taught them to heed the rein [. . .]. And it was nobody else who gave humans ships, sail-driven wagons that the sea buffets. [. . .] The greatest was this: when they fell ill, they had no defence – no balm, no ointment, no elixir – and lacking medicine, they wasted away, until I showed them pharmacy so they could fend off various diseases. [. . .] Here's the whole story in a nutshell: whatsoever *technai* the humans have, they got from Prometheus.[1]

Medical images abound in Aeschylus' play: the Titan is said to be administering a drug (*pharmakon*) for humankind's sickness; words are described as the doctors of a diseased temperament; the wandering Io, pregnant with Zeus's child and half transformed into a cow by the jealous Hera, appeals to him for a remedy for her sufferings. On the other hand, Prometheus is compared to a bad doctor who cannot cure his own disease: despite rescuing humans from their brutish circumstances, he is unable to help himself.[2]

In his third *Pythian Ode* (written between 476 and 467 BC), Pindar narrates the story of another figure half-way between human and divine: the miraculous healer Asclepius. His mother Koronis got pregnant by the god Apollo but unwisely went on to betray him with a mere mortal, thus 'chasing the impossible with hopes unfulfilled' (23, is hope a form of *hubris*?). Apollo duly

[1] [Aeschylus], *Prometheus Bound* 463–522 (written c. 430 BC; I will pretend the question of authorship is uncontroversial), tr. Matthews with modifications; cf. Sophocles, *Antigone* 332–75 (c. 442 BC); Cordes 1994: 35–8. Translations are mine unless indicated otherwise.

[2] [Aeschylus], *cit.* 251, 606, 380, 472–5, respectively. Cf. Xenophon (c. 444–357 BC), *Memorabilia* 1.4.13; Vernant 1965b; Kosak 2004: 43.

had Koronis die, but rescued his son from her womb while she was burning on her funeral pyre (39–40). With the centaur Chiron as a teacher, Asclepius went on to become a most successful doctor, but 'even wisdom is given over to gain' (54). Greed pushed him to overstep the mark and he brought a man back from the dead, only to be struck and killed by Zeus's thunderbolt. Pindar takes the opportunity to exhort readers to respect the hierarchy between gods and mortals, and not to think above their station.[3]

From very early on, Greek culture depicted medicine and similar forms of knowledge as ambiguous: they were terrible and wondrous, dangerous but indispensable, the province of the powerful but morally ambivalent.[4] In this chapter I will address the general question, what is *techne*, through the particular example of how medicine was implicitly or explicitly defined as a *techne* in the fifth and fourth centuries BC.[5]

I have chosen medicine as a case-study for several reasons, not least because we have texts by the technicians themselves, i.e. the Hippocratic Corpus.[6] Medicine was well respected, since it procured the greatest good – health.[7] At the same time, as Aeschylus and Pindar show, medicine was the site of moral ambiguity and paradox. Doctors do unpleasant things – cutting, burning, administering foul-tasting drugs – because they know that ultimately they will be good for you. Saving a life sometimes entails going contrary to common sense.[8] Also, medical images abound in the political and ethical discourse of classical Greece – we have analogies between the human body and the 'body politic', the notion that society's evils are like illnesses, and so on. These parallels ran deep because they inscribed political and ethical values onto the body and onto nature itself.[9]

[3] Cf. Pindar, *Pythian Odes* 3.113, *Nemean Odes* 3.4, 3.53–4, 4.1–5, 5.40–3. The odes date to the first half of the fifth century. Cf. also Descat 1986: ch. 2.6; Mackie 2001.

[4] Cf. Anton 1980: 59; Hutchinson 1988: 22–3, 37, 39; Schubert 1993: 138; Cordes 1994: 34–5, and in general 138–69; Balansard 2001: 158–9; Kosak 2004: 36–7.

[5] I will take the period from mid to late fifth to mid-fourth century BC as pretty much a continuum – see Ober 1989: 35–8; Eder 1995.

[6] I will use (albeit sparingly) the Hippocratic *Decorum, On the Doctor* and *Precepts*, which are all Hellenistic or later, on the assumption (formulated by Jouanna 1992: 70, 92) that they reflect an earlier medical ethic. All the other Hippocratic works are dated between the mid to late fifth and the late fourth century BC.

[7] Plato, *Gorgias* 451e3–452b1, 464b1–6, 490b1–7; [Hippocrates], *Ancient Medicine* 1; *IG* II^2 374, 319 BC or later, honours the doctor Evenor with citizenship; Jouanna 1992: 125.

[8] E.g. Plato, *Gorgias* 521a2–7, 521e3–522a7; Aristotle, *Nicomachean Ethics* 1104b16–18; Xenophon, *Anabasis* 5.8.18; [Hippocrates], *Precepts* 5.

[9] Cf. e.g. tyranny as a disease at Plato, *Republic* 544c, 564b, *stasis* as a disease at *ibid.* 557a, politics as the *techne* of curing souls at *Laws* 650b. The literature on this is vast, see e.g. Jouanna 1978, 1980, 1981; Cordes 1994: 19n. 1, 26, 34, 44; Kallet 1999; Lloyd 2003.

Thus, choosing the case of medicine allows us to explore some interesting features which in my opinion characterized ancient discussions of *techne* in general: great usefulness, moral ambiguity, strong political resonance.

Tracing the ramifications of these discussions is not an easy task. For a start, it does not help that the semantic range of *techne* does not match modern equivalents. Essentially the same thing appears to have been variously called *techne*, *sophia* (knowledge/wisdom), *episteme* (rigorous/stable knowledge), or *dynamis* (power).[10] Also, there was debate as to whether some disciplines, for instance rhetoric, were *technai* at all. The Hippocratic *On Techne*, for instance, is a defence against the contention that the *techne* of medicine does not exist.[11] Moreover, there was debate about what role technicians should play in the community, and about the ethical repercussions of what they did.

One particularly important example of this is the well-known distinction between technician (one of the most common words for it would have been *demiourgos*) and 'base technician' (*banausos*). The baseness of the base technician had to do with greed, or the readiness to do anything for money, and was crucially marked by corporeal deformity. For instance, in Xenophon the *banausikai technai* 'spoil the bodies of the workmen and the foremen, forcing them to sit still and live indoors, and in some cases to spend the day at the fire. The softening of the body involves a serious weakening of the mind'.[12] Similarly Aristotle: 'a deed, *techne* or learning must be considered base if it makes the body or soul or mind of free men useless for the uses and actions of virtue. Therefore we call base those *technai* that render the body worse and the activities done for pay'. Or 'the most technical of these activities are those with the minimum of chance, the most banausic those where the bodies are most mutilated'.[13]

[10] See e.g. Plato (c. 429–347 BC), *Charmides* 165c–d, 170e, *Euthydemus* 289a–c, *Gorgias* 447c, 449d, 455d, 456a, *Protagoras* 357b, *Republic* 518d, *Statesman* 258d–260b, 304b; Aristotle (384–322 BC), *Magna Moralia* 1205a, *Nicomachean Ethics* 1153a24–5, *Rhetoric* 1367a32–3; [Hippocrates], *Law* 4.10; Descat 1986: 129; Cambiano 1991: 74–5, 221–6, 231–4; Balansard 2001: 95–118.

[11] [Hippocrates], *On Techne* 1.18; *Ancient Medicine* 1; *Regimen in Acute Diseases* 8; *Precepts* 9; Plato, *Laws* 937e–938a, on rhetoric. Heinimann 1961; Lloyd 1991: 251; Cordes 1994: 101–37; Laskaris 2002: 74 with references, 78–82.

[12] Xenophon, *Economy* 4.2–3, 6.6–8, Loeb translation.

[13] Aristotle, *Politics* 1337b8–18 and 1258b26–35, respectively, *Economy* 1343b2–6, *Rhetoric* 1367a30. Other *loci classici* include Aristophanes (c. 456–380 BC), *Clouds* 1010–23, *Women in the Assembly* 385; Plato, *Gorgias* 512c–d; Xenophon, *Economy* 6.6–8 (but see the story of Aristarchus at *Memorabilia* 2.7); Plutarch (c. AD 45–125), *Parallel Lives. Agesilaus* 26.4–5. But cf. Aeschines (c. 390–314 BC), *Against Timarchus* 27 and [Demosthenes] (c. 384–322 BC), *Against Phaenippus* 20. On these issues Aymard 1943; Isnardi Parente 1966: 21, 24; Burford 1972; Cambiano 1977: 229–32 and 1991: 53–6; Wood and Wood 1978: 54–5, 84, 100–1, 129, 158; Lévy 1979; Vidal-Naquet 1981: 227, 236, *contra* Saunders 1982; Loraux 1982: 172–5; Balme 1984; Kosak 2004: 27, 32–3. Further references in Morawetz 2000: 16–17, see also Pipili 2000, to which one should add Berger 1970: esp. 92–7.

Such statements have often been taken almost at face value. And yet, given the widespread idea that bodily beauty, or the lack thereof, went together with inner goodness or its opposite, statements that link *techne* to a deformed body and its corresponding lack of virtue, must be seen as charged. It ought to be obvious that the aesthetic of depictions of the worker's body depends on what worth is attached to labour: take, for instance, many official monuments of the former Soviet Union, which represent labourers as embodiments of an idealized strong physicality. What is more, in ancient Greece the worker's body was not represented exclusively as deformed. Several vases depict craftsmen naked, in a way that has been interpreted as the reality of their working situation, but could just as well be a case of 'heroic nudity', meant to celebrate the technician's body, rather than expose it to contempt.[14]

In sum, it is doubtful to what extent the distinction *demiourgos*/*banausos* mapped well-defined groups in a way that the technicians themselves would have recognized. *Banausos* and related terms do not appear to have been used very much until the fourth century BC, when their increased use was perhaps a response to the changed political situation and the increasing power of the *demos* in the period from the 450s onwards, after the fall of the Thirty Tyrants. *Banausos* remains a blurry category, conveying not so much an actual socio-economic class, as the opposite of the citizen – the uneducated anti-citizens, the non-*pepaideumenoi*, the non-leisured underclass.[15] It is often said that Athenian democracy relied for its existence on the exclusion of the 'other', the non-citizen – women, slaves and foreigners. This exclusion at the same time constituted the citizen body as 'the same', and thus cohesive. Interestingly, technicians were often assimilated to the 'other' – to women, slaves and foreigners. Although the majority of metics (i.e. legal aliens) and perhaps freedmen were indeed engaged in crafts and commerce (after all, they could not own land), the fact remains that many technicians living in Athens were citizens.[16] The denial of 'sameness' to technicians and the

[14] Burford 1972: 70–1; Ziomecki 1975: 138–9.

[15] Chantraine 1956; Murakawa 1957: outside Athens *demiourgos* denoted magistrates of the highest rank; De Fidio 1971; Cambiano 1977: 229–32, 1991; Nightingale 1995: 55–9; Descat 1986: 146–54; Brisson 1994: 50, 54, 86–97; Morawetz 2000: ch. 1. The term *banausos* occurs only once in Hippocratic texts from our period: [Hippocrates], *On the Sacred Disease* 18 (ed. Jouanna). The text ends with the exhortation not to rely on purification, magic, 'and all such banausic things', the phrase is not in all manuscripts. Cf. Laskaris 2002: 97–108.

[16] [Xenophon] (c. 430 BC), *Constitution of the Athenians* 1.10, 1.12; Pope 1935; Randall 1953; Burford 1969; Berger 1970: 160–2; Ziomecki 1975: 127–35; Whitehead 1977: 16–17, 114–21; Wood and Wood 1978: 29; Ober 1989: ch. 1; S. Morris 1992: 31–3, 57, 90–1, 231–2; Cordes 1994: 60–1; Loraux 1996: 6; Cohen 2001; Harris 2001: 70; Kosak 2004: 76–7.