MAX-PLANCK-INSTITUT FÜR WISSENSCHAFTSGESCHICHTE
Max Planck Institute for the History of Science

2017

PREPRINT 487

Jens Høyrup

Archimedes: Knowledge and Lore from Latin Antiquity to the Outgoing European Renaissance

Abstract

With only Apuleius and Augustine as partial exceptions, Latin Antiquity did not know Archimedes as a mathematician but only as an ingenious engineer and astronomer, serving his city and killed by fatal distraction when in the end it was taken by ruse. The Latin Middle Ages forgot even much of that, and when Archimedean mathematics was translated in the 12th and 13th centuries, almost no integration with the traditional image of the person took place.

With the exception of Petrarca, who knew the civically useful engineer and the astrologer (!), fourteenth-century Humanists show no interest in Archimedes. In the 15th century, however, "higher artisans" with Humanist connections or education took interest in Archimedes the technician and started identifying with him. In mid-century, a new translation of most works from the Greek was made by Jacopo Cremonensis, and Regiomontanus and a few other mathematicians began resurrecting the image of the geometer, yet without emulating him in their own work.

Giorgio Valla's posthumous *De expetendis et fugiendis rebus* from 1501 marks a watershed. Valla drew knowledge of the person as well as his works from Proclus and Pappus, thus integrating the two. Over the century, a number of editions also appeared, the *editio princeps* in 1544, and mathematical work following in the footsteps of Archimedes was made by Maurolico, Commandino and others.

The Northern Renaissance only discovered Archimedes in the 1530s, and for long only superficially. The first to express a (purely ideological) high appreciation is Ramus in 1569, and the first to make creative use of his mathematics was Viète in the 1590s.

Contents

Marshall Clagett and Marie-Dominique Chenu
in memoriam

Since four centuries, Archimedes has been known among those interested in ancient Greek mathematics – not only those competent in the field – as one of its greatest names. Witness, for present times, the overwhelming interest in the "Archimedes palimpsest".

But it was not always so, neither in the ancient Latin world nor in the Latin Middle Ages or the European Renaissance. Much of the time, Archimedes was certainly an important name among literati. The foundation for his fame, however, varied as much as the situation of the literati themselves.

In the following, I shall trace the fate of this Protean "Archimedes" in the Latin world (excluding thus Greek Antiquity as well as Byzantium and the Islamic world), from Cicero's times until the end of the Renaissance period around 1600.[1]

From Cicero to Cassiodorus

The earliest Roman writer whom we know to have dealt with Archimedes (and the one who spoke more often of him than any other) was Cicero.

Best known is his account in *Tusculanae disputationes* V.xxiii of how he found Archimedes's tomb marked by a column carrying a sphere and a cylinder, going on with a less oft quoted praise of the felicity of the philosopher and the mathematician as compared to that of the tyrant Dionysios. Also in *Tusculanae disputationes* (I.xxv) Archimedes *sphere*, a mechanical model of the planetary system and its motions, is praised as the product of a divine mind. The same sphere is spoken of in *De natura deorum* II.xxv; in *De re publica* I.xiv this model is said to have been generally considered Archimedes's glory, and *Academica* II.xxxvi lets him prove by geometric diagrams that the sun is much larger than the earth. *De finibus* V.xix praises him for being so occupied with his diagrams in the sand that he did not notice Syracuse was taken. *De oratore* III.xxxiii speaks of Euclid and Archimedes as the two cultivators of geometry, while *Actio in Verrem II*, IV.lviii, refers in passing and *hors propos* to Marcellus's admiration for Archimedes, and *Oratio pro Cluentio* xxxii says about the multiplication 16×40000 = 640000 that Archimedes could have done no better. Finally, two letters to Atticus (XII.4,

[1] For Archimedean *mathematics* during the medieval and Renaissance periods, Marshall Clagett's *Archimedes in the Middle Ages* has evidently been an all-important resource. The *Archimedes figure* of the Renaissance has been dealt with from compatible but different perspectives in [Laird 1991] and [Høyrup 1992].

The writing of the paper was spurred by a request to write an encyclopedia article on the topic for "a work of tertiary literature [containing] digested knowledge [but] neither research literature (primary literature) nor review articles summarizing original papers (secondary literature). Content therefore consists of established information in the particular field". As I found out, established published information was too patchy to allow the writing of such an article. The paper is the outcome of the ensuing pursuit of an over-all picture.

XIII.28) refer to an intricate diplomatic problem as a "problem for Archimedes", indicating that Archimedes's unspecific ingenuity was proverbial at least in Cicero's circle at the time .

In Augustean times, Livy (*Ab urbe condita* XXIV.xxxiv, XXV.xxxi) mentions Archimedes's astronomical fame in passing and then describes his war machines in detail, and finally tells how he was killed while drawing figures. Ovid, *Fasti* VI.277 mentions the sphere "made by Syracusan art"[2] without mentioning Archimedes by name. A generation later, Valerius Maximus (*Facta et dicta memorabilia* VIII.vii.7) speaks generically about the efficiency of Archimedes's war machines, about Marcellus's admiration for his genius, and about the death. Vitruvius (*De architectura* I.i) speaks about technical manuals written by Ctesibios, Archimedes and others, which however one cannot understand without having learned natural philosophy; later on in the same chapter he speaks of mechanics writings by Aristarch, Philolaos, Apollonios, Archimedes and others. The introduction to book IX tells the anecdote of Hieron's crown and Archimedes's exposure of the fraud. The Elder Pliny lists Archimedes as one of his many sources for the cosmology of book II of his *Historia naturalis* but does not cite him in the text; in VII.xxxvi.125 he calls Marcellus in as witness of Archimedes's knowledge of the sciences of geometry and machines. In the later first century CE Quintilian, when speaking of the cosmological insights provided by geometry, (I.x) adds that he will not go into the details of tactics nor speak about Archimedes's single-handed defense of Syracuse. In the same epoch or slightly later, Florus (*Epitome* I.xxii.33) mentions Archimedes's ultimately failing defense of Syracuse. In the mid-second century Apuleius *Apologia* [ed. Nisard 1865: 212] ascribes to Archimedes a large treatise explaining rainbows and other optical phenomena, adding that he is most famous for his study of convex and concave mirrors in spite of his admirable subtlety in geometry in general.[3] Probably in the early third century, Solinus's *De mirabilibus mundi* V.13 mentions Archimedes's knowledge of stars and machines, with no more details.

In the fourth century, Ammianus Marcellinus (XXVI.i.8) lists Meton, Euctemon, Hipparchos and Archimedes as the most distinguished students of the stars; Firmicus Maternus (*Matheseos libri VIII* VI.xxx.26 [ed. Kroll & Skutsch 1897: II, 148] refers briefly to Archimedes's ingenious sphere and the efficacy of his machines; finally, Claudianus (shorter poems, LI) disparages Archimedes sphere as a poor imitation of the divine creation.

Then, in the early fifth century, Macrobius (*Commentarii in Somnium Scipionis* I.xix) enrolls Archimedes and the Chaldaeans as supporting Cicero's opinion about the order of the spheres of the planets. Roughly contemporary is probably Martianus Capella telling about Plato and Archimedes rotating golden spheres (*De nuptiis* II.213). Probably

[2] As all translations in the following where no translator is indicated, the author is responsible.

[3] Such a work has not survived, but also Theon of Alexandria and others refer to it – cf. [Heiberg 1972: II, 550]; even though it is lost, it is thus likely to have existed.

somewhere in the fifth century, ps.-Priscian, *Carmen de ponderibus* [ed. Hultsch 1864: II, 95–97] tell the story of the crown.

This overview so disregarded the (even more meagre) patristic references. In the *Patrologia latina* we find the following:

Tertullian, *De anima* [PL 2, col. 669] refers to Archimedes's wonderful hydraulic organ. Lactantius, *Divinarum institutionum* II [PL 6, col. 297] seems to borrow from what Cicero writes in *Tusculanae disputationes* I.xxv about the sphere. Orosius, *Historia* IV.xvii [PL 31, col. 896] speaks about Archimedes's machines and their efficiency in defending Syracuse; the words suggest use of Valerius Maximus, but the death story is omitted. Augustine, in *De utilitate credendi* [PL 42, col. 74][4] asks rhetorically who would take Epicuros as his guide to Archimedes's geometrical writings – "against which he spoke with much tenacity, in my opinion without understanding them".[5]

While this remark suggests that Augustine (alone among Latin authors, at most together with Apuleius!) understood not only that Archimedes did geometry but also that proofs and not mere drawings or results were essential, Mamertus Claudianus [PL 52, col. 781] only refers to his use of the *radius*, in parallel to Orpheus's use of the plectrum (etc.).[6] Similarly, Cassiodorus's *Institutiones* II.vi.3 only mentions Archimedes along with Euclid and Apollonios "and other authors" as Greek writers about geometry [PL 70: col. 1213]. His *Epistola* XLV [PL 69. col. 539, also PL 63, col. 564] states that Boethius translated "the mechanician Archimedes".

The Latin Middle Ages

From the Middle Ages proper, the *Patrologia latina* only offers two references. Paulus Winfridus (or Diaconus) [PL 95, col. 784] repeats a couple of lines from Orosius about Archimedes and the efficiency of his machines in the defense of Syracuse for his *Historia miscella*; Dungalus Reclusus [PL 105, col. 450] borrows what Macrobius tells about the order of the heavenly spheres as described by Cicero and in agreement with Archimedes and the Chaldaeans in an *Epistola de duplici solis eclipis anno 810*. In total, four lines, out of the some 11–12 million lines in those volumes of the *Patrologia latina* that cover the period 550–1200.

The 12th century gave access to some genuine Archimedean works, and to works drawing on Archimedes. Two translations of the *Measurement of the circle* were made;

[4] My translation, as other translations with no identified translator in the following.

[5] Epicuros being older than Archimedes, Augustine presumably refers to Epicurean objections to the foundations of theoretical geometry which Archimedes shared, perhaps more specifically to Eudoxean theory – cf. [Sedley 1976] and [Cambiano 1999: 587–590] (the passage in Cicero, *Academica* II.xxx, about Polyaenos the geometer converted to Epicureanism and then claiming the whole of geometry to be false, cannot be Augustine's source).

[6] The passage is also found in a letter to Claudianus from Sidonius Apollinaris (*Epistulae* IV.iii.5), which can hence be supposed to be Claudianus's direct source

one was possibly made by Plato of Tivoli, the other in any case by Gerard of Cremona. The latter circulated well among mathematically active university scholars – witness the production of at least nine revised versions from the 12th through the 14th century [Clagett 1964]. Archimedean material – explicitly ascribed to Archimedes – was also contained in the *Verba filiorum* of the Banū Mūsā [ed. Clagett 1964: 264], similarly translated by Gerard. The well-circulated *De curvis superficiebus* compiled in the late 12th or earlier 13th century by John of Tynemouth (also responsible for the so-called Adelard-III version of the *Elements* [ed. Busard 2001]) contained material in Archimedean style though not in direct translation; Roger Bacon ascribes it to Archimedes in the *Communia mathematica* [ed. Steele 1940: 44] while he never refers to the genuine works (as we shall see, others were to make the same ascription until the 16th century).

In 1269, William of Moerbeke made an almost complete translation of the Archimedean corpus from the Greek [ed. Clagett 1976] – among the works known today, only *The Sandreckoner* and *On Method* are lacking.[7] Nobody but Witelo appears to have used it in the 13th century, but in the 14th it was drawn upon by Jean de Murs, Oresme, Henry of Hesse and Albert of Saxony [Clagett 1978: 3–144] – all linked to Paris University.

Outside the restricted circle of these five – Witelo, Jean, Oresme, Henry and Albert – only Gerard's translation of the *Measurement of the Circle* had repercussions. Around 1250, Vincent of Beauvais combined in *Speculum historiale* V.XLIII [1624: 149]) quotations from Orosius (the machines and the defense of Syracuse) and Valerius Maximus (the death story) with a reference to Archimedes's *Measurement of the Circle*, "of which Aristotle says that it can be but is not known".[8] In the 1340s, Walter Burley added to this in *De vita et moribus philosophorum* [1487: b.ii^{v}] a long *verbatim* borrowing from Valerius Maximus. But that is as far as the integration of the Latin Archimedes with the author of mathematical writings went in 13th-14th-century scholastic culture. On the whole, the Arabo-Latin as well as Moerbeke's Greco-Latin translations circulated in complete isolation from interest in the person – and information about the person was drawn from very few sources: Orosius, Macrobius, and Valerius Maximus.[9]

[7] *On Method*, as well known, is a recent discovery – details in [Heiberg 1907].

[8] The reference is probably to *Categories* 7^{b}31–33, maybe in interaction with Boethius's commentary to the work [PL 64, col. 231]).

[9] It may not have helped integration that the figure known from Latin authors was *Archimedes*, while the author of the translation from the Arabic was designated *Archimenides*. However, Moerbeke seems to have been just as convinced as Vincent of Beauvais that the two were identical – see [Clagett 1976: 66].

Early Italian Humanism

As a rule, 14th-century Humanists were interested in neither the works nor the person. One was, however, though only in the person: Petrarca – often regarded as the most eminent of early Humanists, and therefore worth looking at even if an exception.

To judge from Petrarca's his letters, Archimedes was not central even to him – he is not mentioned at all in the *Familiari*, nor in the *Extravagantes;* only two passages in the *Senili* refer to him, both from 1362. One [ed., trans. Fracassetti 1869: I, 46] speaks about his overpowering love of studies, on a par with that of Cato, Varro, Livius Drusus, Appius Claudius, Homer, Socrates, Isocrates, Sophocles, and eight more named classical writers and philosophers; the other (*ibid.* p. 63) lists him together with Ptolemy and Firmicus Maternus as representatives of the class of famous astrologers (in the modern sense of that word, to judge from the context).

Yet Petrarca produced two biographical notices. In *De viris illustribus vitae* (1338), within the biography of Marcellus [ed. trans. Razzolini 1874: I, 280–282], he narrates in his own words Valerius Maximus's stories about Archimedes's powerful war machines and his death. This gives Petrarca the possibility to insert his own observations, twists and additions: that even though Firmicus Maternus disparages Archimedes as a mechanic, he was formidable both as an astrologer and a mechanic; and that the figures he was drawing were astrological or geometrical; finally, that Cicero found Archimedes's grave. In *Rerum memorandarum libri* I.23 (1343) [ed. Billanovich 1943: 22–24], an arrival in Syracuse offers the occasion to expand Livy's single line about Archimedes's unique observation of the heavens and the stars into a general praise of Archimedes's study of nature and of his sphere. This instrument is praised for allowing understanding of the celestial motions not only by the mind but also, apparently better, by our eyes – rather un-Platonic, but Petrarca does not know. Even more commendable, according to the ascending rhetorical curve, were Archimedes's terrestrial mechanical feats; his fatal distraction when Syracuse was taken, on the other had, is slightly censured as "immoderate" – once again, Platonizing celebration of the pure intellect is wholly foreign to Petrarca's perspective. All in all, the value scale is that of Cicero and the Roman elite of his time, and Archimedes is *almost* perfect when measured thus. At least, as we see, Archimedes was part of the legitimate ancient heritage, respected because of his sophisticated machines, his planetary model as well as those that could serve efficiently in war. Even Petrarca's aversion for astrology only induces him to compare modern astrologers unfavourably to Ptolemy, Archimedes and Firmicus Maternus, not to denigrate this aspect of his "Archimedes".

A final reference to Archimedes, in *De suis ipsius et multorum ignorantia* (1367) [ed. Capelli 1906: 47] says nothing about Archimedes himself, it only denounces the opinion that Archimedes's construction of the model of the heavens should be more admirable than nature's production of the original – apparently an echo of Claudianus.

The 15th century

Other 14th-century Humanists seem not to have been interested in the Archimedes figure at all. That changed to some extent in the 15th century, as "higher artisans" (architects, painters, military engineers, etc.) and their ambience began to have intercourse with Humanists. The engineer Mariano Taccola (1382 to c. 1453) was proud to be known as the "Archimedes of Siena" [Prager and Scaglia 1972: 17 and *passim*]; he was no mathematician, and never mentions Euclid nor Archimedes in his writings; but he was an accomplished designer of military and other engines and also a good artist. Filippo Brunelleschi, with similar credentials, enjoyed the similar honour to be considered a "second Archimedes" [Laird 1991: 633].

Those who awarded such honours must have had an idea of what the name "Archimedes" stood for – at the overlap between, on one hand, what information about Archimedes was available, on the other, what Taccola and Brunelleschi were famous for. That overlap encompasses neither mathematical theory nor pictorial arts – the "Archimedes" of the day was a skilled engineer and architect, a designer of machines. We may imagine he was also thought of as a patriot defending his city and his prince by means of his supreme skills, but there is no evidence for that.

The most likely main source for the admiration of Archimedes among the higher artisans is Vitruvius, a colleague so to say. Leon Battista Alberti – the earliest outstanding Humanist who was also active as a higher artisan, and Brunelleschi's partner in the creation of perspective technique – takes over Vitruvius's version of the crown story in the *Ludi matematici* [ed., trans. Williams, March & Wassel 2010: 66]. However, his *De re aedificatoria* shows that increasing familiarity with Plutarch's biography of Marcellus was also influential – in VI.vi [Alberti 1541: 83^{v}] he cites Plutarch for the story of Archimedes moving a loaded ship on the ground and for his promise to be able to move this world if he could only go to another one.

As informative as borrowings is the way they are filtered. Medieval and early Renaissance writers could not go beyond the Latin sources with which they were familiar, and that may explain the paucity of what they tell; Alberti, however, distances himself from part of what he reads, and omits an essential part of Plutarch's Platonizing message. Firstly, Plutarch's insistence that Archimedes considered mechanical work and even mechanical treatises unworthy (*Marcellus* xvii.3–4) is not argued against, it is by-passed in silence – after all, it would have undermined Alberti's own undertaking. Neoplatonism and esoteric Platonism remain as unthinkable as they had been for Petrarca. Secondly, in *De re aedificatoria* IX.x [1541: 245^{r}] Alberti declares not to intend to be Zeuxis in painting, Nicomachos in the manipulation of numbers, or Archimedes when dealing with angles and lines; as in the treatises he has written about painting and drawing (that is, *Elementi di pittura* and *Elementa picturae*) he will stick to the basic principles and that which gives honour and fame to the architect. Admitting here that Archimedes had been the supreme geometer (which he could read in Plutarch, *Marcellus* xvii.4–7), Vitruvius distances himself from this aspect of the Hero.

Even among Humanists with no direct links to architecture and engineering there seems to have been some interest in Archimedes, probably because of what the Latin sources tell about him. In 1423–24, rumours circulated that Rinuccio da Castiglioni had brought back from Byzantium an unknown Archimedes manuscript; Rinuccio confirmed to have a manuscript by Archimedes *De instrumentis bellicis et aquaticis* [Rose 1975: 31] – suspicious as an Archimedean title, to be sure, but in line with commonplace Latin lore, which can only reinforce our doubts. In any case, nobody ever saw the manuscript in question (then or in later centuries), and some 25 years passed before more happened among Humanists. Around 1450, however, Jacopo da San Cassiano Cremonensis made a fairly complete translation (dealt with in depth in [d'Alessandro & Napolitani 2012]). Of the works translated by Moerbeke, *On Floating bodies* is missing in the new translation and from the manuscript used by Jacopo, while the *Sandreckoner*, absent from Moerbeke's Greek manuscript, is translated by Jacopo. None, of course, knew *On Method*. Whether Jacopo's translation was made while he was still in Mantua or after his move to the Papal court is not clear, but in any case the undertaking agrees well with Nicholas V's broader translation programme. This translation is the basis for Regiomontanus's judgment (in a lecture "explaining briefly the mathematical sciences and their utility", held in Padua in 1463/1464 [ed. Schmeidler 1972: 45]) that Euclid was

> followed by Archimedes citizen of Syracuse, and by Apollonios of Perga, customarily called the Divine because of the height of his genius, of whom it is not easy to say whether one is to be preferred to the other. While namely Apollonios described the elements of conics in eight books, which have never been put into Latin, the first rank appears to belong to Archimedes the Sicilian by the variety of publications, which under Pope Nicholas V were rendered in Latin by a certain Jacobus of Cremona.

This translation was also the one Regiomontanus intended to print [ed. Schmeidler 1972: 533].

Both Jacopo and Regiomontanus were connected to Bessarion's circle, though at different moments. Bessarion himself was interested enough to get a copy for his library, and Cusanus expressed his gratitude to the Pope for having put the manuscript at his disposition (which, however, did not affect his idiosyncratic approach to mathematics much, see [Clagett 1978: 297–319]). Apart from that, echoes among Humanists cannot be discerned during the first decades. It is noteworthy, moreover, that Jacopo himself had a thorough training in university philosophy; Regiomontanus, on his part, was an accomplished university astronomer, already familiar with the medieval direct and indirect Archimedean tradition before being introduced to Humanism by Bessarion [Clagett 1978: 343–354]. Both therefore had a substantial fundament allowing them to understand Archimedes as an awe-inspiring geometer. Humanists with no similar background could only take such Latin sources upon faith as claimed without specifying that he was ingenious – among other more important things also as a geometer; at most they could read Plutarch's generic praise. Even Regiomontanus, however, did not go

beyond recognition – his own mathematics is not marked by Archimedean inspiration (after all, his primary interests were astronomy and astrology, as also obvious from the rhetoric of the Padua lecture if read in its integrity).

Among writers in the vicinity of the abbacus tradition (not fully separate from the Italian university environment, some abbacus teachers also taught mathematics and astronomy at university) and the higher artisanate, there was a certain impact. Piero della Francesca, who had access to Jacopo's translation (and even copied at least part of it [d'Alessandro & Napolitani 2012: 84*f*]), has some Archimedean namesdropping in *De quinque corporibus regularibus* concerning matters that already appear but without such reference in his earlier *Trattato d'abbaco* [Clagett 1978: 396–398]. There are apparently no references in his works to Archimedes beyond that. Luca Pacioli, too, must have seen Jacopo's translation [Clagett 1978: 448, 460], but mostly draws on the direct and indirect medieval traditions for Archimedes's mathematics, giving only quite imprecise references; on the other hand, in the *Summa de arithmetica* ... [1494] he refers in the unpaginated dedication to Duke Guidobaldo to "the great Syracusan geometer Archimedes" who, with "his machines and mechanical inventions kept Syracuse safe for long". The passage is repeated almost verbatim in his *Divina proportione* [1509: b ii^{r}] – now addressed to Ludovico Sforza of Milan and characterizing Archimedes as a "noble ingenious geometer and most worthy architect" and pointing out that he defended his *patria*. In the same work Pacioli gives further imprecise references to Archimedes's results.

The case of Leonardo da Vinci is somewhat similar but not identical. He appears to draw on recent as well as medieval Archimedean mathematics [Clagett 1978: 478]. He understands that Archimedes "never squared any figure with curved sides" but "only squared the circle minus the smallest portion that the intellect can conceive, that is the smallest point visible" [trans. Richter 1883: II, 446]. Also insightful at least as to the conditions of his own epoch, Leonardo believes Marcellus wanted to find Archimedes in order to make use of his services – but he appears to draw on sources from approximate memory, believing that it was Cato, not Cicero who found Archimedes's tomb, and that the latter defended some Spanish city in its wars with the English (*ibid.*, pp. 446, 451).

One late-15th-century pure-breed Humanist manifested interest in Archimedes the mathematician: Giorgio Valla. He bought the manuscript from which Moerbeke had made his translation, and he at least saw Jacopo's translation [Clagett 1978: 462]. He also possessed a manuscript of Proclos's commentary on *Elements* I, copied in part by himself [Rose 1975: 47]. His posthumous *De expetendis et fugiendis rebus* [1501] returns to Archimedes time and Again. Regularly it refers to what *could* have been be known from Plutarch and the Latin sources but Valla draws his information from Proclos (reversely, almost every passage in Proclos's commentary referring to Archimedes is used). Sometimes Valla discusses Archimedes's mathematics (not merely quoting or using results), in which cases neither Latin sources not Pluarch would have had

anything to offer. On page a I.iii^{v} we find the siege and death stories, embellished by the additions that Archimedes did not ponder flight, and that he used geometry to inspect the possibilities of defense (apparently Valla's own inventions, the latter corresponding to what court mathematicians of the epoch were doing); page I.b.i^{r} speaks of Archimedes's work on mechanics (drawn from Proclos [ed. Friedlein 1873: 41]) and page I.n.ii^{r} relates the ship and crown stories (again from Proclos [ed. Friedlein 1873: 63*f*]); page I.n.ii^{v} borrows from Proclos [ed. Friedlein 1873: 68] that Archimedes mentions Euclid. Further, passing to mathematics, on page I.n.v^{v}, Archimedes is cited for the definition of the straight line as the shortest lines between the extremities (actually the first postulate of *On the Sphere and Cylinder*) and claims it to be equivalent to Euclid's definition, which is indeed what Proclos argues [ed. Friedlein 1873: 110]; page I.i^{v} ascribes to Archimedes the description of 13 regular and semiregular bodies, information drawn from Pappos's *Collectio* V.xix [ed. Hultsch 1876: I, 352–354]. Some further references to Archimedean results could come from anywhere (often they are made in passing in an unspecific context), or they may be results of Valla's own readings of Archimedes (in particular those of vol. II). Chapter ii of Book XIII (pages u.v^{v}–x.iiii^{r}), draws upon Eutocios's commentary to *On the Sphere and Cylinder II*.

All in all, Valla's "Archimedes" builds upon the same sources as his acquaintance with Archimedean mathematics – he has no need, neither for Plutarch nor for Latin anecdotes, even though he presents much of their substance.

The 16th century

The 15th-century "Archimedes" did not disappear completely for that matter. In 1568, Giorgio Vasari [ed. Milanesi et al 1846: XI, 98] could still characterize the painter and architect Bartolomeo Genga as a new Archimedes because of his design of fortifications. Twenty years later, Sperone Speroni, trained in natural philosophy (by Pomponazzi, among others), was told to have been in doubt whether the famous technician had left anything in writing – thus Bernardino Baldi [ed. Narducci 1886: 401], who forgives this "alert mind of our age" because of his different profession. However, *within* the increasingly important and increasingly competent mathematical professions,[10] Archimedes the mathematician came to equal or even overshadow his mechanic namesake.

The 16th century brought the printing of Archimedean works. In [1503], the astronomer Luca Gaurico published a small volume containing Archimedes's *Quadrature of the parabola* and *Measurement of the circle* in Moerbeke's translation along with ps.-Campanus's *Tetragonismus id est circuli quadratura* (the latter provided with due critical commentary). In [1543], Tartaglia republished Gaurico's two Archimedean editions together with *On the Equilibrium of Planes* and *On Floating Bodies* I, even these in Moerbeke's version. Without claiming it explicitly, Tartaglia managed to make the world

[10] See [Biagioli 1989].

believe that he had translated from the Greek himself – a belief that survived until the rediscovery of the Moerbeke manuscript in 1882 [Clagett 1978: 553]. In [1560], Tartaglia further published as Book III of *La quarta parte del general trattato de' numeri e misure* an Italian translation of *On the Sphere and Cylinder* I; it was probably first made in 1531 on the basis of a Moerbeke text but then corrected by means of Jacopo's translation before the final publication [Clagett 1978: 541].

The *editio princeps* of the Archimedean corpus was published by Thomas Gechauff Venatorius in Basel in [1544]. The Greek text was accompanied by Jacopo's translation as corrected by Regiomontanus. These two, and the new partial translation which Federico Commandino published in [1558a] and [1565a], were the main sources for later 16th and 17th-century Archimedean work [Clagett 1978: 568].

[Commandino 1558a] contained *On the Measurement of the Circle*, *On Spiral Lines*, *On the Quadrature of the Parabola*, *On Conoids and Spheroids*, and *The Sandreckoner;* they were translated directly from Greek manuscripts, and accompanied by a separate volume of commentaries [Commandino 1558b]. [Commandino 1565a] was a revised version of the Moerbeke translation of *On Floating Bodies*, which was absent from the *editio princeps* and from available Greek manuscripts. All were much sounder than preceding translations.

A further incomplete translation was made by Antonius de Albertis at some moment before 1555 [Clagett 1978; 1357–1365]. It remained in manuscript and appears to have had no influence.

Better text versions and publication in print are one aspect of the novel way the 16th century approached Archimedes. Another aspect is the *use* made of Archimedean theory. Most important in this respect is what was done by Francesco Maurolico and Commandino.

Maurolico's "Archimedean" inspiration went beyond mathematics. When unpaid Spanish auxiliary troops were marauding Sicily in 1539, so he tells, he "put aside his rule and compass and took up arms, the example of Archimedes warning him not to be devoting himself to describing lines and circles at the time of such danger"; concretely, he assisted in the fortification of Messina [Clagett 1978: 755].

Already in 1534, he had composed his own versions of *On the Quadrature of the Parabola*, *On the Measurement of the Circle*, and *On the Sphere and the Cylinder*, making use of the various direct and indirect medieval traditions combined with information drawn from Valla [Clagett 1978: 773]. In *De momentis aequalibus* from 1547–48 he took up the investigation of the centres of gravity of solids (as Maurolico [1685: 156] points out, Archimedes had only dealt with those of plane figures in *On the Equilibrium of Planes*). This topic also occupied him later on, and in the 1550s or 1560s he applied Archimedean mechanics and medieval impetus theory to the ps.-Aristotelian *Mechanica*.

Commandino, too, was to publish on the centres of gravity of solids in [1565b]. Giovanni Battista Benedetti, Guidobaldo del Monte and Baldi confronted the ways mechanical questions were dealt with by Archimedes, Heron, Pappos, Aristotle, ps.-

Aristotetle, Jordanus and impetus-theory – confronting also each other [Rose 1975: 154–156, 230–233, 249–253].

As could be expected, knowing the Archimedean texts intimately and using them changed the image of Archimedes among competent mathematicians. This can be illustrated by how Girolamo Cardano, Commandino and Baldi spoke about him.

In *Encomium geometriae*, read by Cardano in the Academia Platina in Milan in 1535, we find a long list of names of geometers, drawn as far as the minor figures are concerned from Proclos's recently published commentary to *Elements* I and thus ultimately from Eudemus. Then comes the observation [Cardano 1663: 443] that

> they are all defeated by Archimedes of Syracuse, almost all of whose findings we possess. A man of the highest genius, and who will have shown the circumference of the circle pretty closely, and taught by solid geometry how to interpose two lines between two others in continuous proportion. But that has been lost.

In the context of a praise of geometry, only Archimedes's mathematics finds its place. In *De subtilitate* [Cardano 1550], the situation is different. Book I refers repeatedly to Archimedes in the discussion of mechanical questions; book IV refers to a book about parabolic burning mirrors mistakenly ascribed to Archimedes and to Archimedes setting fire to Roman ships by means of burning mirrors (a story Cardano attributes to Galen). Book XVI, finally, situates Archimedes first in a list of subtle minds (pp. 313*f*)

> not only because of his works which have now been published but also because of his mechanics which, as Plutarch relates in his *Life of Marcellus*, discouraged the Roman troops time and again by his inventions, and discourages us no less by Galen's testimony, in both areas not only the first but inimitable.

Archimedes is followed by Ptolemy, Aristotle, Euclid, John Scot, Swineshead, Apollonios, Archytas, al-Khwārizmī, al-Kindī, Jābir ibn Aflaḥ, Galen and Vitruvius[11] – a striking order, given Cardano's own primary engagement in astrology, medicine and, when it comes to mathematics, algebra.

Venatorius, in the dedicatory letter introducing his edition of the Greek text, speaks at some length about the mathematics it deals with; but in the end he comes to the defense of Syracuse and to Archimedes's promise to move the earth if only he might get another globe.

Both Commandino's translation [1558a] and his commentaries [1558b] contain dedicatory letters speaking about Archimedes. The former, addressed to Ranuccio Cardinal Farnese (to whose household Commandino belonged since years), first explains that the mathematics, dealing with the intelligible only, have higher rank than metaphysics and natural philosophy: these depend on matter, and even Plato and Aristotle cannot agree about them. This higher rank is also to be ascribed to those

[11] For some reason, Ptolemy has disappeared from the list in [Cardano 1663: III, 307], Aristotle becoming *secundus* instead of receiving the *tertium locum*. This is the list I cited in [Høyrup 1992: 94]. Archimedes is not touched.

mathematical disciplines which *contemplate* the sensible: mechanics, astronomy, optics, etc. So, nothing is more useful nor more necessary for the human race than mathematics, neither in private matters nor in public management – not only geometry, arithmetic and proportion but also mechanics and the preparation of instruments (perhaps for the sake of decorum written in Greek). This leads naturally to Archimedes – first his astronomy and sphere, then arithmetic (the *Sandreckoner*). Though Archimedes is not known for anything in music, Commandino finds it plausible that he excelled even in this discipline. That he was "a kind of God in geometry nobody sane of mind" can deny. Mechanics he first practised for war, and then transferred to peace – specifically, we hear about the ship, the defense of Syracuse, about Marcellus's grief, and about Cicero finding the grave. "Much other we hear which, although it be eminently true, arouses more admiration than belief among posteriors". In contrast to all less competent predecessors, Commandino dares characterize Archimedes's "few extant writings [as] most obscure, and hardly understandable by exertion of the greatest efforts" – but Eutocios, Regiomontanus and Maurolico, so he adds, have been able to fathom them.

The dedication of the commentaries is addressed to the Cardinal's brother-in-law, Duke Farnese. It is much shorter, and concentrates on military mathematics – thus reminding us that dedications tell us as much about the opinion the writer holds about the addressee and what interests him as it does about the writer's own thinking about the subject-matter. None the less, the former dedication seems really to reflect Commandino's own thought. Later in the commentary volume (fol. 42^{v}) we find another personal paratextual observation – namely that Maurolico is so "skilled in mathematics that in these times he can with justice be said to be another Archimedes".

Baldi had studied with Commandino, and began work on his *Vite de' matematici* after the latter's death in 1575. The longest of these is that of Pythagoras, written in 1588; according to Baldi's excuses [ed. Narducci 1887: 199], however, this is for Italian patriotic reasons. Almost as long is the biography of Archimedes (from 1595), which needs no excuse [ed. Narducci 1886: 388]:

> In all domains there have been some who, having arrived at the peak of excellence, have demonstrated how far the human intellect can advance in that direction. Without doubt Archimedes was such a man in mathematics, since the first place is due for good reasons to him.

Baldi builds as much as possible on Archimedes's own introductory letters; but he also draws on Plutarch, Cicero, Ovid, Ptolemy, Pappos, Proclos, Martianus Capella, Lactantius, Claudianus, etc., confronting them critically with each other. This allows him to present all the usual stories about Archimedes's life and his mechanical feats, and also to speak of his surviving works (still including the falsely attributed *De curvis superficiebus*) as well as lost writings known from more or less reliable references.[12]

[12] On the other hand, while referring to Apuleius's testimony concerning catoptric writings by Archimedes, Baldi corrects Maurolico's ascription of ibn al-Haytham's treatise about that topic

About Guidobaldo del Monte it is said because of his "most subtle demonstrations", and in particular because of his machines, that he possesses "if not the soul then at least the same genius as Archimedes" (p. 390). In conclusion (p. 453) Commandino is cited for the opinion that "that one can hardly call himself a mathematician who has not studied the works of Archimedes".

Among the mathematicians of the outgoing Renaissance, Archimedes had thus becomes primarily a mathematician creating advanced theory; but his fame as most skilled in theoretical as well as practised mechanics was not discarded. These mathematicians themselves, often working at princely courts, were engaged not only in theory but also in practical service to prince and state. Their Archimedes was one of their own kind, as that of Taccola and Brunelleschi had been in the early 15th century – only their kind had changed.

Archimedes in the Northern Renaissance

All of this, from Petrarca onward, concerned Italy (with Venatorius's publication of the *editio princeps* as only exception – a partial exception, Venatorius having learned much of his mathematics in Italy).

In the Northern Renaissance, references to Archimedes's mathematics are late and rare, and those to the person even fewer. Stifel tells the crown story in the *Arithmetica integra* [1544: 267^{r}], and refers to $3^{1}/_{7}$ as the value for the ratio between the circular perimeter and diameter "whose originator is said to be Archimedes" (225^{v}). The dedicatory letter of [Scheubel 1550: II] mentions the defense of Syracuse, after which neither Archimedes nor his mathematics appears in that work. In the *Protomathesis*, Oronce Finé [1532: 59^{v}–82] gives an Archimedean squaring of the circle (followed unfortunately by an "exact" construction of his own). Other works of his contain the same, or scattered references showing that Finé has consulted [Valla 1501]. Joannes Buteo's *De quadratura circuli* from [1559] obviously also refers repeatedly to Archimedes – it consists indeed of translations with commentary of *On the Measurement of the Circle* and Eutocios's commentary, and of refutations of Finé's and other erroneous circle squarings. But Archimedes only appears as needed for this purpose.

The earliest example of Northern worshipping "Archimedism" is to be found in Petrus Ramus's *Scholae mathematicae* from [1569]. The presentation of Archimedes begins (p. 26) almost as that of Baldi:

> God has decided that there should be in each art something like a unique idea which everybody studying the discipline would propose to himself as a model – as in eloquence, Demosthenes and Cicero, and in medicine Hippocrates and Galen: thus Archimedes in mathematics.

---

to Archimedes [Narducci 1886: 401].

From Ramus's own pseudo-practical orientation, from his lack of mathematical depth and from his castigation of Euclid's "Platonic error" (p. 27*f*) one should expect him to praise first of all Archimedes the engineer. But that does not happen – first comes Archimedes's excellence as a pure mathematician, excelling in arithmetic (the *Sandreckoner*) and as well as geometry. Only afterwards it is admitted that according to Plutarch Archimedes was imbued with Plato's error – and then we are told, as implicit refutation, about the crown and about the mechanical and military feats. Ramus's own mathematics was uninfluenced by Archimedes – his Archimedism was pure ideology, it did not inspire him to become an Archimedean.

The first Northern figure to approach Archimedean mathematics *as mathematics* and not only as a small collection of famous results is thus Viète, at the very end of the 16th century. In his *Opera mathematica* [van Schooten 1646], the Archimedean treatise which plays the largest role in *On Spiral Lines*, being referred and used repeatedly in *Apollonius Gallus* and *Variorum de rebus mathematicis responsorum liber VIII*. When it fitted his mathematical intent, Viète was thus an Archimedean; however, there is no general praise in the works, neither of the person, nor of Archimedes as a mathematician; even for a mere presentation of either of these one will look in vain. In double contrast to Ramus, Viète, sometimes Archimedean, was no Archimedist.

References

Greek and Latin classics, where the text makes use of standard reference systems, are not included. Any scholarly edition will do.

Alberti, Leone Battista, 1541. *De re aedificatoria libri decem*. Strasbourg: Jacob Cammerlander.

Biagioli, Mario, 1989. "The Social Status of Italian Mathematicians, 1450–1600". *History of Science* 27, 41–95.

Billanovich, Giuseppe (ed.), 1943. Francesco Petrarca, *Rerum memorandarum libri*. Firenze: Sansoni.

Burley, Walter, 1487. *Libellus de vita et moribus philosophorum et poetarum*. Antwerpen (?): Drucker der Mensa philosophica.

Busard, Hubert L. L. (ed.), 2001. *Johannes de Tinemue's Redaction of Euclid's Elements, the So-Called Adelard III Version*. 2 vols. Stuttgart: Franz Steiner.

Buteo, Joannes, 1559. *De quadratura circuli libri duo, ubi multorum quadraturae confutantur, et ab omnium impugatione defenditur Archimedes*. Lyon: Guillaume Rouilles.

Cambiano, Giuseppe, 1999. "Philosophy, Science and Medicine", pp. 585–613 *in* Keimpe Algra et al (eds), *Cambridge History of Hellenistic Philosophy*. Cambridge: Cambridge University Press.

Capelli, L. M. (ed.), 1906. Pétrarque, *Le traité De sui ipsius et multorum ignorantia*. Paris: Honoré Champion.

Cardano, Girolamo, 1550. *De subtilitate libri XXI*. Nürnberg: Ioh. Petreius.

Cardano, Girolamo, 1663. *Operum* tomus quartus. Lyon: Jean Antoine Huguetan & Marc Antoine Ragaud.

Clagett, Marshall, 1964. *Archimedes in the Middle Ages*. Vol. I. *The Arabo-Latin Tradition*. Madison, Wisconsin: University of Wisconsin Press.

Clagett, Marshall, 1976. *Archimedes in the Middle Ages*. Volume II, *The Translations from the Greek by William of Moerbeke*. Philadelphia: The American Philosophical Society.

Clagett, Marshall, 1978. *Archimedes in the Middle Ages*. Volume III, *The Fate of the Medieval Archimedes 1300–1565*. Philadelphia: The American Philosophical Society.

Commandino, Federico (ed., trans.), 1558a. Archimedis *Opera nonnulla*. Venezia: Manuzio.

Commandino, Federico, 1558b. *Commentarii in* Opera nonnulla *Archimedis*. Venezia: Manuzio.

Commandino, Federico (ed.), 1565a. Archimedis *De iis quae vehuntur in aqua libri II*. Bologna, Benacci.

Commandino, Federico, 1565b. *Liber de centro gravitatis solidorum*. Bologna, Benacci.

d'Alessandro, Paolo, & Pier Daniele Napolitani (ed., trans.), 2012. *Archimede latino: Iacopo da San Cassiano e il* corpus *archimedeo alla metà del quattrocento*. Paris: Les Belles Lettres.

Finé, Oronce, 1532. *Protomathesis.* Parigi, Morrh & Petre.

Fracassetti, Giuseppe (ed., trans.), 1869. Francesco Petrarca, *Lettere senili*. 2 vols. Firenze: Le Monnier, 1869–70.

Friedlein, Gottfried (ed.), 1873. Procli Diadochi *In primum Euclidis Elementorum librum commentarii*. Leipzig: Teubner.

Gaurico, Luca, 1503. *Tetragonismus idest circuli quadratura per Campanum, Archimedem Syracusanum atque Boetium mathematicae perspicassissimos adinventa*. Venezia: Giovanni Battista Sessa.

Heiberg, J. L., 1907. "Eine neue Archimedes-Handschrift". *Hermes* 41, 235–303.

Høyrup, Jens, 1992. "Archimedism, not Platonism: on a Malleable Ideology of Renaissance Mathematicians (1400 to 1600), and on its Role in the Formation of Seventeenth-Century Philosophies of Science", pp. 81–110 *in* Corrado Dollo (ed.), *Archimede. Mito Tradizione Scienza*. Firenze: Leo S. Olschki.

Hultsch, Friedrich (ed.), 1864. *Meteorologicorum scriptorum reliquiae*. 2 vols. Leipzig: Teubner.

Hultsch, Friedrich (ed., trans.), 1876. Pappi Alexandrini *Collectionis* quae supersunt. 3 vols. Berlin: Weidmann, 1876–1878.

Kroll, Wilhelm, & F. Skutsch (eds), 1897. Iulii Firmici Materni *Matheseos libri VIII*. 2 vols. Leipzig: Teubner.

Laird, W. Roy, 1991. "Archimedes among the Humanists". *Isis* 82, 629–638.

Maurolico, Francesco, 1685. *Admirandi Archimedis syracusani Monumenta omnia mathematica, quae extant*. Palermo, Cillenio.

Milanesi, Gaetano, et al (eds), 1846. Giorgio Vasari, *Le vite de' più eccellenti pittori, scultori e architetti*. 13 vols. Firenze: Le Monnier, 1846–1857.

Narducci, Enrico (ed.), 1886. "Vite inedite di matematici italiani scritti da Bernardino Baldi". *Bullettino di Bibliografia e di Storia delle Scienze matematiche e fisiche* 19, 335–406, 437–489, 521–640.

Narducci, Enrico (ed.), 1887. "*Vita di Pitagora*, scritti da Bernardino Baldi, tratta dall'autografo ed annotato". *Bullettino di Bibliografia e di Storia delle Scienze matematiche e fisiche* 20, 197–308.

Nisard, Désiré (ed., trans.), 1865. Pétrone, Apulée, Aulu-Gelle, *Oeuvres complètes*. Paris: Firmin-Didot.

Pacioli, Luca, 1494. *Summa de Arithmetica Geometria Proportioni et Proportionalita.* Venezia: Paganino de Paganini.

Pacioli, Luca, 1509. *Divina proportione*. Venezia: Paganius Paganinus.

PL: *Patrologiae cursus completus, series latina*, acccurante J. P. Migne. 221 vols. Paris, 1844–1864.

Prager, Frank D., & Gustina Scaglia, 1972. *Mariano Taccola and his Book De ingeneis*. Cambridge, Mass.: M.I.T. Press, 1972.

Ramus, Petrus, 1569. *Scholarum mathematicarum libri unus et triginta*. Basel: Eusebius Episcopius.

Razzolini, Luigi (ed., trans.), 1874. *Le vite degli uomini illustri* di Francesco Petrarca. 2 vols. Bologna: Gaetano Romagnoli, 1874, 1879.

Richter, Jean Paul (ed., trans.), 1883. *The Literary Works of Leonardo da Vinci*, compiled and edited from the original manuscripts. 2 vols. London: Sampson Low, Marston, Searly & Rivington.

Rose, Paul Lawrence, 1975. *The Italian Renaissance of Mathematics. Studies on Humanists and Mathematicians from Petrarch to Galileo*. Genève: Droz.

Scheubel, Johann (ed., trans.), 1550. Euclidis Megarensis *Sex libri priores, De Geometricis principiis, Graeci et latini, ... Algebrae porro regulae* .... Basel: Hervagius.

Schmeidler, Felix (ed.), 1972. Joannis Regiomontani *Opera collectanea*. Osnabrück: Otto Zeller.

Sedley, David, 1976. "Epicurus and the Mathematicians of Cyzicus". *Cronache Ercolanesi* 6, 23–54.

Steele, Robert (ed.), 1940. *Communia mathematica* fratris Rogeri partes prima et secunda. Oxford: The Clarendon Press.

Stifel, Michael, 1544. *Arithmetica integra*. Nürnberg: Petreius.

Tartaglia, Nicolò (ed.), 1543. *Opera Archimedis syracusani philosophi ed mathematici ingeniosissimi*. Venezia: Venturino Ruffinello.

Tartaglia, Nicolò, 1560. *La quarta parte del general trattato de' numeri et misure*. Venezia: Curtio Troiano.

Valla, Giorgio, 1501. *De expetendis et fugiendis rebus opus*. 2 vols. Venezia: Manuzio.

van Schooten, Frans (ed.), 1646. François Viète, *Opera mathematica*. Leiden: Elzevier.

Venatorius, Thomas Gechauff (ed.), Jacopo da Cremona (trans.), Joannes Regiomontanus (corr.), 1544. Archimedis Syracusani philosophi ac geometrae excellentissimi *Opera, quae quidem extant omnia*. Basel: Hervagius.

Vincent de Beauvais, 1624. *Bibliotheca mundi seu speculi maioris*. Tomus quartus, *Speculum historiale*. Douai: Baltazar Bellerus.

Williams, Kim, Lionel March & Stephen R. Wassell (ed., trans.), 2010. *The Mathematical Works of Leon Battista Alberti*. Basel: Birkhauser.

MAX-PLANCK-INSTITUT FÜR WISSENSCHAFTSGESCHICHTE

Max Planck Institute for the History of Science

Preprints since 2013 (a full list can be found at our website)

442 William G. Boltz and Matthias Schemmel **The Language of 'Knowledge' and 'Space' in the Later Mohist Canon** (TOPOI fi Towards a Historical Epistemology of Space)

443 Stefano Bordoni **Looking for a Rational Thermodynamics in the late XIX century**

444 Sonja Brentjes and Jürgen Renn **The Arabic Transmission of Knowledge on the Balance**

445 Horst Nowacki **Archimedes and Ship Design**

446 Matthias Schemmel **Elements of a Historical Epistemology of Space** (TOPOI fi Towards a Historical Epistemology of Space)

447 Martin Thiering and Wulf Schiefenhövel **Spatial Concepts in Non-Literate Societies: Language and Practice in Eipo and Dene Chipewyan** (TOPOI fi Towards a Historical Epistemology of Space)

448 Jürgen Renn **Einstein as a Missionary of Science**

449 Hubert Laitko **Der Ambivalenzbegriff in Carl Friedrich von Weizsäckers Starnberger Institutskonzept**

450 Stefano Bordoni **When Historiography met Epistemology.** Duhem„s early philosophy of science in context

451 Renate Wahsner **Tausch – Allgemeines – Ontologie** oder **Das Auseinanderlegen des Konkreten und seine Aufhebung**

452 Jens HÃyrup **Algebra in Cuneiform.** Introduction to an Old Babylonian Geometrical Technique

453 Horst Nowacki **Zur Vorgeschichte des Schiffbauversuchswesens**

454 Klaus Geus and Mark Geller (eds.) **Esoteric Knowledge in Antiquity** (TOPOI fi Dahlem Seminar for the History of Ancient Sciences Vol. II)

455 Carola Sachse **Grundlagenforschung. Zur Historisierung eines wissenschaftspolitischen Ordnungsprinzips am Beispiel der Max-Planck-Gesellschaft (1945–1970)**

456 David E. Rowe and Robert Schulmann **General Relativity in the Context of Weimar Culture**

457 F. Jamil Ragep **From Tūn to Turun: The Twists and Turns of the Ṭūsī-Couple**

458 Pietro Daniel Omodeo **Efemeridi e critica all'astrologia tra filosofia naturale ed etica: La contesa tra Benedetti e Altavilla nel tardo Rinascimento torinese**

459 Simone Mammola **Il problema della grandezza della terra e dell'acqua negli scritti di Alessandro Piccolomini, Antonio Berga e G. B. Benedetti e la progressiva dissoluzione della cosmologia delle sfere elementari nel secondo '500**

460 Stefano Bordoni **Unexpected Convergence between Science and Philosophy: A debate on determinism in France around 1880**

461 Angelo Baracca ***Subalternity vs. Hegemony* – Cuba's Unique Way of Overcoming Subalternity through the Development of Science**

462 Eric Hounshell & Daniel Midena **"Historicizing Big Data" Conference, MPIWG, October 31 – November 2, 2013** Report

463 Dieter Suisky **Emilie Du Châtelet und Leonhard Euler über die Rolle von Hypothesen.** Zur nach-Newtonschen Entwicklung der Methodologie

464 Irina Tupikova **Ptolemy's Circumference of the Earth** (TOPOI fi Towards a Historical Epistemology of Space)

465 Irina Tupikova, Matthias Schemmel, Klaus Geus **Travelling along the Silk Road: A new interpretation of Ptolemy's coordinates**

466 Fernando Vidal and Nélia Dias **The Endangerment Sensibility**

467 Carl H. Meyer & Günter Schwarz **The Theory of Nuclear Explosives That Heisenberg Did not Present to the German Military**

468 William G. Boltz and Matthias Schemmel **Theoretical Reflections on Elementary Actions and Instrumental Practices: The Example of the *Mohist Canon*** (TOPOI fi Towards a Historical Epistemology of Space)

469 Dominic Olariu **The Misfortune of Philippus de Lignamine's Herbal or New Research Perspectives in Herbal Illustrations From an Iconological Point of View**

470 Fidel Castro Díaz-Balart **On the Development of Nuclear Physics in Cuba**

471 Manfred D. Laubichler and Jürgen Renn **Extended Evolution**

472 John R. R. Christie **Chemistry through the 'Two Revolutions': Chemical Glasgow and its Chemical Entrepreneurs, 1760-1860**

473 Christoph Lehner, Helge Wendt **Mechanik in der Querelle des Anciens et des Modernes**

474 N. Bulatovic, B. Saquet, M. Schlender, D. Wintergrün, F. Sander **Digital Scrapbook – can we enable interlinked and recursive knowledge equilibrium?**

475 Dirk Wintergrün, Jürgen Renn, Roberto Lalli, Manfred Laubichler, Matteo Valleriani **Netzwerke als Wissensspeicher**

476 Wolfgang Lefèvre **„Das Ende der Naturgeschichte" neu verhandelt**

477 Martin Fechner **Kommunikation von Wissenschaft in der Neuzeit: Vom Labor in die Öffentlichkeit**

478 Alexander Blum, Jürgen Renn, Matthias Schemmel **Experience and Representation in Modern Physics: The Reshaping of Space** (TOPOI fi Towards a Historical Epistemology of Space)

479 Carola Sachse **Die Max-Planck-Gesellschaft und die Pugwash Conferences on Science and World Affairs (1955–1984)**

480 Yvonne Fourès-Bruhat **Existence theorem for certain systems of nonlinear partial differential equations**

481 Thomas Morel, Giuditta Parolini, Cesare Pastorino (eds.) **The Making of Useful Knowledge**

482 Wolfgang Gebhardt **Erich Kretschmann. The Life of a Theoretical Physicist in Difficult Times**

483 Elena Serrano **Spreading the Revolution: Guyton's Fumigating Machine in Spain. Politics, Technology, and Material Culture (1796–1808)**

484 Jenny Bangham, Judith Kaplan (eds.) **Invisibility and Labour in the Human Sciences**

485 Dieter Hoffman, Ingo Peschel (eds.) **Man möchte ja zu seinem Fach etwas beitragen**

486 Elisabeth Hsu, Chee Han Lim **Enskilment into the Environment: the *Yijin jing* Worlds of *Jin* and *Qi***

487 Jens Høyrup **Archimedes: Knowledge and Lore from Latin Antiquity to the Outgoing European Renaissance**