Important Notes for
The Scientist in the Early Roman Empire

Chapter 1

Introduction

On the Christianity-helped-science thesis compare the best case in Hannam 2009 with rebuttals of all cases in Carrier 2010, Efron 2009 and Gruner 1975.

In this book I use "Roman" to refer to all Greek or Latin speaking inhabitants of the Roman Empire (whether actual Roman citizens or not).

On the nature and origins of the university system, which arose after the 11th century, see Ferruolo 1998, Pedersen 1997, De Ridder-Symons 1992, Hastings 1987, Bowen 1975, and Haskins 1923 (with one possible exception in the East, the rather unique Academy of Constantinople, founded in the 5th century, developed in the 9th, and disbanded in the 14th: see Markopoulos 2008, Constantelos 1998 and, though perhaps less reliably, Kyriakis 1971). For a broad, although fairly unsophisticated introductory survey of the development of education from Greece, through Rome, into the Middle Ages and then the modern era, see Dobson 1932. For a broader multicultural survey of ancient education, see Bowen 1972.

On science content of medieval universities see Rossi 2001: 192-202. It should also be noted that medieval students did not enjoy the same intellectual liberty that ancient students did (largely due to attitudes detailed here in chapter seven). See Freeman 2002, esp. where supported by Carrier 2010: 419 n. 56.

On early American schools see Reese 2005.

Quote from McGrayne 2011: 63. See also D. Lee 1973: 70-71 and Green 1990: 470-73 and 855 (notes 38 and 39).

On the craze for mathematics in the Renaissance see Nahin 1998: 8-47.

Chapter 2

Who Was Educated

Quotations from throughout Marrou 1956, translated from the French by Dr. Carrier.

Hill analogy discussed in Cribiore 2001: 1-12. On the *Tablet of Cebes*, see Seddon 2005 and Trapp 1997 as well as Diogenes Laertius, *Lives and Opinions of Eminent Philosophers* 2.125. The *Tablet of Cebes* is commonly dated to the 1st century A.D. (though it purports to have been written centuries earlier), although the Christian Tertullian claims a close relative of his composed it (see Tertullian, *Prescription against Heretics* 39), which if true (and if he means the same book) would more likely place it in the 2nd century A.D.

Facts and quotes and statistics throughout this chapter principally from Harris 1989 and Cribiore 2001.

The only significant attempt to respond to Harris has been Humphrey 1991, which attempts to offer rebuttals or qualifications to Harris' conclusions, but the included essays do not offer any effective challenges to his methodology and I found no evidence there that Harris hadn't already considered, either in fact or in kind. See also in support of Harris *OCD* 843–44 (s.v. "literacy"), Hezser 2001, Woolf 2000, and Johnson and Parker 2009 (which also includes an extensive post-Harris bibliography: 333-82).

On Caracalla bestowing universal citizenship see Sherwin-White 1973: 279-87, 392-93.

On the alimentary charities see Ramsay 1936, Duncan-Jones 1982: 288-319 and 333-42, Patterson 1987: 124-33, and Woolf 1990 (and sources in each). For a summary see *OCD* 61–62 (s.v. "alimenta"). See also Marrou 1964: 437 with 611 n. 11 (= Marrou 1956: 303) and Lewis & Reinhold 1990: 2.255-59, 2.268-70 (§II.70). For similar charities outside Italy (which may have included non-citizens): C.P. Jones 1989. See also Lamotte 2007 for the Trajanic system (possibly conceived by Nerva: Page 2009) and Cao 2010 for the whole gamut of alimentary charities in the Roman period, public and private.

Pliny the Younger, *Panegyric* 26-28, reports that in Rome alone such a scheme was serving "nearly five thousand" boys (and the number was growing: Duncan-Jones 1982: 290, 293), and this may have been in addition to girls. Even if girls were not already included, they certainly were by the time of Antoninus Pius in the middle of the second century, as reported in the *Historia Augusta* = 'Julius Capitolinus', *Life of Antoninus Pius* 8.1, and confirmed by coins and reliefs, cf. Cohen & Rutter 2007: 66-67, but considerable evidence suggests this practice had already begun with Trajan, cf. Ramsay 1936. It is estimated that between one hundred thousand and two hundred thousand Italian children benefitted at any given time from Trajan's charity (Duncan-Jones 1982: 317), while even more would have benefitted from other similar charities in and out of Italy.

On the rising access to education among women in the Hellenistic and Roman periods see Pomeroy 1977: 52-53 and 1995: 170-76; and Whitmarsh 2001: 109-16. And see Bauman 1992, with Valerius Maximus, *Memorable Deeds and Sayings* 8.3, cf. also 3.8.6 and 8.2.3, and Gaius, *Institutes* 1.190-91.

Quintilian, *Education in Oratory* 1.1.6. For his date and background see *OCD* 1251–52 (s.v. "Quintilian (Marcus Fabius Quintilianus)"). On the women he names as orators see Snyder 1989: 123-27 and Plant 2004: 104-05.

Delphic inscription: Agusta-Boularot 2004: 322, 330, with *Fouilles de Delphes* 3.4.79.

For evidence of women philosophers: Levick 2002; J. Barnes 2002: 293-94 and 303; Taylor 2003: 173-226; Irby-Massie 1993; Snyder 1989: 99-121; Waithe 1987; Pomeroy 1977: 57-62; Marrou 1964: 578 n. 39 (= Marrou 1956: 414-15); Tod 1957: 140; *OCD* 1577 (s.v. "women in philosophy"); and following notes.

Lactantius, *Divine Institutes* 3.25. Also, regarding his flat earth views, ibid. 3.24 vs. Pliny the Elder, *Natural History* 2.65.

Women named as philosophers: Diogenes Laertius, *Lives and Opinions of Eminent Philosophers* 6.96-98 (Hipparchia) and 2.86 (Arete). On Hipparchia there is also an epigram by Antipater of Sidon (*Palatine Anthology* 7.413). Pythagoras was also reputed to have made philosophers of his wife and daughter (*OCD* 988 and 1450, s.v. "Myia" and "Theano"; however cf. *EANS* 49 and 781-82, s.v. "Aisara of Lucania" and "Theano, pseudo") as well as Themistoclea, and Plato's "disciples" included "two women," Lastheneia and Axiothea, according to Diogenes Laertius, *Lives and Opinions of Eminent Philosophers* 3.46; and others (Snyder 1989: 106-13; Plant 2004: 68-86). Plato himself claims one woman (Diotima) among the 'presocratic' philosophers (insofar as she was teaching when Socrates was a student, assuming the account is not fictional): Plato, *Symposium* 201d-212b. Epicurus was also famed for including women in his school—elite prostitutes in particular (these *hetairai*, lit. "companions" or "lady friends," were already expected to be well educated in order to hold stimulating conversation with elite male clients, cf. Pomeroy 1995: 89-92, 141, and thus would have been of all women at that time the most suited to studying philosophy). The most famous of these was Epicurus' lover Leontion (herself perhaps the first published feminist philosopher—her tract defending women against the disparaging remarks of Theophrastus is lost), but other women studying under Epicurus had telltale names suggestive of a similar profession (Hedeia, "Sweety"; Mamarion, "Titsy"; Erotion, "Sexy"; Boidion, "Oxeyes," similar to our "Doe Eyes"; and the more ordinarily named Demetria, "Demeter's Girl"); see Pomeroy 1995: 103-05. A Galenic treatise also praises an otherwise-unknown Arria, identified as Galen's best friend (*philtatê*), and as a brilliant Platonist philosopher: cf. Nutton 2004: 223, citing *On Theriac to Piso* Kühn 14.218 (not 14.208 as misreported

in Nutton), and Nutton 1997 (which convincingly defends Galen's authorship of this treatise). Notably an unnamed female Platonist philosopher is also the dedicatee of Diogenes Laertius' *Lives and Opinions of Eminent Philosophers* 3.47, written around the same time. For many more examples see scholarship cited in previous and following notes (e.g. women philosophers as dedicatees of inscriptions: Levick 2002: 134, etc.).

On women in the ancient medical profession: Kudlien 1970: 17-18; Nickel 1979; King 1986; Jackson 1988: 86-87 and 1993: 85-86; Irby-Massie 1993: 364-67; Nutton 1995: 18-19; Künzl 1995 (see also occasional data in Gourevitch 1970, supplemented by Agusta-Boularot 2004: 328-29, esp. n. 61); Parker 1997; Nutton 2004: 142, 196-98; and most recently Flemming 2007 (see also *EANS* 94, s.v. "Antiokhis of Tlos"). Flemming also examines the question of whether any women wrote medical books, but finds the evidence disputable, encountering the same problem that plagues the alchemical tradition (see note below). Of course, whether we know of any is not the same as whether there were any. In any case see *EANS* 121, 173, 281, 316, 354, 447, 456, 482, 500, 552, 564, 588, 596, 719, 725, 755, 778-79 (s.v. "Aquila Secundilla," "Aspasia," "Elephantine/ Elephantis," "Eugeneia" and "Eugerasia," "Hagnodike of Athens," "Iuliana," "Iunia/Iounias," "Kleopatra of Alexandria," "Laïs," "Metrodora," "Muia, pseudo," "Olumpias of Thebes," "Origeneia," "Romula," "Salpe¯ (of Lesbos?)" and "Samithra/Tanitros (?)," "Soteira," and "Thaïs").

On the education of midwives: Galen, *On the Doctrines of Hippocrates and Plato* 9.3; Soranus, *Gynecology* 1.3-4.

Comparing Galen's sexism with that of the 19th and early 20th centuries: Nutton 2004: 235.

On women research scientists in antiquity: Ptolemaïs of Cyrene wrote a treatise on harmonics and music theory around the turn of the era (first century B.C. or A.D.). We know nothing else about her, except that her work appears to have been at least modestly brilliant and influential (Levin 2009: 230-93; Plant 2004: 87-89; Irby-Massie & Keyser 2002: 344-45; Barker 1989: 239-42; *OCD* 1234 [s.v. "Ptolemaïs of Cyrene"], *NDSB* 5.172-73 [s.v. "Ptolemais of Cyrene"], and *EANS* 705-06 [s.v. "Ptolemaïs of Kurene"]). Hypatia of Alexandria, a professor of Platonic philosophy in the late fourth and early fifth century A.D., wrote commentaries in mathematics and astronomy, and was consulted on the construction and use of laboratory instruments for the study of physics (Deakin 2007; Dzielska 1995; Snyder 1989: 113-20; *DSB* 6.615-16 [s.v. "Hypatia"]; *NDSB* 3.435-37 [id.]; *OCD* 716 [id.]; *EANS* 423-24, [s.v. "Hupatia"]; and Harich-Schwarzbauer 2011). Pandrosion taught in the fourth century A.D. (Netz 2002: 197; *EANS* 608-09, s.v. "Pandrosion"), but we're told no details of her scientific interests. Likewise there may have been at least one female agricultural writer, but this conclusion is based on a single letter in a name that could have been corrupted in transmission (*EANS* 637, s.v. "Persis," which could be an error for Perses). Some alchemical treatises were attributed to otherwise unknown female authors, but their names do not seem authentic (e.g. "Maria," cf. *EANS* 531, more probably an apocryphal attribution to the sister of Moses), and fanciful pseudonyms were common in the alchemical tradition (Irby-Massie & Keyser 2002: 238-41, 243-45; Plant 2004: 130-47; e.g. *EANS* 446, s.v. "Isis, pseudo (Alch.)" and "Isis, pseudo (Pharm.)"), and since alchemists believed their art had been "revealed" to mortal women by fallen angels in their attempt to woo them (from the *Book of Enoch* 6-8; cf. *DSB* 14.631, in s.v. "Zosimus of Panopolis" and *OCD* 51–52, s.v. "alchemy"), suspicion is warranted when alchemical knowledge is attributed to a woman. But their involvement in the art is possible. Other possible female scientists in antiquity are listed in *EANS* 1029 (and discussed in their associated entries).

Agusta-Boularot 2004 finds evidence of female teachers above the elementary level scarce, but abundant for female scribes, secretaries, and librarians, and to some extent elementary teachers (ibid.: 329-30).

On class system thinking: contrast Toner 2002 with Atkins & Osborne 2006: 4-11.

Julia Domna was called "the philosopher Julia" in Philostratus, *Lives of the Sophists* 2.622 and was said to have actively studied philosophy in Cassius Dio, *Roman History* 76.15.7 and 78.18.3; both men knew her personally. For scholarship on Julia Domna see Bowersock 1969: 101-09, Hemelrijk 1999: 122-28, Levick 2007: 107-23, and OCD 754 (s.v. "Iulia Domna").

On Cleopatra: Plutarch, *Antony* 27-29.

Evidence of education among elite women is comprehensively surveyed in Hemelrijk 1999, with Levick 2002 discussing women's educational access to philosophy in particular; several prominent examples from the Roman period are discussed in Snyder 1989: 122-51 (and more in Levick 2002: 146-48 and Plant 2004).

On Cornelia: Plutarch, *Life of Pompey* 55.1-2 (cf. Plant 2004: 101-03).

Juvenal, *Satires* 6.186-88, 6.434-56, and 6.574-78.

Quote from Plutarch, *Marriage Advice* 48 (= *Moralia* 145b-d).

For more on this Algaonike see Bicknell 1983.

Material in Plutarch from Plutarch, *Marriage Advice* 48 (= *Moralia* 145e-146a).

Musonius Rufus, *Sermons* 3 and 4.

On gender disparity in education: Harris 1989: 239-40 and Cribiore 2009.

Pseudonymous treatise on educating the poor: Pseudo-Plutarch, *On the Training of Children* 11 (= *Moralia* 8e-f).

On the "gymnasial" class as a recognized elite social status see Whitehorne 1982 and Hin 2007.

Galen, *Advice for an Epileptic Boy* 3-4 (= Kühn 11.361-62, see Temkin 1934).

Education of artisans: Haines-Eitzen 2000: 55.

Clarysse and Thompson 2006: 2.125-33 (with Katelijn Vandorpe). Cited in Oleson 2008: 735.

Urban population dominance in Egypt: Tacoma 2008.

Modern class size ratios according to the Center for Education Reform: http://www.edreform.com/Fast_Facts/K12_Facts.

The other group of scholars quoted: Johnson and Parker 2009: 46-51.

Vitruvius, *On Architecture* 6.pr.1-3.

Diodorus Siculus, *Historical Library* 12.12.4-12.13.3.

Origen, *Against Celsus* 1.27: *hoi idiôtai kai agroikoteroi*, "idiots and farmhands," or more literally, "nonprofessionals and countrydewellers," the latter in the comparative ("more so" hence "more hick"). In context these words carry the definite connotation of "ignorant laymen and those more rustic," compared with *tôn en logois gegumnasmenôn*, "those practiced in reason," i.e. those having received oratorical education and experience in the public *gymnasia*. See *LSG* 15 (s.v. "agroikos"), 819 (s.v. "idiôtês" III.1-3), and 362 (s.v. "gymnazô" I.Pass.) and 1057-59 (s.v. "logos" e.g. IV.1).

Origen, *Against Celsus* 1.9-13; Lactantius, *Divine Institutes* 3.25.

Tertullian, *Against Praxeas* 3: using the words *simplices*, *imprudentes*, and *idiotae*, "simple, naive," "foolish, ignorant," "layman, amateur," respectively. See *OLD* 1764-65 (s.v. "simplex" 8.b), 853 (s.v. "imprudens" 1), 820 (s.v. "idiota" 1).

Galen, *On the Affections and Errors of the Soul* 2.3 (= Kühn 5.71): *tois epitugchanousin anthrôpois* literally translates "the men chanced upon," which in context indicates the average man you would meet if you just grabbed someone at random. Notably, all of Galen's examples (*aipolois*, "goatherds"; *boukolois*, "cowherds"; *skapaneusi*, "diggers"; and *theristais*, "reapers, harvesters") are agricultural, but these would still have been the most common occupations in antiquity, even among men who would be wandering around town during the day. Galen says such men are *agumnastoi*, lacking an education of the *gymnasia*, but in context he clearly means lacking any education at all.

Galen, *On the Therapeutic Method* 1.1.5 and 1.3.2.

Pliny the Elder, *Natural History* 25.6.16 (where *agrestes* are *litterarum ignari*); Ptolemy, *Tetrabiblos* 1.2.7-8 (*geôrgos* and *nomeus*).

Quintilian, *Education in Oratory* 1.1.

Cicero, *On the Republic* 1.15.23-24.

Several times Quintilian refers to the assumed illiteracy of the lower classes (e.g. *Education in Oratory* 2.20.6, 2.21.16, 10.3.16, 12.10.53).

Netz 2002: 201-09.

See also Rihll 2002: 12-21 who discusses how various aspects of the education system limited the number of scientists in all eras of antiquity, though she comes to no definite conclusion as to numbers.

Nutton 2004: 153.

At the other extreme, Collins 1998: 76-77 estimates the number of 'significant philosophers' (those responsible for major innovations) at no more than thirty in any given century, but his methods rely on extant literature, which can only have resulted in an undercount.

Chapter 3

What They Were Taught

This chapter's analysis draws on the findings and conclusions developed in Cribiore 2001 and corroborated in the scholarship that will be cited in more specific detail as the occasion arises. For a brief yet broad survey of ancient education see *OCD* 487–91 (s.v. "education, Greek" and "education, Roman") and König 2009. Marrou 1964, once the standard resource, has been updated considerably: see Too 2001 and Pailler & Payen 2004 (which also includes a bibliography of books on ancient education published after 1964 on pp. 361-68), as well as Wolff 2015 and Sandnes 2009: 16-39; and Bloomer 2011 (for imperial education in Latin). A handy if eclectic collection of sources on ancient education is also provided in Joyal, McDougall, and Yardley 2009.

Diocletian's *Edict on Maximum Prices (EMP)* 7 (some of which is in Lewis & Reinhold 1990: 2.425-26; with relevant discussion in Harris 1989: 308).

For a general introductory discussion of ancient "higher" education, including rhetoric, philosophy, and the *enkyklios paideia*, and the ages of students embarking on it, see Kleijwegt 1991: 116-23.

Morgan 1998: 3, 6.

Problems with Latin vocabulary: Pliny the Younger, *Letters* 4.18; Pliny the Elder, *Natural History* 2.13.63; Lucretius, *On the Nature of Things* 1.136-39, 1.830-33, 8.258-60; Quintilian, *Education in Oratory* 8.3.33; Cicero, *On the Boundaries of Good and Evil* 3.51 and *Tusculan Disputations* 2.35. For qualifications and discussion of this point see Fögen 2000, Brunschwig 2002, Dufallo 2005, and (most importantly) Ostler 2007: 118-219.

Bilingualism and multilingualism in antiquity: Mullen & James 2012. See, for example, the casual observations of Quintilian, *Education in Oratory* 1.1.12-14. Adams 2003, and Adams et al. 2002 provide detailed discussion (superseding Horsfall 1979, whose evidence is mostly pre-empire and whose analysis ignores comparative studies of modern bilingualism). For further context and bibliography: *OCD* 231–32 (s.v. "bilingualism"). And

on the Roman adoption of Greek-style education in general: Wallace-Hadrill 1983: 26-49.

Ancient technical dictionaries: Horsfall 1979: 81-82; Witty 1974.

Rawson 1985: 98.

Quintilian, *Education in Oratory* 1.12.6.

Marrou 1964: 372-88, with 592-94 notes 11-17 (= Marrou 1956: 254-64, 426-27); also argued in Greene 1994: 30 and documented (though with excessive rancor directed at the pre-Christian period) in Stahl 1962 and 1971, and more soberly in Diederich 1999.

Decline in the middle ages: Clagett 1955: 146-67. Pliny's accuracy: French & Greenaway 1986; Healy 1999. Isidore and Boethius: *DSB* 2.228-36 (s.v. "Boethius, Anicius Manlius Severinus"), *OCD* 238 (s.v. "Boethius, Anicius Manlius Severinus"), and *EANS* 195 (s.v. "Anicius Manlius Seuerinus Boëthius"). For similar examples of consequent decline in the same period see Beagon 1992: 52-53, and Stückelberger 1988: 111-26, 179-84.

On the role in all this of a declining Latin-Greek bilingualism see Ostler 2007: 58-104, 203-04, 211-12, 246-49.

Chapter 4

Lower Education

On ancient primary and secondary education in general see Kleijwegt 1991: 75-91 and Cribiore 2001.

Eusebius, *Preparation for the Gospel* 11.7.10.

Plutarch, *How the Young Man Should Study Poetry* (= *Moralia* 14e-37b).

Ps.-Plutarch, *On the Training of Children* 10 (= *Moralia* 7c-8a; moral philosophy: 7d-f; political philosophy: 8a).

Cribiore 2001 documents the obsessive focus on reading and writing (on numeracy: 180-83). On the Roman *calculator* (arithmetic teacher) see Clarke 1971: 46-47 and Marrou 1964: 599-600 n. 13 (= 1956: 431).

Math education: Cuomo 2000: 46-47. On mathematics in Roman education generally see: Marrou 1964: 265-79 (= 1956: 176-85) and Rawson 1985: 156-69. For the broader context of the place of mathematics in the early Roman empire see Cuomo 2001: 143-211; and for the evident widespread need of basic numeracy and practical and applied mathematics in civic life (for which its inclusion in general education must have been essential) see Karin Tybjerg's survey in Oleson 2008: 777-84. Even just the process of paying one's taxes required it: see e.g. Wallace 1938 and Nelson 1983. As well as the ubiquitous employment of coinage, weights and measures: Oleson 2008: 759-77.

On the role of physical gymnasia as both schools and social institutions in the Hellenistic and Roman world see Brenk 2007, König 2005: 45-72, Kah & Scholz 2004 (esp. 103-28), Gauthier 1995, Delorme 1960: 316-36, and Forbes 1945. On the subject of school buildings in general, see summary in König 2009: 392-95 and König 2005: 45-49; on the Christian use of private homes for churching and teaching see MacMullen 2009: 1-10.

On the social status of teachers: Harris 1989: 236-38. See Robinson 1921 for a still-useful survey of literary evidence for the social and economic status of Roman schoolteachers; and Laes 2007 for epigraphic evidence (Kaster 1988 treats both but only for late antiquity). Most recently on their lives and social and economic status: Maurice 2013.

Science inadequacy of lower level teachers was observed by Morgan 1998: 3.

Quintilian, *Education in Oratory* 1.4-9 and 2.1.

Quotation of Thrax: Cribiore 2001: 185, quoting Dionysius Thrax, *Greek Grammar* 1.1 (c. 100 B.C.).

Asclepiades of Myrlea (1st century B.C.) via Sextus Empiricus, *Against the Professors* 1.91-94 and 1.252-53.

Material principally from Cribiore 2001. See also Morgan 1998.

On Aratus see Gain 1976 and Taub 2003: 51-54 and 2010; *DSB* 1.204-05 (s.v. "Aratus of Soli"); *OCD* 132 (s.v. "Aratus (1)"); *EANS* 123-24 (s.v. "Aratos of Soloi"). Numerous commentaries on the poem were produced (e.g. cf. Maass 1958).

Clement of Alexandria, *Stromata* 1.19, discussing Acts 17:28.

On the recovered school commentary on Aratus: Cribiore 2001: 142-43, 202; Clarke 1971: 49-51; Bonner 1977: 78; Rawson 1985: 167; Marrou 1964: 273-74, 570 notes 11-12 (= Marrou 1956: 408).

On the possibly rarity of Aratus in lower education: Morgan 1998: 43, although Morgan's source (Haarhoff 1920) is obsolete and pertains principally to the wrong period and place.

OCD 461 (s.v. "Dionysius (9) 'Periegetes'") and *EANS* 261-62 (s.v. "Dionusios of Alexandria, Periegetes"). On *Gem Lore* and *Bird Lore* (among other works, cf. *EANS* 263-64, s.v. "Dionusios of Philadelpheia" and 259, s.v. "Dionusios (Lithika)," etc. *passim*).

On the role of scientific poetry see see Taub 2008.

On the aim of using of education to separate the elite from the *hoi polloi*, see Whitmarsh 2001: 96-108.

Varro's head shepherd: Harris 1989: 256; referencing Varro, *On Agricultural Matters* 2.2.20.

On pricing the ancient cost of books: Harris 1989: 195, 224-25 (corroborated by Hezser 2001: 145-46; whereas Winsbury 2009: 19-23 greatly underestimates this cost). Four to five drachmas equals 24 to 30 obols. The ancient equivalent of a 'minimum wage' was three obols per day (more or less—there was no fixed standard, cf. *OCD* 1567, s.v. "wages"). As of 2009 the federal hourly minimum wage in the U.S. was $7.25 and the standard full-time work-day consisted of eight hours, for $58 per day. So the modern social equivalent of one obol is in the vicinity of $19. Four or five drachmas thus approximates the value that $450 to $570 would have had to the average U.S. household in 2009, which multiplied by five makes $2250 to $2850, which is well over $2000. Books in codex form were less expensive, but not by enough to make much difference to the present point. Skeat 1982 argues a cost savings of 26%, and though many elements of his estimates and math are questionable (e.g. he greatly underestimates the number of lines that fit in a standard roll), even granting his conclusion would entail a $2000 book could be got for around $1500, hardly a discount of use to the average citizen. Moreover, Skeat fails to count the added expense of binding the codex (whereas this cost is already included in the cost of papyrus rolls, which came pre-bound), so even on his own assumptions his estimated discount is too high (since binding books requires professional skill, as well as considerable time and a variety of materials). And *fine* codices even cost more than scrolls (Nicholls 2010).

See evidence and sources in Millard 2000: 165, who estimates that copying cost "six to ten" drachmas per roll, which is 30 to 50 drachmas (120 to 300 obols) for a five-chapter book, adding as much as $2000 to $6000. Thus even a small book could cost the equivalent of $4000 to $8000. See also Richards 2004: 165-70 who corroborates Millard; and see Cribiore 2001: 146-59 for a detailed discussion of the cost of books vs. more casual writing materials (such as for making notes and sales receipts). On other issues pertaining to the cost and difficulty of procuring books see Marshall 1976, Oleson 2008: 715-39, White 2009, Winsbury 2009, and Bagnall 2009: 256-81.

See also Rowland & Howe 1999: 1 and Cribiore 2001: 146-47. And Starr 1990. For overall context see *OCD* 239–43 (s.v. "books, Greek and Roman," "books, poetic," and "books, sacred and cultic").

On having slaves as teachers: Cribiore 1996.

Aulus Gellius, *Attic Nights* 9.4.1-6. Assuming an average of six books of five rolls each, or thirty rolls, and assuming "a few bronze" as something in the vicinity of half a drachma, that would equal about $110, for an amazing discount of one sixtieth the cost of the papyrus alone. Though some scholars doubt the account of this sale, even as fiction the prices, condition, and buyer's reaction were probably realistic (as most good fiction aims to be).

On the Second Sophistic see Bowersock 1974 and 2002, Anderson 1993, Whitmarsh 2005 and 2013, Schmidt & Fleury 2011, and *OCD* 1337–38 (s.v. "Second Sophistic"). See von Staden 1995 and Brunt 1994 for it's relevance to Roman science.

Rabanus Maurus, *Homilies* 42.

Oral lectures: Mudry 1986. On the full range of popular sources of oral (and visual) education (mostly political, mythical, and religious in content) see Meggitt 2010: 56-61, 68-70 (with Toner 2010).

Galen, *On My Own Books* Kühn 19.19, 19.21; see also the (possibly) related remark in Galen, *On Venesection against the Erasistrateans at Rome* Kühn 11.194. On the library there, built by Vespasian (in 75 A.D.): Staikos 2000: 111. This library was accidentally destroyed by fire later in Galen's life (along with his personal collection of books and notes: Galen, *On Conducting Anatomical Investigations* 11.12; and now *On Escape from Grief*, on which: Nicholl 2011, Jones 2009, and Tucci 2008), which would have been around the dawn of the 3rd century. Whether it was restored is unknown.

For sources and scholarship on public lectures see Tountas 2009.

Dio Chrysostom, *Discourses* 33.4-6.

Delphic astronomy professor: König 2005: 50.

Regular people attending lectures: Galen, *On the Affections and Errors of the Soul* 2.2 (= Kühn 5.64-66).

Juries drawn from the people: Quintilian, *Education in Oratory* 12.10.53. Geometry and science in court: Quintilian, *Education in Oratory* 1.10.36 (see also Cuomo 2001: 4-5, 20-21, 215-17 and Campbell 2000: xxix, xxxvi).

OCD 1089–90 (s.v. "pathology"). On medicine as an issue in court see Amundsen 1978 and 1979, who claims the legal system in Roman Egypt may have been unique in employing doctors forensically (as he proves it did do), but he presents no evidence it was in fact unique there, nor is there any reason to believe it would be.

Chapter 5

The Enkyklios Paideia

Strabo, *Geography* 1.1.22.

On frequency of attending: Clarke 1971: 6-7. As witnesses Clark references Quintilian (late 1st century, early 2nd century A.D.), Dionysius of Halicarnassus (late 1st century B.C.), Aelius Theon of Alexandria (1st century A.D.), Lucian of Samosata (2nd century A.D.), and Galen (late 2nd century A.D.), to which we can add the remarks of Aulus Gellius (*Attic Nights* 1.9.6-7). Galen often complains of ignorance of advanced mathematics among his peers (e.g. Iskandar 1988: 158, §P.68,14-15, though one could just as easily remark upon the same popular ignorance of geometry and trigonometry today, the very subjects Galen means). Many students nevertheless did study the full curriculum: Clarke 1971: 7, 111; Bonner 1977: 78; Marrou 1964: 265-79, 372-73 (cf. 1956: 183-84); Rawson 1985: 4-5 (and examples below). For a partial survey of some of the scientific content of this curriculum see Marrou 1964: 265-79, 372-73, 410. For general discussion of the content and status of the

enkyklios (especially in the Roman period) see Stahl 1971: 90-99; Bonner 1977: 77; Rawson 1985: 156-57; J. Barnes 1988; Russell 1989; and Doody 2009.

Stahl 1962 and 1971 documents a decline in the quality of this education in Latin schools during and beyond the 4th century, although he over-exaggerates the quality of this education *before* the Roman period. As we shall see in a moment, however, Stahl's claim that "the only people who seriously promoted the study of all seven liberal arts were philosophers" is false (Stahl 1971: 91). Most philosophers did have a special interest in the mathematical and scientific content of the *enkyklios*, but so did the most noteworthy professors of rhetoric.

Nicomachus of Gerasa, *Introduction to Arithmetic* 1.3.4. For background see *OCD* 1014 (s.v. "Nicomachus (3)"), *DSB* 10.112-14 (s.v. "Nicomachus of Gerasa"), and *EANS* 579 (s.v. "Nikomakhos of Gerasa"). A Latin edition of this was produced by Apuleius in the 2nd century (cf. S.J. Harrison 2000: 31-32). On a possible planned astronomy textbook of Nicomachus: D'Ooge et al. 1926: 81-82. Archytas: *DSB* 1.231-33 (s.v. "Archytas of Tarentum"), *OCD* 145 (s.v. "Archytas"), and *EANS* 161-62 (s.v. "Arkhutas of Taras").

On efforts to classify medicine as a liberal art see Kudlien 1976, but the idea is most eloquently voiced in Plutarch, *Advice on Keeping Well* 1 (= *Moralia* 122d-e).

Drawing: Aristotle, *Politics* 8.2.1337b. See also: Pliny the Elder, *Natural History* 35.36.77; Plutarch, *Life of Aemilius Paullus* 6.5; and probably Varro, cf. Rawson 1985: 193, 198.

Galen is describing a Greek's education in *Advice for an Epileptic Boy* 2-5, which simply assumes a student went to gym class, whereas we find some distaste for gymnastics in the Latin author Quintilian (as we'll soon see). On the issue of athletics in ancient education in general see König 2005 and Petermandl 2014.

Ancient algebra is discussed in Christianidis & Oaks 2013 and Derbyshire 2006: 31-42; see also *DSB* 4.110-19 and 15.118-22 (s.v. "Diophantus of Alexandria"), *EANS* 267-68 (s.v. "Diophantos of Alexandria"), and *OCD* 465 (s.v. "Diophantus"), which correctly dates him "between 150 BC and AD 280," hence probably Roman-era. A good case for dating Diophantus to the 1st century A.D. is presented in Knorr 1993 and Russo 2003: 322-23 (esp. n. 230).

Some basic principles of algebra might date as far back as the 4th century B.C., cf. *DSB* 13.399-400 (s.v. "Thymaridas") and *EANS* 808-09 (s.v. "Thumaridas (of Paros?)"). Similarly, while basic principles of trigonometry were already developed as early as the 3rd century B.C., plane and spherical trigonometry were fully formalized by Menelaus in the 1st century A.D., cf. *DSB* 9.296-302 and 15.420-21 (s.v. "Menelaus of Alexandria"), *EANS* 546 (s.v. "Menelaos of Alexandria"), and *OCD* 932 (s.v. "Menelaus (3)"), as well as *OCD* 1507 (s.v. "trigonometry"), with analysis in Russo 2003: 52-55 and Van Brummelen 2009 and 2013. (Modern systems of trigonometry and algebra are entirely different, as both sciences were all but forgotten and had to be reinvented, this time by medieval Indians and Muslims respectively, who improved both before diffusing them to the West. But the ancient systems still worked and achieved the same basic goals.)

Hein 2012. On ancient combinatorics see: *DSB* 15.220 (in s.v. "Hipparchus") with Russo 2003: 281-82, Netz 2003: 283-84, Netz, Acerbi & Wilson 2004, Netz & Noel 2007: 54-59, 233-60, Bobzien 2011, and the bibliography in *DSB* 15.223-24 (even Plutarch was aware of combinatorics: Plutarch, *Tabletalk* 8.9 = *Moralia* 732f-733a). On ancient logistics and other mathematical fields see: Geminus (1st century B.C./A.D.) as paraphrased in Proclus (5th century A.D.), *Commentary on the First Book of Euclid's 'Elements'* pr.1.13.38-42, with translation and commentary in Evans & Berggren 2006: 43-48, 243-49. On isoperimetry see: *DSB* 14.603-05 (s.v. "Zenodorus"), *OCD* 1588 (id.), and *EANS* 845 (s.v. "Zenodoros").

Isoperimetry: Quintilia, *Education in Oratory* 1.10.39-45. Campbell 2000: 12-13. Cuomo 2000: 57-90. Aristotle, *Posterior Analytics* 1.13.79a.

Role of geometry: Vitruvius, *On Architecture* 1.1.4, 1.1.7, 1.1.16.

Musicology: Morgan 1998: 35; cf. Vitruvius, *On Architecture* 1.1.8-9. That many among the elite had received such an education in the science (and not merely the craft) of music is shown in Barker 1994: 59-60, and (though less thoroughly) in Vendries 2004; note that Vendries incorrectly believes there is no evidence "of an anticipation of

the *trivium*...and the *quadrivium*" in the early Roman period, a conclusion refuted by evidence in our present chapter, as well as by the survey in Stückelberger 1965: 32-44, 46-52 and comments in J. Barnes 1988: 56-57.

On the actual content of astronomy taught in the encyclical curriculum see Evans & Berggren 2006: 8-12 (and for a textbook applying astronomical science to the philosophy of cosmology around the same time see Bowen & Todd 2004).

Varro's encyclopedia: known in Latin as the *Disciplinae* or the *Disciplinarum Libri IX*. Although this appears to have been the first such book in Latin, it was certainly not the first time Romans were exposed to these subjects, since their bilingual elite had already been familiar with Greek education—many had even studied in Greece—for a century or more before Varro wrote. See Stahl 1971: 96 (and 7: n. 11); Clarke 1971: 2; and *DSB* 13.588-89 (s.v. "Varro, Marcus Terentius"), *OCD* 1441 (s.v. "Terentius Varro, Marcus"), and *EANS* 774-78 (s.v. "M. Terentius Varro of Reate"). A Latin epitome (or inferior plagiarization) of Varro's encyclopedia may have been produced in the mid-3rd century by Censorinus, of which fragments survive (see *DSB* 3.175-76, s.v. "Censorinus," *OCD* 296, id., and *EANS* 212, s.v. "Censorinus (II)"). See also: Stahl 1971: 44-53; Rawson 1985: 158-59.

Evidence of considerable knowledge and interest in medical science among educated laypeople in the Roman period is surveyed in Nutton 1985 and 2004: 252-53 (with Ballér 1992 and Durling 1995). Note that an encyclopedia of the arts superior to Varro's was produced a century later by Aulus Cornelius Celsus, which also included medicine as a subject. We're not sure of the full range of subjects this treated (we have only scattered hints in Quintilian, *Education in Oratory* 12.11.24, and Columella, *On Agricultural Matters* 1.1.14), but its treatment of medicine is rather superb: see *DSB* 3.174-75 (s.v. "Celsus, Aulus Cornelius"), *NDSB* 2.81-84 (s.v. "Celsus, Cornelius (Aulus)"), *OCD* 377 (s.v. "Cornelius Celsus, Aulus"), *EANS* 217-19 (s.v. "A. Cornelius Celsus"), with Scarborough 1970: 298-302. For a comparative analysis of the encyclopedic works of Cato, Varro, Celsus, and Pliny, see Doody 2009.

Suetonius, *Virgil* 15.

For some examples of Galen's inclusion of engineering in an ideal education and of his own considerable knowledge of the subject see Galen, *On the Affections and Errors of the Soul* 2.2-5 (= Kühn 5.64, 5.68-5.69, 5.80-5.91). Galen's effort to promote a full encyclical education is also reflected in his treatise *Exhortation to Study the Arts*.

Plato, *Republic* 7.525a-531e (and see Stahl 1971: 90-98). On the enormous advances in these sciences after the era of Plato and Aristotle, continuing into the Roman period, see Carrier 2010, Russo 2003, and Rihll 1999. I will treat the subject in some detail in *The Scientist in the Early Roman Empire*.

Aristotle, *Nicomachean Ethics* 6.8.1142a.

Quadrivium in philosophy schools: Bonner 1977: 78-79; Clarke 1971: 3-5.

Plato, *Republic* 7.525a-531d and 531e-532d.

Science in ancient education is briefed in Marrou 1981: 193-95. But corrected by Demont 2004 with respect to the earlier argument in Marrou 1964.

Quotes from Poulakos 1997. Like Poulakos, Hutchinson 1988 also produces a more accurate analysis of how Plato, Isocrates, and Aristotle *really* differed (and as often agreed) on the purpose, process, and ideal content of education. Wareh 2012 argues that ongoing debates between Isocrateans and Platonists produced this alignment of interests.

Isocrates, *Antidosis* 261-69.

IQ argument: see discussion and sources in Cheyne 2010.

Isocrates, *Panathenaica* 26-32.

Seneca, *Moral Epistles* 88 (fully analyzed in Stückelberger 1965 and more briefly in Kidd 1988: 359-65).

Cicero, *On the Republic* 1.18.30.

Seneca, *Moral Epistles* 88.36-41 (with other parallels to Isocrates in 88.2 and 88.29-30). See Stückelberger 1965: 46-52.

Galen, *On the Doctrines of Hippocrates and Plato* 9.7.9-9.9.14.

Views of education in antiquity: Morgan 2011.

Isocrates, *Panathenaica* 12 and *Antidosis* 130-36, 174, 285.

Bonner 1977: 65-66.

On Cicero's educational views see Bonner 1977: 81-89.

Cicero, *Brutus* 44.10.

Cicero, *Orator* 15.3 (citing Plato, *Phaedrus* 269e).

Cicero, *Orator* 119.6 (see also *On the Orator* 1.20, 1.72 and 2.5).

On Plato as earliest to divide philosophy into three branches: Dillon 1993: 57.

Cicero, *On Divination* 2.30.2-11.

Cicero, *On Invention* 1.8; *On the Orator* 3.107-10.

Gwynn 1926: 101; cf. Cicero, *On the Orator* 1.10.44-1.18.84.

Cicero, *On the Orator* 1.53-57, 2.65-70.

Cicero, *On the Republic* 5.5.14 and *On the Orator* 1.15.65-1.18.84.

Strabo, *Geography* 1.1.20-22; Vitruvius, *On Architecture* 1.1.11-18.

Tacitus, *A Dialogue on Oratory* 30-32.

Quintilian, *Education in Oratory* 1.10-12.

Cicero, *On the Orator* 1.16.72-73.

See discussion in Cuomo 2000: 47-48 (Quintilian) and Cuomo 2001: 187-88 (Galen).

Astronomy: Quintilian, *Education in Oratory* 1.10.46-48; cf. also 1.4.4. The division of astronomy into its mathematical and physical aspects is a phenomenon I'll discuss in *The Scientist in the Early Roman Empire*, but may have been influenced by the fact that the mathematics could be taught by a geometrician aiming foremost to teach abstract principles while the astrophysical part could be taught by an astronomer aiming foremost to teach specific facts and practices. That both aspects of astronomy were nevertheless a common part of education is further implied by Cicero in *On the Orator* 1.35, 1.128, 1.149, 1.158, 1.187, 2.28. The same implication follows from Seneca's remarks in *Moral Epistles* 108.1, 114.10-19, 115.1 (and most of epistle 88).

Compare Aristotle, *Politics* 8.2.1337b.

Philo of Alexandria, *On Mating with the Preliminary Studies* 3.9-11, 4.14-18, 14.74-79 (throughout he explicitly

names only six of the standard seven, omitting arithmetic, but he adds arithmetic to geometry and harmonics in *On the Special Laws* 2.32.200 and *On the Creation of the World* 37.107); and Philo, *On Agriculture* 3.14-4.20 (which also adds natural, moral, and dialectical philosophy in making the same point; cf. also Philo, *On the Change of Names* 10.70-76). In *Mating* Philo uses the 'handmaiden' theme to produce allegorical interpretations of various biblical passages and stories, especially Abraham's 'conjugal' relations with Sarah and Hagar. For more on Philo's views see chapter nine (I will further explore his views in *Scientist*, where I shall also discuss how Philo's 'handmaiden' idea was later adapted by Christians to subordinate the whole of philosophy to the gospel, which is also touched on briefly here in chapter nine).

Enkyklios: Cicero, *On the Republic* 1.15.24-1.16.25. Examples of others lauding its value to the state: Valerius Maximus, *Memorable Deeds and Sayings* 11.1; Plutarch, *On Superstition* 8 (= *Moralia* 169a-b).

Frontinus, *Stratagems* 1.12 (seven examples involve manipulating the superstitions of soldiers (§ 1, 2, 4, 5, 6, 7, 12); three examples are of using science lessons to the same end (§ 8, 9,10)).

Philo of Alexandria, *On Mating with the Preliminary Studies* 14.74-79. See Sandnes 2009: 68-78.

On encyclical education see Clarke 1971: 47-49.

Nicolaus of Damascus, *FGrH* (*Die Fragmente der griechischen Historiker*) 90.F132 (= Suda, s.v. "Nikolaos" [*nu* 393]).

Cribiore 2001: 180-84.

On the use of sandboxes in geometry: Clarke 1971: 51-52; Bonner 1977: 77; cf., e.g., Seneca, *Moral Epistles* 88.39. Other educational aids: Lucian, *Nigrinus* 2; on the use of similar spheres in education see Clarke 1971: 52; elaborate armillary spheres for use in their lectures (e.g. Theon of Smyrna, *Aspects of Mathematics Useful for Reading Plato* 3.16.146; I'll discuss the use and manufacture of such advanced instruments in *The Scientist in the Early Roman Empire*).

Rural evidence vs. urban: Morgan 1998: 7.

Aulus Gellius *Attic Nights* 1.9.6-7; Quintilian, *Education in Oratory* 1.12.16-18 (with 1.10.3-8); Galen, *On the Uses of the Parts* 10.12 (= May 1968: 490, 492). See Netz 2002: 210-13 on Polybius as a counter-example.

Plutarch, *On Listening to Lectures* 2 (= *Moralia* 37f).

Plutarch, *On Listening to Lectures* 10 (= *Moralia* 43a-b).

Chapter 6

Higher Education

That law was the primary purpose of rhetoric schools is most forcefully argued in Parks 1945, who also advances a useful running counter-argument against more negative assessments of the 'Second Sophistic' (on which see also notes in chapter four). For a full survey of the aims and content of an ancient education in rhetoric see Gunderson 2009, Morgan 2007, and Wouters 2007 (supplemented by Panella 2011-2012, Walker 2011, and Brodie 2004: 2-79). And on law as a profession (for which one certainly needed an education) see Kleijwegt 1991: 165-86.

Eumenius, *For the Restoration of the Schools* (= *Latin Panegyrics* 9), regarding the school at Autun, Gaul, c. 298 A.D. (after the devastating events of the 3rd century). See Cribiore 2007 for similar evidence in Lucian and Libanius. On the evidence of Eumenius: La Bua 2010.

Level of advancement vs. dropping out: Cribiore 2001: 220-44 and Marrou 1981.

Seneca, *Natural Questions* 4a.pr.14.

Lucian's view: See Cribiore 2007.

Curriculum in Greek: Cribiore 2001: 225-38, 231-44. In Latin: See Quintilian, *Education in Oratory* 1.8.5-12, and 10.1, where the emphasis is on poets, orators, and historians, in that order—though he does include some philosophy, that would not have been common.

Science content: Cribiore 2001: 144.

Quote: Marrou 1956: 254 (= Marrou 1964: 372).

Ben-David 1984: 42 (though his use of the term "institutions" here may be a bit anachronistic).

Cribiore 2001: 3.

Apuleius, *Florida* 20 Diodorus Siculus, *Historical Library* 2.29.5-6.

Middle Ages: Beaujouan 1963 (with relevant discussion in subsequent scholarship on medieval universities cited here in previous notes).

Critical mass theory: Essentially argued in Rihll 2002: 12-15, Collins 1998: 523-69, Crombie 1963: 9, and Edelstein 1952: 598-99 and 1963: 30-32 (although see my estimate of numbers in chapter three; I'm unaware of any comparable estimate attempted for the Middle Ages or the Renaissance). I will discuss this theory further in *Scientist*.

On the myth of theory-practice myth between Greeks and Romans: Marrou 1964: 274-77 (= Marrou 1956: 182-84) and Grant 1952: 78. Compare Gwynn 1926: 18-92 and Eyre 1963 with Marrou (1965: 410 = 1956: 282), LeHoux (2012: 2-8), and Cuomo (2001: 192-211).

Lack of science content in education during the Roman Republic: Rawson 1985: 156-69, 287-88.

Complaining about bad teachers: see Tacitus, *A Dialogue on Oratory* 29 (discussed in chapter five) and Galen, *On My Own Books* Kühn 19.9. The latter is certainly hyperbolic, since Galen asserts that Greeks "always" used to be taught letters and grammar, which was certainly never the case.

Bonner 1977: 102-03.

Cribiore 2001 for quotes and content regarding rhetoric school content.

Quintilian, *Education in Oratory* 12.2.4, ibid. 12.2.10, and 1.pr.16.

Quintilian, *Education in Oratory* 12.2.20-23.

Aelius Theon of Alexandria, *Preliminary Exercises* 2.69 (see Bonner 1977: 83). For other examples of medical science in rhetorical exercises see Gibson 2013 and Ferngren 1982 (esp. pp. 280-81). And see my discussion of juries in chapter four.

Importance of science and natural philosophy in rhetoric schools: Quintilian, *Education in Oratory* 1.pr.16-18.

Chapter 7

Advanced Education

The two school tracks, rhetoric and philosophy, as options in antiquity: Morgan 1998: 193; Bonner 1977: 82-83.

Eclecticism: See Dillon & Long 1988 (briefed in *OCD* 483, s.v. "eclecticism"); Gottshalk 1987: 1164-71. The best ancient example is the Roman doctor Galen, *On the Affections and Errors of the Soul* 1.8 (= Kühn 5.42-43; also 2.6-2 = Kühn 5.96-103); on which see Hankinson 1992. The Roman astronomer Ptolemy was likewise an eclectic (Huby & Neal 1989; Long 1988), as was the Roman engineer Hero (Tybjerg 2005). Other good examples of this principle being expressed by Roman intellectuals include Seneca, *Moral Epistles* 33 and Celsus, *On Medicine* pr.45-47. This trend became so popular among Romans that an actual 'Eclectic' sect was formed in the reign Augustus (at the end of the 1st century B.C.): see *OCD* 1199 (s.v. "Potamon (2)"), *EANS* 693 (s.v. "Potamon of Alexandria"), and Diogenes Laertius, *Lives and Opinions of Eminent Philosophers* 1.21.

On the comparable attitudes of all these sects toward the *enkyklios*: Rawson 1985: 182. On Hellenistic developments in the demarcation and popularity of philosophical sects leading into the Roman era: *OCD* 657-58 (s.v. "Hellenistic philosophy").

The standard Stoic curriculum in natural philosophy is summarized in Diogenes Laertius, *Lives and Opinions of Eminent Philosophers* 7.38-160 and partly reflected in Seneca's *Natural Questions*. See also Sellars 2006, Evans & Berggren 2006: 23-27, Inwood 2003, Morford 2002: 161-239, Stückelberger 1988: 35-38, and Edelstein 1967: 137-38, 145, 167-78; along with *OCD* 1403-04 (s.v. "Stoicism").

Platonist curriculum is illustrated by the textbooks on the quadrivium by Nicomachus (see note in chapter five) and remarks in Roman-era introductions to Platonism, like Alcinous, *Epitome of Platonic Doctrine*. See also Kalligas 2004, Joost-Gaugier 2006, Remes 2008, Gerson 2013, and *OCD* 1007-08, 1155-58, 1245-46 (s.v. "Neoplatonism" and "Neopythagoreanism"; "Plato (1)" and "Platonism, Middle"; and "Pythagoras (1), Pythagoreanism"). However, on the probable obsolescence of the "Middle" and "Neo" terminology: Catana 2013. On the role and influence of Pythagorean thought in Roman-era Platonism: Joost-Gaugier 2006.

This is readily apparent in the pervasive body of Aristotle's works that remained in circulation (and not only his own, but those of his pupils and successors), many of which survive to this day. See also Boylan 1983, Gottschalk 1987, J. Barnes 1995: 105-67, Falcon 2013, *OCD* 1108 (s.v. "Peripatetic school"), and *EANS* 142-45 (s.v. "Aristotle"), cf. also *EANS* 145-53.

Epicureans and science: See O'Keefe 2010, Warren 2009, Di Muzio 2007, Asmis 2004 (with Too 2001: 209-39), Ferguson & Hershbell 1990, and Edelstein 1967: 135-37, 160-65 and 1952: 594-96, as well as *OCD* 513-14 (s.v. "Epicurus") and *EANS* 287-89 (s.v. "Epicurus of Samos"). Exactly how much science Epicureans taught is a vexed question, but a general idea of its content in the Roman period is probably reflected in Lucretius, *On the Nature of Things*, though there were always exceptional Epicureans who studied more than the school required (including advanced mathematics, a fact I shall examine in *Scientist*).

Skeptics and science: All this is evident from the extant collected writings of Sextus Empiricus and the philosophical essays of Cicero, although Skeptics disagreed with each other on what to teach regarding the sciences: Edelstein 1967: 165-67. I will treat the relationship between ancient Skeptics and science in more detail in *Scientist*.

Cynics: See Desmond 2008 with *OCD* 402-103 (s.v. "Cynics") and Edelstein 1967: 58-63.

Socrates on science: Xenophon, *Memorabilia* 4.7; cf. Prince 2006 and McKirahan 1994.

Aulus Gellius, *Attic Nights* 1.9.6-8.

Plutarch, *On Listening to Lectures* 11 (= *Moralia* 43c).

Ethics and science inseparable: For example, Cicero, *On the Boundaries of Good and Evil* 5.20.57; Maximus of Tyre, *Orations* 6, 10, 13, and 27; and it's a repeated theme in Seneca's *Natural Questions* and Galen's *On the Errors and Affections of the Soul*.

On the epistemological purposes behind Ptolemy's *Optics* see A. Smith 1999 and LeHoux 2012 (esp. 106-32); for his extant treatise on epistemology, see Huby & Neal 1989. Sextus the Pyrrhonist, author of *Against the Logicians* in two volumes (= *Against the Dogmatists* 1-2 = *Against the Professors* 7-8), was also a medical scientist of the Empiricist school: *OCD* 1358-59 (s.v. "Sextus Empiricus"). Hero, to give just one example, produces a formal proof of his theorem of least action to explain the laws of reflection in his *Katoptrics*. And Galen's *Institutio Logica* remains the only real textbook in formal logic to survive from the Roman period (on this and his other writings on logic see Morison 2008).

See Epictetus, *Discourses* 1.7, with Crivelli 2007 and Long 2002: 149-52.

J. Barnes 1997: 126.

Stoic interest in physics: Barker & Goldstein 1984.

Galen, *To Thrasybulus* 22 (= Kühn 5.843); *On the Affections and Errors of the Soul* 2.3, 2.5 (= Kühn 5.69-71, 5.91); *On My Own Books* Kühn 19.9, 19.52; *That the Best Doctor Is Also a Philosopher* 2 (= Kühn 1.57); *On the Sects for Beginners* 6.14-15 (see Walzer & Frede 1985: 10-11 and Hankinson 1994: 1781-82). On quack engineers: Vitruvius, *On Architecture* 6.pr.6-7.

Strabo, *Geography* 2.5.1-2 (cf. 1.1.13).

Cuomo 2001: 178-80.

Kudlien 1970: 20.

Galen, *That the Best Doctor Is Also a Philosopher* 3-4 (= Kühn 1.60-63); mathematics and astronomy: ibid. 1 (= Kühn 1.53-54).

Astronomy needed by doctors: Argued in Galen's *Commentary on Hippocrates' 'Airs, Waters and Places'*.

Professional standards: For example, Vitruvius, *On Architecture* 1.1.4 and 6.pr.5-7 (see also Rowland & Howe 1999: 13; Goguey 1978; and Galen, *On the Affections and Errors of the Soul* 2.3 = Kühn 5.68-69).

Education of midwives: Soranus, *Gynecology* 1.3-4.

Astronomers and surveyors expected to be educated: Xenophon, *Memoirs* 4.2.10.

Architect of the Mausoleum's book: For sources and discussion on the contents of this lost work see *OCD* 1247 (s.v. "Pythius") and *EANS* 712 (s.v. "Putheos of Priene"). See also Cuomo 2001: 170-73.

Columella, *On Agricultural Matters* 1.pr.3, 1.pr.5.

Columella, *On Agricultural Matters* 1.pr.22-24 (and cf. 1.pr.32).

Theory generates respectability: As argued, for example, in Barton 1994a, Pearcy 1993, and von Staden 1997.

Methods of instruction: Cribiore 2001: 145-46; on all fields in the Roman period see "Professional Education" in Clarke 1971: 109-18; for a school of 'Egyptian' medicine before the Roman period, which might have established a model for later scientific schools, see Cribiore 2001: 25.

On the different types of texts used in ancient science education and their relation to oral instruction see Taub 2008: 13-29 (and for another example see Nicholls 2010).

Galen, *On Conducting Anatomical Investigations* 2.1 (= Kühn 2.280-83); Vitruvius, *On Architecture* 6.pr.4-7.

On the nature and content of astronomy education in antiquity see Evans & Berggren 2006. On mathematics

education: Cuomo 2001 (with Cuomo 2000, Evans & Berggren 2006: 43-48, 243-49, and other references I cited on mathematics education in chapter five).

Astrology was an art taken quite seriously at the time, although not by everyone: see Barton 1994b (and 1994a) and *OCD* 187-88 (s.v. "astrology"); for ancient arguments pro and con see Long 1982 and Sextus Empiricus, *Against the Professors* 5. All Epicureans and Skeptics rejected astrology, but so did others; even the occasionally gullible Pliny the Elder: cf. *Natural History* 2.6.28-29. Nevertheless, astrology was not only lucrative and popular, it also typically demanded real scientific expertise in astronomy (on which besides Barton, see A. Jones 1994).

On medical education in antiquity (to which I shall soon turn) see: Kudlien 1970; Clarke 1971: 109-12; Nutton 1975 and 1995 (with 1993: 11-15); Kollesch 1979; Duffy 1984; Todd 1984; Iskandar 1976 and 1988; Jackson 1988: 58-64, 129-30; and Kleijwegt 1991: 135-63. Together, these authors (and the scholarship they cite) also demonstrate (among other things) the existence of formal medical associations in dozens of cities throughout the Roman empire (on which also Korpela 1987: 102-06), as well as several legionary hospitals (*valetudinaria*)—and wherever doctors associated and worked in significant numbers, there would have been students. For more on Roman military hospitals, some of which were the most advanced medical facilities in the world until early modern times, see: Scarborough 1968; Davies 1970; Harig 1971; Pitts & St. Joseph 1985: 91-103; Korpela 1987: 106-10; Press 1988; Jackson 1988: 65, 113, 133-37 and 1993: 88-89; Wilmanns 1995; James & Thorpe 1994: 6; Nutton 2004: 178-82. On the (perhaps less) scientific use of Asclepian temples as early civilian hospices, see discussion and sources in P. Green 1990: 487-89 and Nutton 2004: 103-10.

Engineering education: Marrou 1964: 287-91 (= Marrou 1956: 191-94). We actually know more about engineering education than Marrou is aware: see Donderer 1996: 57-62 (and 70), Goguey 1978, Dilke 1971: 47-65, and (in general) the discussion of surveyors and engineers throughout Cuomo 2000 and 2001, and the introductions to Rowland & Howe 1999 and DeVoto 1996.

Rosumek 1982, cf. p. 165. See also Oleson 2004 and Greene 1992.

Students attending doctors and engineers at work: E. Evans 1994.

Galen, *On the Affections and Errors of the Soul* 1.8 (= Kühn 5.41-42); *On My Own Books* Kühn 19.39-43 (where Galen also says his father learned mathematical subjects from his grandfather and great-grandfather, suggesting a family tradition in the engineering profession). Supporting the inclusion in Galen's education of rudiments of trigonometry (spherics and conics, including some knowledge of the production of conical sundials), see Galen, *On the Affections and Errors of the Soul* 2.1 (= Kühn 5.59-60). On Galen's use and knowledge of mathematics and mathematical sciences in his works and methodologies in general see Lloyd 2005. For important examples see: Galen, *On My Own Books* 11 (= Kühn 19.40), *On the Affections and Errors of the Soul* 2.3-7 (= Kühn 5.66-103), *On Treatment by Venesection* 3 (= Kühn 11.255-56), *On the Doctrines of Hippocrates and Plato* 8.1.19-21 (with 9.4.30-31), *On the Therapeutic Method* 1.4.4-6 (with 1.4.12 and 1.5.1, and related notes in Iskandar 1988: 158 (§P.68,14-15)). For examples of Galen's astronomical knowledge and interests see Strohmaier 1993 and especially Galen's *Commentary on Hippocrates' 'Airs, Waters and Places'*. For his knowledge and interest in these, and other sciences as well, see Nutton 1999: 169-70 (§P.82,19).

For more detail on Galen's education: *DSB* 5.227-29 (in s.v. "Galen"), *NDSB* 3.91-93 (in s.v. "Galen"), Hankinson 1991: xix-xxii and Nutton 2004: 216-19 (and Nutton 1973 establishes the chronology of Galen's education and early career). See also *EANS* 335-39 (s.v. "Galen of Pergamon"), Hankinson 2008, and Mattern 2013.

Galen, *On the Affections and Errors of the Soul* 1.9 (= Kühn 5.48). For evidence regarding Galen's inheritance see Iskandar 1988: 145 (§P.42,12) and Nutton 2004: 389 (notes 4 and 11) with Hankinson 2008: 355-90.

Galen, *On My Own Books* (especially = Kühn 19.52-61). See also Hankinson 1994: 1782-84.

Marrou 1964: 290 (= Marrou 1956: 193).

Galen's *On My Own Books* is full of references to public anatomical and surgical demonstrations. See also Galen, *On the Uses of the Parts* 15.1 (= May 1968: 658) and *On Examinations by Which the Best Physicians Are Recognized* 9.6.

Plutarch, *How to Tell a Flatterer from a Friend* 32 (= *Moralia* 71a).

Dio Chrysostom, *Discourses* 33.6.

See Nutton 2004: 250. For a full survey of the evidence for scientific dissection and public medical, anatomical and surgical demonstrations, lectures, and contests in the early Roman empire see: Kudlien 1970: 20-21; Ferngren 1982: 278-79; Nutton 1995 (with 1985: 27); Debru 1995; von Staden 1995 and 1997; Byl 1997; Selinger 1999; Rocca 2003: 1-14; and Mattern 2008: 69-79. Relevant material can also be found in: Singer 1956; Duckworth, Lyons and Towers 1962; May 1968; Nutton 1971a; von Staden 1975; Lloyd 1983; Furley & Wilkie 1984; etc. I will discuss this 'revival' of dissection under the Romans before Galen (and the occasional practice of human dissection) in *The Scientist in the Early Roman Empire*.

For more on Vitruvius see *DSB* 15.514-21 (s.v. "Vitruvius Pollio"), *OCD* 1561-62 (s.v. "Vitruvius (Pol(l)io)"), and *EANS* 830-32 (s.v. "M. Vitruuius Pollio").

Galen's *Exhortation to Study the Arts* contains enough uncanny coincidences with remarks in Vitruvius' *On Architecture* that Galen must have read and liked it (or else some Greek work Vitruvius followed quite faithfully, as some scholars suggest he did). Compare, for example, *Exhortation* 5 and 8-9 (= Kühn 1.15, 1.20) with *On Architecture* 6.pr.1, 6.pr.4., and 9.pr.1-2.

Vitruvius, *On Architecture* 6.pr.4.

Vitruvius, *On Architecture* 6.pr.5 mentions again his having several teachers, who taught him professional ethics as well as the skills of his field, and 9.1.16 mentions his learning astronomy from several teachers.

Vitruvius, *On Architecture* 6.pr.3 (repeated in Galen, *Exhortation to Study the Arts* 8, = Kühn 1.15). For something of the underlying sentiment see Xenophon, *Economics* 20.15.

Vitruvius, *On Architecture* 6.pr.6.

Galen, *On Conducting Anatomical Investigations* 2.1 (= Kühn 2.280-83).

Vitruvius, *On Architecture* 6.pr.6-7.

Vitruvius, *On Architecture* 1.1. See Iskandar 1988.

Vitruvius, *On Architecture* 1.1.4-10 (mechanics is added in 10.pr.3).

Vitruvius, *On Architecture* 1.1.7.

Vitruvius, *On Architecture* 1.1.8-9 and 5.4-5.

Vitruvius, *On Architecture* 1.1.10; on lead pipes: 8.6.10-11.

Vitruvius, *On Architecture* 1.1.4.

Vitruvius, *On Architecture* 6.2 and bks. 3, 4, and 6; on this point see also Athenaeus the Mechanic, *On War Machines* 28.5-12, along with Whitehead & Blyth 2004: 139-40.

Vitruvius, *On Architecture* 9.pr.17-18 (see Rowland & Howe 1999: 8).

Vitruvius, *On Architecture* 1.1.3 (cf. 1.1.13).

Vitruvius, *On Architecture* 1.1.11-18.

Vitruvius, *On Architecture* 1.1.17.

Vitruvius, *On Architecture* 1.1.1-2, 1.1.11.

Quoting Hero: Pappus, *Mathematical Collection* 8.1.(1024).

Strabo, *Geography* 4.1.5.

Zilsel 1945: 342. See quotation of McGrayne 2011: 63, and my related discussion and notes in chapter one.

Chapter 8

State and Public Support for Education

Aristotle, *Politics* 8.1.1337a. Plato's *Republic* and *Laws* articulate similar claims.

Morgan 1998: 27.

For some social and cultural analysis of this trend, drawing on inscriptions and literary sources, see Nilsson 1955. As just a few examples, inscriptions attest educational foundations for the citizens of Xanthus (*SEG* 30 [1980] no. 1535.24-28) and Teos and Miletus (*SIG* 2.577-78).

Marcus Aurelius, *Meditations* 1.4: i.e. *dêmosias diatribas* would normally mean "state-owned schools" rather than merely "common schools" (cf. *LSG* 387, s.v. "*dêmosios*" with ibid., suppl. p. 86); Pliny the Younger, *Letters* 4.13.6-8.

See Marrou 1964: 265 (= 1956: 176), with supporting inscriptions extending well into the Roman era: 1964: 280-84 (= 1956: 186-87), and commentary: 1964: 567-68 notes 1-2 (= 1956: 406); for more extensive discussion see Nilsson 1955: 21-29, Chankowski 2004, and Watts 2006: 24-47, and summary and bibliography in König 2009: 395. See also *OCD* 508, s.v. "*ephêboi*."

Athenian school for boys: Tod 1957: 137, 139.

Others: See Hin 2007; König 2005: 47-63; Kah & Scholz 2004: 104-24, 193-210; and Kleijwegt 1991: 91-101, 155. On the pre-Roman history of the function and state sponsorship of the *ephebeia*: Kozak 2013 and Casey 2014.

On all these facts: Harris 1989: 130-33, 141-44, 283, 307; Cribiore 2001: 63-64; Cuomo 2001: 30-32, 34-37, 39-40, 43-44; Clarke 1971: 8; Marrou 1964: 431-39 (= Marrou 1956: 301-08); P.J. Parsons 1976 (esp. pp. 410-14 and Appendix II: 441-46). On possible motives for the disparity in support between secondary and elementary education, see Christes 1988. One indirect exception may be certain charities that subsidized living expenses (discussed in chapter two), which could have made primary education more affordable to thousands.

Also: Harris 1989: 235-36, 241-47; Clarke 1971: 8-9.

Slave teacher economics: See Harris 1989: 258-59.

Caesar's law: Suetonius, *The Divine Julius* 42.

Its extension: See for example Lewis & Reinhold 1990: 2.206-08 (§56). Nutton argues the tax and other exemptions for doctors can be dated as far back as Julius Caesar (cf. Nutton 1985: 29, 2000a: 964 n. 63, and 2004: 249-50), although Cassius Dio, *Roman History* 53.30.3 places their origin under Augustus. Imperial privileges awarded to professors are discussed in Marrou 1964: 440-43, Bowersock 1969: 30-42, Nutton 1971b, Cuomo 2000: 31-37, and Perrin-Saminadayar 2004. The whole of *Digest of Justinian* 27.1.6.1-12 documents that doctors, rhetors, philosophers, grammarians, and law professors were all granted exemptions at least as early as the mid-second century A.D., while *Digest of Justinian* 50.4.18.30 suggests they existed as early as Vespasian (in the 70s A.D.).

Public salaries for doctors: Cohn-Haft 1956; Meunier 1997; and Nutton 1977, 1981, 1985: 34, 2004: 153-55.

For engineers: See Vitruvius, *On Architecture* 10.16.3, and Cuomo 2001: 158-59, 176.

Doctors paid to teach: See *Digest of Justinian* 27.1.6.9.

Korpela 1987: 102-06; Kollesch 1979: 512-13 (see also Woodside 1942: 128), with primary sources in *Fontes Iuris Romani Antejustiniani* 1.1 (1941): 230 (§77).

'Aelius Lampridius', *Life of Severus Alexander* 44.4.

Special legal protections: *Digest of Justinian* 50.13.1.1-11.

Marrou 1964: 434-36 (= Marrou 1956: 301-03) and *Digest of Justinian* 27.1.6.2, reporting an interpretation of the third century Roman jurist Herennius Modestinus of the second century decision of emperor Antoninus Pius.

Digest of Justinian 27.1.6.4. On all the above aspects of Roman imperial support for doctors see Jackson 1993: 80-84 and Scarborough 1970: 297.

Galen, *On the Doctrines of Hippocrates and Plato* 9.4.3-6.

Digest of Justinian 27.1.6.7 (in the context of 27.1.6.5-9), which also suggests philosophers were expected to teach for free, or at least not to complain if their students failed to pay (a point supported by *Digest of Justinian* 50.13.1.4).

Digest of Justinian 50.5.8.4. See Trapp 2007: 19-20.

Philosophers nevertheless receiving privileges: See Cuomo 2000: 36-37.

Suetonius, *Vespasian* 17-18; Cassius Dio, *Roman History* 65.12.1. Suetonius does not say how many or where, but possibly only one of each and at Rome. See discussion in Woodside 1942.

See *OCD* 974-75 (s.v. "museum").

Philostratus, *Lives of the Sophists* 1.22.524.

Strabo, *Geography* 17.1.8. On the Museum of Alexandria see Schürmann 1991: 13-32 and (though outdated in several respects) E. Parsons 1952 and Sarton 1959: 29-34, 141-57.

Nutton 1971a, 1975, and 1995; Marrou 1964: 284-91, 574 n. 15 (= Marrou 1956: 190-93, 411); and sources in von Staden 1989: 460 (esp. n. 75-76).

On the Athenian Museum see Oliver 1977.

Eusebius, *History of the Church* 7.32.6-12 and Cassius Dio, *Roman History* 78.7.3 (= *Epitome* 77.7.3). Herodian, *History of the Empire after Marcus* 4.8.6-4.9.9 . The *Augustan History* = 'Aelius Spartianus', *Caracalla* 6.2; cf. Cassius Dio, *Roman History* 78.22-23 [= *Epitome* 77.22-23] and Herodian, ibid.

For Dionysodorus: Turner 1980: 86, with *Sammelbuch griechischer Urkunden aus Ägypten* 2.6012 (1915). For Asclepiades: *P. Cair. Masp.* 3.67295.

On the lost history of the institution (*On the Museum at Alexandria*) written by Aristonicus (*OCD* 157, s.v. "Aristonicus (2)"); likewise *On Alexandria* by Callixeinus of Rhodes (*OCD* 268, s.v. "Callixeinus"); only fragments (see Christian Jacob's contribution to König, Oikonomopoulou, and Woolf 2013: 57-81). But extant papyrological evidence includes: *P. Merton* 19 (in 173 A.D. Valerius Diodorus was 'ex-vice librarian and member of the Museum'), *BGU* 3.729 and *P. Ryl.* 2.143 (144 and 38 A.D., examples of men granted the right to dine for free at the Museum for life), *P. Kron.* 4 (135 A.D. discusses certificates of membership at the library in

Alexandria); see also Tod 1957: 138, Lewis 1963, and Turner 1980: 86-87 for more examples. Literature confirms these observations (see following note on the Library of Alexandria). And we have at least one inscription, declaring that in 56 A.D. Tiberius Claudius Balbillus was appointed head "of the Museum and Library of Alexandria," cf. *Forschungen in Ephesos* 3 (1912): 128.

Cassius Dio, *Roman History* 71.31.3. For more detail: Philostratus, *Lives of the Sophists* 2.2 (§566-67); and Lucian, *The Eunuch* 3. See Oliver 1981 and 1970: 80-84, and Trapp 2007: 246.

Athenaeum: See Boatwright 1987: 202-08.

Tod 1957 for more discussion and examples.

The possibility that many provinces were favored with similar set-ups is by itself plausible, but also suggested in the (albeit not always reliable) *Augustan History* (= 'Julius Capitolinus', *Life of Antoninus Pius* 11.3; and possibly implied in 'Aelius Spartianus', *Life of Hadrian* 16.8).

On the many libraries in Rome: Staikos 2000: 111-12. See also the recent findings from a lost work of Galen on the libraries of Rome: Nicholl 2011, Jones 2009, and Tucci 2008. In the early third century the Christian engineer Julius Africanus also "converted the Pantheon into a library for Alexander Severus" in Rome: Julius Africanus, *Kestoi* frg. 5.1 (*P.Oxy.* 3.412).

Pliny the Younger, *Letters* 1.8.2, with *Corpus Inscriptionum Latinarum* 5.5262. The general destruction has made it difficult to be certain but there is also evidence of a *public* library at Pompeii (Richardson 1977). For the others named (and general discussion of Roman-period libraries) see: *OCD* 830-31 (s.v. "libraries") with König, Oikonomopoulou, and Woolf 2013; "Library" 2005; Staikos 2004 and 2000: 57-136; Houston 2002 and 2009; Casson 2001; Gamble 1995: 176-89, 308-17; Fehrle 1986; Johnson 1984. For additional data (though in some cases dated): Rawson 1985: 12, 113; Wallace-Hadrill 1983: 81-82; Strocka 1981; Marrou 1964: 285 (= Marrou 1956: 188); J.W. Thompson 1962; Nilsson 1955: 49-53; E. Parsons 1952: 3-52; Götze 1937; Boyd 1915; "Bibliotheken" 1897; and Pliny the Elder, *Natural History* 35.2.10.

Seneca, *On Tranquility* 9.5. See Marshall 1976 for an extended discussion of the creation and use of private libraries in the Roman Empire.

Problem of unattested regions: For example, Hanson 1989.

Suetonius, *Domitian* 20. For scholarship on the Alexandrian libraries: Staikos 2004: 1.157-248 and 1.283-88 (with McKenzie 2007: 50); Chapman 2001; Staikos 2000: 57-90; MacLeod 2000; El-Abbadi 1992 (with El-Abbadi & Fathallah 2008); Blum 1991; Canfora 1987; E. Parsons 1952. See previous note for mentions in Roman-period papyri. Mentions in Roman-period literature include: Strabo, *Geography* 13.1.54, 17.1.8; Galen, *Commentary on the 'Epidemics' of Hippocrates* 3; Philostratus, *Lives of the Sophists* 22.3, 25.3; Athenaeus, *The Dinnersages* 15.677e; *Augustan History* = 'Aelius Spartianus', *Life of Hadrian* 20.2.

Suetonius, *Claudius* 42. Athenaeus, *The Dinnersages* 1.3a. Strabo, *Geography* 17.793-4.

Pausanias, *Description of Greece* 1.18.9. See Oliver 1977 (esp. p. 166 n. 10) and Boatwright 2000: 153-57 and Staikos 2000: 125.

This inscription even includes part of the catalogue of the library's collection: Gamble 1995: 182 and Marrou 1964: 285 (= Marrou 1956: 188).

On using private libraries of one's patrons and friends: See discussion in Marshall 1976.

Parapegmata: See Taub 2003: 20-37, 41-43, 173-76; and Lehoux 2007.

Cassius Dio, *Roman History* 60.26.

Diogenes of Oenoanda, *Epicurean Inscription* = M.F. Smith 1996 (cf. *OCD* 457, s.v. "Diogenes (5)," and *EANS*

253-54, s.v. “Diogenes of Oinoanda”). See also Warren 2009: 54-59.

Archimedes inscription: Cicero: Cicero, *Tusculan Disputations* 5.23.64-66 (cf. Plutarch, *Marcellus* 17; Simms 1990; Cuomo 2001: 197-98; Jaeger 2002: 55-56). Eratosthenes: see Russo 2003: 111; Netz 2002: 213-15; Knorr 1989: 131-53; Cohen & Drabkin 1948: 62-66). “Keskinto Inscription” (*Inscriptiones Graecae* 12.1 §913. That and the “Canobic Inscription” are covered in Evans 1999: 384-85, and Hamilton, Swerdlow, and Toomer 1987. Gaelic inscription: Nutton 2004: 216-17.

Chapter 9

Jewish and Christian Education

Lapin 1996: 505 (cf. 505-08).

Acts 4:1-6. The word *agrammatoi* literally means “without letters,” hence unable to read or write (*LSG* 14, s.v. “agrammatos” I), while *idiôtai* means without professional training or knowledge (see note in chapter two).

That the apostles were probably highly educated: Carrier 2014: 263-64, 440.

John 7:14-18. The mention of Jesus drawing something on the ground in John 8:6-8 is ambiguous and generally regarded as not even original to the Gospel of John (called the *pericope adulterae*, it has been identified as a later interpolation). It cannot be known on present evidence if Jesus, granting that he was historical at all, could read, since the authors of the Gospels, believing Jesus was divine, might simply assume a god could read. But if Jesus was an actual Rabbi (Mt. 26:25, 26:49; Mk. 9:5, 11:21, 14:45; Jn. 1:38, 1:49, 3:2, 4:31, 6:25, 9:2, 11:8), he would almost certainly have been literate—and therefore probably (in reality) from a family of some means, regardless what the Gospels claim.

On the higher status of Bible scholars among the elite: Marrou 1964: 454-55, 616 notes 6-7 (= Marrou 1956: 316-17, 445). On debates surrounding the meaning and provenance of the following passages see Rubenstein 2003, pp. 200-201, esp. n. 68.

Quotes from b.Talmud, *Pesachim* 49a-49b.

Hezser 2001. See Quick 2014 for a survey of subsequent scholarship on Jewish education and literacy, especially Rollston 2010, though none of it challenges Hezser.

Debate: Millard 2003a and 2003b (with Carrier 2003) and Millard 2000: 154-84. In light of: Harris 1989: 281-82, Marrou 1964: 373-75 (= Marrou 1956: 254-56), and most decisively Hezser 2001: 39-109.

Gamble 1995: 6-8. An even bolder case is made in Safrai 1969, but Safrai’s account of Jewish education is wholly unreliable and his discussion of the evidence often wildly inaccurate.

b.Talmud, *Baba Bathra* 20b-21a.

Deuteronomy 6:1-2, 6:7, 6:20-25.

See Hezser 2001: 94-109 (with *OCD* 1419, s.v. “synagogue”).

Schools only religious content and not in Greek: Lapin 1996: 498-511; Gerhardsson 1961: 56-66 and 85-92; and conceded even by Millard 2000: 158.

Debate on age of consent for girls in Talmud: Meacham 2000.

Quotes: b.Talmud, *Sotah* 49b. For more discussion see sources cited in Judge 1983: 9.

Scientific medicine relationship in Talmud: Newmyer 1996 (and following note).

There were certainly Jewish scientific doctors: see Kudlien 1985 and Rosner 1994.

Diaspora different: See Gruen 1998 and 2002.

For a detailed treatment of Philo's views on education, see Sandnes 2009: 68-78.

Philo of Alexandria, *On the Change of Names* 39.219-22.

Philo, *On the Giants* 13.60.

Philo, *On the Giants* 13.61-14.63. See also Philo, *On the Change of Names* 9.66-68 & 10.76.

Philo, *On the Giants* 15.65. A similar staged scheme of values is described in Philo, *Who is the Heir of Things Divine* 9.45-48, 20.96-99, 22.108-23.116.

Philo, *On Mating with the Preliminary Studies* 9.47-49, 10.51.

See Philo, *On Dreams* 1.10.(52-60).

Christianity as syncretism: See Klauck 2003; Carrier 2011 and 2014; Fox 1987.

No other schools to learn in: Corroborated by Sandnes 2009: 5-7.

For a discussion of education metaphors in the New Testament (and an important analysis of Paul's latent hostility to higher education) see Judge 1983.

Paidagogus: *LSG* 1286, s.v. "paidagôgos."

Gamble 1995: 6. See also Jacobs 2011 and Sandnes 2009.

Tertullian, *On Idolatry* 10. See Sandnes 2009: 111-23.

Hippolytus, *Apostolic Tradition* 2.16.5.

Decline in Christin hostility: As summarized in Jacobs 2011. And besides following notes, see Pailler & Payen 2004: 265-67 and Sandnes 2009 (and, tangentially, Hauge & Pitts 2016 and Dutch 2005). Opposition for women: Levick 2002: 151-53. And adding to Jacobs, see Too 2001: 405-32 for Sara Rappe's analysis of the Christian struggle to assimilate pagan education during the transition to the Middle Ages, while Kaster 1988: 70-95 discusses the divergence on this point between Eastern and Western branches of medieval Christianity.

Quoting *The Catholic Teaching of the Twelve Apostles* 1.6, here modernizing an older English translation (from the extant Syriac translation of the Greek original, which may date back as far as the second century) in Connolly 1929: 12; cf. *ODCC* 479 (s.v. "Didascalia Apostolorum"). See Sandnes 2009: 102-10.

Gamble 1995: 6.

Ellspermann 1949: 1-3. For a survey of early Christian education see Marrou 1965: 451-71 (= Marrou 1956: 314-29).

Catechetical schools: See Pack 1989 and Clarke 1971: 122-23.

Gamble 1995: 6-7. His conclusions are corroborated in Sandnes 2009.

Origen, *Against Celsus* 3.55. Note that this Celsus is likely the Epicurean friend of Lucian (addressed in Lucian, *Alexander the Quack Prophet* 1-3 and 60-61; cf. Origen, *Against Celsus* 3.35), but probably not the same as the engineer of the same name and similar date, and certainly not the same as the encyclopedist Aulus Cornelius Celsus, who dates a century earlier.

Origen, *Against Celsus* 3.56-58.

Eusebius, *Preparation for the Gospel* 14.10.10.

Ptolemy's epigram survives in the *Palatine Anthology* 9.577. Galen said essentially the same thing of a medical education, e.g. Galen, *On the Uses of the Parts* 3.10 and 17.3 (= May 1968: 189-91, 733).

Christian hostility to education a reversal of pagan praise: See the analysis of Copan 1998.

Lactantius, *Divine Institutes* 3.25.

Lactantius, *Divine Institutes* 3.26-27.

Christianity's affinity for Platonism: Georges 2012, Ulrich 2012, and Sandnes 2009: 84-95.

Justin Martyr, *Dialogue of Justin and Trypho the Jew* 2.

Stoic theology in earliest Christianity: M. Lee 2006; Engberg-Pedersen 2000 and 2010 (on which see the critical exchange in *Journal for the Study of the New Testament* 33.4 [2011]: 406-43), and Rasimus, Engberg-Pedersen, and Dunderberg 2010.

Eusebius, *History of the Church* 5.28. See discussion in Walzer 1949: 75-86 and for background see *ODCC* 1242 (s.v. "Paul of Samosata").

For background on Origen see *OCD* 1047-48 (s.v. "Origen (1) (Origenes Adamantius)") and *ODCC* 1193-95 (s.v. "Origen" and "Origenism"). See also Jacobs 2011 for Christian debate over the value of Origen's educational ideals in the 4th century; and Gemeinhardt 2012 on the Origen-Gregory correspondence and its relation to evolving educational values in Christianity.

Little is known of the Alexandrian curriculum, but for discussion of what might have went on at that Christian school at Alexandria see van den Broek 1995 and Osborn 2005: 19-24.

The attitudes of these two schools to education (judging from the works of Origen of Caesarea and Clement of Alexandria, respectively) are well analyzed in Sandnes 2009: 124-59.

Gregory Thaumaturgus, *Panegyric Oration on Origen* 1 and 5. There is some dispute as to the actual identity of this author, but his identification with Gregory the Thaumaturge is supported by Eusebius (*History of the Church* 6.30), who was using Origen's library at the time (Carriker 2003) and thus would be in a good position to know, while arguments against the attribution are not very persuasive. Whatever his name, the author was certainly a student of Origen writing in the middle of the third century. See Trigg 1998: 36-37 and 249 (n. 6); and Crouzel 1979 and 1969; with *OCD* 636 (s.v. "Gregory (4) Thaumaturgus") and *ODCC* 713-14 (s.v. "Gregory Thaumaturgus, St.").

Quotes from Lapin 1996. And Origen, *Letter to Gregory* 1-3.

Origen, *Homilies on Leviticus* 7.6.6-8.

Origen, *Commentary on the Song of Songs* pr.3 (cf. Lawson 1957: 39-46, 317-20).

Origen's scientific heresy about resurrection: Carrier 2005: 123-35, 143-44 (with associated FAQ: www.richardcarrier.info/SpiritualFAQ.html#origen). John Philopon: *ODCC* 896 (s.v. "John Philoponus"); *OCD* 1135 (s.v. "Philoponus, John"); *DSB* 7.134-39 (s.v. "John Philoponus"); *NDSB* 4.51-53 (s.v. "John Philoponus").

Augustine, *The Literal Interpretation of Genesis* 1.19, cf. Sandnes 2009: 214-30.

Bacon 2001: 5-38 [orig. published 1605]. See P. Harrison 2001 and 1998, Crouch 1975 (esp. pp. 37-90), and Lougee 1972 (esp. pp. 45-60). Their conclusions are supported by Kenny 2004 and 1998; Daston 1998; Eamon 1996; Lloyd 1973: 167–71; and Clagett 1955: 118–82.

Origen, *Commentary on the Song of Songs* pr.3 (cf. Lawson 1957: 39-46, 317-20). As for the other two branches, Origen says Abraham represents ethics because of his obedience to God and Jacob represents metaphysics or theology because of his ladder to heaven. Similarly, Origen elsewhere identifies the Biblical Ahuzzath as symbolizing physics because his name means "he who holds," and natural philosophy contains or 'holds' everything in nature (in the context of Origen, *Homilies on Genesis* 14.3, where he first says Abimelech represents logic, and his two subordinates, Ahuzzath and Phicol, represent physics and ethics, respectively).

Origen, *Letter to Gregory* 4.

Gregory Thaumaturgus, *Panegyric Oration on Origen* 13 (cf. 11-15). Other schools (like Pythagoreanism) were by that time either nonexistent or too scarcely represented to have mattered educationally, or (like Cynicism) already spurned natural philosophy. On Origen's fondness for Platonism: Edwards 2012.

See Carrier 2010.

Plutarch, *Marcellus* 14.7-12 and 17.5-7.

Jerome, *On Illustrious Men* 54.

Eusebius, *History of the Church* 6.18.3.

That Plotinus discussed such sciences: Porphyry, *Life of Plotinus* 3, 14, 20; that Origen might have, too: Eusebius, *History of the Church* 6.19. For more on Origen's education and school see Clarke 1971: 125-29; Marrou 1964: 468-69 (= Marrou 1956: 314-15); and Knauber 1968. For a full discussion of Origen's curriculum see Crouzel 1969: 68-70, 141-43, 186-95.

Clement of Alexandria, *Stromata* 6.10-11.

Augustine, *The Literal Interpretation of Genesis* 1.19, 1.20 and 2.9.

For example: Tertullian, *To the Nations* 2.2.42, 2.4.47, *Prescription against Heretics* 7 (cf. 11-14, 21-28), *On the Soul* 1-2; Lactantius, *Divine Institutes* 3; Eusebius, *Preparation for the Gospel* 14.10 (cf. 14.13.9).

Clement of Alexandria, *Stromata* 1.5 (§29.9), where he also draws on Philo (whose views we examined earlier).

Clement of Alexandria, *Stromata* 1.9, 6.11.

On modern science being a re-paganization of Christianity: see discussion and sources in Carrier 2010 (esp. pp. 412-19).

Chapter 10

Conclusion

For general background see *OCD* 861 (s.v. "Lucian").

Lucian, *On the Dream* or *Lucian's Career* 1, 7, 10.

Lucian, *On the Dream* or *Lucian's Career* 11, 18.

Horace: see *OCD* 704-07, in s.v. "Horace (Quintus Horatius Flaccus)".

Lactantius, *Divine Institutes* 3.25-27.

Galen, *On the Affections and Errors of the Soul* 2.2 (= Kühn 5.64-66). Galen composed an abbreviated version of this same point in *On the Natural Faculties* 3.10 (= Kühn 2.178-80). For similar arguments elsewhere see Galen, *On the Doctrines of Hippocrates and Plato* 2.3.12-17 and *On the Uses of the Parts* 10.12, 10.14, 12.6 (= May 1968: 490, 502, 558-60).

Lactantius, *Divine Institutes* 3.26.

This culture war has been examined in regard to pagan and Christian attitudes toward miracles in Grant 1952 and Remus 1983; and in other respects by Fox 1987 and MacMullen 1984 and 1997.

Exceptional difficulty of educational success: Cribiore 2001: 1-4, 220-23.

Claim about Romans, for example: Diederich 1999: 66-67.

See Witty 1974 (although incomplete and outdated). On encyclopedism as in fact a pre-Roman fad beginning in the very heyday of Alexandrian science, see two chapters on the subject in König & Woolf 2013: 23-83. On the phenomenon in the Roman period: Doody 2009.

The continued advance of scientific research through the early Roman Empire is briefed in Carrier 2010; it's abandonment thereafter becomes clear by comparison. I will demonstrate this in *The Scientist in the Early Roman Empire*.