

The Question of the Authenticity of the *Mechanical Problems*

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Until the nineteenth century there was little doubt among scholars as to the authenticity of the Aristotelian *Mechanical Problems*. There were some doubters among the Renaissance humanists, but theirs were general doubts about the authenticity of a large class of writings, not doubts based on the individual characteristics of this particular work. Some Humanists¹ distrusted any text that hadn't been passed by the Arabs to the Latin West in the High Middle Ages. However, by the end of the 18th century after Euler and Lagrange, the *Mechanical Problems* had ceased to be read as part of science and had become the object of history of science; and there the reading of the text becomes quite different from the Renaissance readings. In his *Histoire des mathématiques* J.E. Montucla² (1797) dismisses the *Mechanical Problems* with such epithets as “entirely false,” “completely ridiculous,” and “puerile.” William Whewell remarks in the *History of the Inductive Sciences*³ that “in scarcely any one instance are the answers, which Aristotle gives to his questions, of any value.” Neither of them, however, cast doubt on the authenticity of the work. Abraham Kaestner's *Geschichte der Mathematik* (1796–1800) mentions doubts – but does not share them.⁴

Serious doubts about the authenticity of the *Mechanical Problems* as an individual work seem to be more a consequence of the disciplinary constitution of classical philology, particularly in nineteenth-century Germany. Some time between about 1830 and 1870, the opinion of most philologists shifted from acceptance to denial of the authenticity of the *Mechanical Problems*.⁵ There is however very little documentation of the reasons for this change of opinion.⁶ Part of the self-understanding of the academic disciplines of classical

¹ Burja 1796 mentions Girolomo Cardano and Francesco Patrizi. “Huiusmodi praeteriisse Aristotelem, demiror, quae nimis fuerunt in conspicuo, ut dubitem ne non suus sit ille liber, qui eius penè nihil sapiat obscuritatem.” (Cardano, *Opere* IV, 515)

² *Histoire des Mathématiques*, Paris, Year VII [1797]: “Ils trouveront sans doute que la plûpart des explications qu'il donne sont entièrement fausses, et que la principale et la première est tout-à-fait ridicule. ... Aristote la cherche dans les propriétés merveilleuses du cercle, dont il fait la puérile énumération;...” p. 189. Montucla's opinions must have been well known since Abel Burja already contradicted him in an Academy lecture in 1791; see Burja 1796.

³ *History of the Inductive Sciences* (London 1837) p. 51.

⁴ “Einige Gelehrte zweifeln, ob es des Philosophen Arbeit sey, die meisten aber erkennen es dafür, wegen der Schreibart, auch der Scharfsinnigkeit.” *Geschichte der Mathematik seit der Wiederherstellung der Wissenschaften bis an das Ende des achtzehnten Jahrhunderts* (Göttingen 1796–1800; vol ii, p. 130).

⁵ The first German translator of the *Mechanical Problems* (1829) could still write in his introduction: “Die Schreibart und Methode der Abhandlung im Allgemeinen ist so sehr Aristotelisch, nach einstimmigem Urtheil aller Herausgeber und Erklärer der Werke dieses Philosophen, daß eben jene für einen Hauptbeweis gelten der Ächtheit dieser Schrift, und diese zu den wenigen gehört, die ohne allen Widerspruch für ächt erkannt werden.” (F. T. Poselger, “Über Aristoteles Mechanische Probleme” in: *Abhandlungen der Königlischen Akademie der Wissenschaften zu Berlin aus dem Jahre 1829* [Berlin 1932] p. 65)

⁶ Christian Brandis, *Geschichte der Entwicklungen der griechischen Philosophie*, 2 vols. (Berlin 1862-4, vol. 1, p. 397). Brandis says about a number of doubtful works (including the *Mechanical Problems* and *De motu animalium*): “Größtenteils ist es entschieden unaristotelisch und sollte sich bei genauerer Prüfung einiges

philology and history of ancient philosophy was the hermeneutic authority to separate genuine works of the masters from other works later smuggled into a corpus. With regard to the *Mechanical Problems* there is however very little by way of argumentation to be found and especially little philological argument. Two genuinely philological arguments against the authenticity are occasionally adduced: (1) the preface on wonders and circles is stylistically unaristotelian⁷ and (2) the *Mechanical Problems* is a mathematical text and Aristotle produced no mathematical texts and himself even says that he wrote no mathematical texts.⁸ These two arguments are flanked by a third consideration, which Valentine Rose (1854) claimed to disregard but nonetheless could not resist mentioning: that the text is trivial and confused (*questionum minutias et confusionem*). Thus, an evaluation of the intellectual quality of the work similar to that of Montucla and Whewell unofficially underwrites the conclusion that the author cannot have been Aristotle.⁹ British scholars of the 20th century have tended to deny

Aristotelische darin nachweisen lassen, – unsre Kenntniß des Lehrgebäudes würde dadurch nicht wesentlich bereichert oder berichtigt werden.” See also Eduard Zeller, *Die Philosophie der Griechen in ihrer geschichtlichen Entwicklung Part II,2* [1879] (4th ed. Leipzig 1921, p. 90n); I quote his entire argumentation on the subject: “Ohne nähere Angabe nennt SIMPL. Categ. 1, ζ (Bas.) Aristoteles’ γεωμετρικὰ τε καὶ μηχανικὰ βιβλία. Unsere Μηχανικὰ jedoch (D. 123. An. 114: μηχανικὸν oder -ῶν), die richtiger (wie bei Ptol. 18) μηχανικὰ προβλήματα genannt würden, sind gewiss nicht aristotelisch. (Vgl. auch Rose a.a.O. 192.)” Wilhelm Windelband, *Geschichte der alten Philosophie*, (2nd ed., Munich: Beck, 1894) just says: “Eine Anzahl besonderer Abhandlungen sind verloren, die erhaltenen *mêkanika* unecht, ebenso *peri kosmou* ...” (p.148)

⁷ A recent version of this argument is De Gandt (“Force et science des machines,” in J. Barnes et al., *Science and speculation: studies in Hellenistic theory and practice*, Cambridge Univ. Press 1982): “Ce morceau de rhétorique sur les merveilles et les contraires me paraît déplacé ici, peu digne de la sobriété d’Aristote. D’ailleurs le Philosophe avait remarqué ces propriétés du mouvement circulaire, et les avait mentionné d’une manière beaucoup plus brève et sèche.” (p. 119)

⁸ This argument derives from Valentine Rose (*De Aristotelis librorum ordine et auctoritate commentatio*, Berlin, 1854, p. 192): “That the *Mechanical Problems*, which deals with the balance and the lever and various other things (...), is not by Aristotle, even disregarding the composition itself and the details and the confusion of the questions (...), follows (...) from the discourse of the prologue on the wonder-working circle from which all the θαύματα of mechanical motions are derived (...) and [from the fact] that if we listen to him himself, it is clear that he is the author of no mathematical writing at all.” [This translation of Rose’s nineteenth-century Latin may be somewhat conjectural: Valentine Rose *De Aristotelis librorum ordine et auctoritate commentatio*, Berlin, 1854, p. 192: „Mechanica vero Problemata quae versantur circa libram et vectem aliaque deinde varia (ad vectem autem ceterarum rerum mechanicarum explicationem referendam esse vult omnium p. 848, 13) non esse Aristotelis si negligas compositionem ipsam et quaestionum minutias et confusionem (multis tamen quae bene vereque intellecta exposuit auctor refertarum cf. van Cappelle p. 152 sqq. et 184, ita ut in huius libri laude multi essent antiquiores ut Monantholius cuius cf. Praef. et Comm., p. 211) et ex praefationis sermone circuli ex quo mechanicorum motuum θαύματα omnia repetit mirabilia efferentis (847b17 sqq. et Vitruv.10, 1. 8) et ex eo sequitur (nihili enim sunt. quae pro Aristotele auctore verba fecere Henr. Monantholius in Comm. ad Ar. Mech. Paris. 1599 p. 1-2 et van Cappelle in ed. Mech. Amstelodami 1812 Animadverss. p. 127, quem cf. de cod. Paris. p. 125, sermonem Aristotelis et disputandi modum agnoscentes) quod si ipsum audimus nullius omnino scripti mathematici auctorem eum fuisse patet.“ (p.192)] Fritz Krafft, the leading advocate of the authenticity of the *Mechanical Problems*, singles out Rose as presenting the only serious argument against the work’s authenticity, but he does not actually report what he takes that argument to be, nor does he address it directly. See Krafft, *Dynamische und statische Betrachtungsweise in der antiken Mechanik*, Wiesbaden: Steiner, 1970 esp. pp. 15 and 69.

⁹ See in particular Paul Tannery, “Sur les Problèmes mécaniques attribués à Aristote” (*Memoires scientifiques III*, Paris, 1915, p. 33): “Tout d’abord, il est bien certain que nous ne sommes pas en présence d’un ouvrage d’Aristote, c’est-à-dire d’un penseur auquel on ne peut dénier, en tout état de cause, d’avoir constamment visé la séparation des concepts emmêlés dans les significations imprécises des mots du langage usuel. [...] Si, d’autre part, j’ai parlé de compilation à propos des *Mechanica*, j’ai voulu seulement constater qu’il s’agit d’un recueil, sans ordre et sans méthode, de questions très diverses à la solution desquelles l’auteur n’a pas su imprimer le

that Aristotle is the author, without however adopting a negative attitude towards its quality.¹⁰ Two other arguments of no great consequence should also be mentioned for the sake of completeness: (3) the failure of ancient authors such as Archimedes, Hero, Athenaios, and Pappus to mention Aristotle as the author,¹¹ and (4) the purported fact that the incorporation of the *Mechanical Problems* into the Aristotelian corpus began with Bessarion, who had a special liking for mechanics.¹²

At some point however, philologists and historians of philosophy also decided that the *Mechanical Problems* were unaristotelian in its subject matter.¹³ The most prominent such argument, codified by Gercke in *Pauly*, at the end of the 19th century and also adduced by Forster in preface to his translation is that: “Whilst the scientific standpoint of the *Mechanica* is certainly Peripatetic, the writer’s interest in the practical application of the problems involved is quite un-Aristotelian.”¹⁴ Gercke and Forster’s argument is not very convincing. Farrington, for instance, dismisses it out of hand; Clagett points out, that this “is doubtful reasoning at best, considering the enormous range of intellectual activity of Aristotle during his last years at the Lyceum.”¹⁵ And in fact the analysis of oars and masts, wedges and tooth extractors is carried out not to apply or improve such mechanical devices, but rather to show that a wide variety of technical situations in which the motion (effect) seems not to be proportional to the force (cause) – and thus to be incompatible with a fundamental principle of Aristotle’s physics – are in fact compatible. A second argument based on subject matter has somewhat more substance: The analysis of circular motion into a “natural” tangential component and an “unnatural” centripetal component, as carried out in Problem 1, is difficult to reconcile with the usual picture of Aristotle.¹⁶ Furthermore, Heiberg argues that *one* of the

sceau d’une originalité personnelle (où par conséquent ont pu être intercalés postérieurement, sans qu’on ait les moyens de le reconnaître, des problèmes étrangers à la composition primitive).”

¹⁰ David Ross (1923) *Aristotle*, London: Methuen, p. 12; G.E.R. Lloyd (1970) *Early Greek Science: Thales to Aristotle*, New York: Norton, p. 135.

¹¹ Who said this? See below for Athenaeus mentioning Aristotle.

¹² Paul L. Rose and Stillman Drake, “The Pseudo-Aristotelian Questions of Mechanics in Renaissance Culture,” In: *Studies in the Renaissance XVIII* (1971) 65-104, pp. 75–6; Ms Z.Gr.200 (1547) “is the first known manuscript in which the *Mechanica* appears together with the genuine works of Aristotle”: [This would seem to be made irrelevant by the existence of Pachymeres’ *Philosophia*. Is it even true?]

¹³ “Zu den besseren unter diesen pseudoaristotelischen Schriften gehören auch die mechanischen Probleme, welche aber zu wenig Anklänge an philosophische Sätze enthalten, um hier bei ihnen zu verweilen.” (Zeller, *Die Philosophie der Griechen*, II,2, p. 940)

¹⁴ This is Forster’s *entire* argument. Cf. Gercke (in *Pauly*, 1044): “Die Μηχανικά gehen von allgemeinen Gesichtspunkten aus, die denen der ältesten Generationen im Peripatos entsprechen, jedoch zielen die Probleme und Lösungen im einzelnen auf praktische Nutzenwendung hin, was (Rose De ord. 192) ganz unaristotelisch ist.” The new *Pauly* (*Der neue Pauly: Enzyklopädie der Antike*, Stuttgart: Metzler 1996ff) is salomonic: the article on Aristotle (Frede) considers the *Mechanical Problems* inauthentic; the article on Mechanics (Krafft) authentic. On the whole, historians of ancient technology are more likely to see the work as authentic than are other scholars; see Helmut Schneider, *Das griechische Technikverständnis: von den Epen Homers bis zu den Anfängen der technologischen Fachliteratur*, Darmstadt: Wiss. Buchges., 1989, 234f and Astrid Schürmann, *Griechische Mechanik und antike Gesellschaft: Studien zur staatlichen Förderung einer technischen Wissenschaft*, Stuttgart: Steiner, 1991, 33f.

¹⁵ Benjamin Farrington, *Greek Science*, (Baltimore: Penguin, 1961) pp.186–7; Marshall Clagett, *The Science of Mechanics in the Middle Ages* (Madison: Univ. of Wisconsin Press, 1979) p. 4.

¹⁶ De Gandt (1982) 126.

mathematical terms used in the *Mechanical Problems* was actually coined by Euclid thus making the work later than Aristotle – though he admits this is conjectural.¹⁷

If we drop the specious and non-philological background argument, that the subject matter and the quality of the work don't fit Aristotle, we are left with a critique of the style of the Preface and a purported claim by Aristotle not to have written a mathematical work. If in view of the tradition of attributing the work to Aristotle we place the burden of proof on denial, it would seem that a rational justification for denying the authenticity of the work could only be based on an analysis of its content; and here the last mentioned objection must be taken seriously. But none of the arguments against the authorship of Aristotle himself provides any reason to doubt that the author was someone from his school who flourished in the later days of his life. And since the way letters are used to denote points is definitely pre-euclidian in style, whoever actually wrote the text was either a fourth-century philosopher or a later thinker who deliberately used an archaic style

If we list up all serious remaining evidence against the default setting, Aristotle, we have: (1) The mathematical style of argument of Problem 1 is unusual for Aristotle. (2) The analysis of circular motion into “natural” tangential and “unnatural” centripetal components carried out in Problem 1 is not quite coherent with Aristotle's other positions. (3) The text of the first Problem (according to Heiberg) contains one instance of post-Euclidean mathematical terminology.

Against this there are a number of other considerations: Few of those denying the authenticity are aware of the Arabic tradition of the writing; they ignore the evidence for a possible (lost) Latin tradition of the writing, but most importantly they ignore the content of the work.

Points relevant to the question of authenticity

A. A number of ancient sources refer to a *Mechanics* in Aristotle's works¹⁸

- 1) All three traditional lists of Aristotle's works mention a mechanics:
 - Diogenes Laertius (traced back to 3rd century BC)
 - the *Vita Hesychi* (traced back to 3rd century BC)
 - Ptolemaeus *Chennus* or *al-Garib* (traced back to 1st century AD)
- 2) Simplicius (6th c.) *In aristotelis categorias commentarium* mentions (as did Elias) Aristotele's *Mechanics*. *Commentaria in aristotelem graecae* viii, Berlin 1907, p. 4, l. 26; οἷα γεωμετρικὰ τε καὶ αὐτῷ γέγραπται καὶ μηχανικὰ βιβλία.

¹⁷ According to Heiberg (“Mathematisches zu Aristoteles” in *Abhandlungen zur Geschichte der mathematischen Wissenschaften mit Einschluss ihrer Anwendungen* 18, 1904, 3–49) the word τετράπλευρον (used at 848b20 in the course of the analysis of compounded motion) was coined by Euclid to denote a quadrilateral figure since the existing term τετράγωνον (quadrangle) had already acquired the meaning “square” for the Pythagorians (pp. 15, 32). Krafft (1970, 92) disputes this judgment, pointing out that the mathematical terminology used in this passage to introduce the letters marking points in the diagrams is unequivocally pre-Euclidean, and arguing that the term τετράπλευρον may well have already existed in colloquial usage and that the context makes it clear that it is the four *sides* of the figure not its angles that are of interest. Interestingly Heiberg begins his discussion with the assertion that this one word is the only terminological aspect of the work that speaks against an Aristotelian origin.

¹⁸ Düring 1957, Hein 1985, van Leeuwen 2012.

- 3) Athenaeus of Naucratis (1st c. BC) “On Machines” dismisses Strato, Hestiaeus Archytas and Aristotle as just beginners’ stuff – not for real practitioners.¹⁹
 - 4) Vitruvius discusses several problems from the *Mechanical Problems* in Bk. 10 of *De architectura* without ascription. In Bk. 7 he mentions 12 writers on machines – without including Aristotle among them.²⁰
- B. The text was known to the Arabs. A partial translation was made in the 11th century and included in a compilation from the early 12th century.²¹
- C. There may have been a Latin (partial) translation.
- 1) The *Falkenbuch* of Friedrich II (early 13th c.) mentions and quotes a *Liber de ingenii levandi pondera* of Aristotle: “quod magis facit levare pondus maior circulus”.
 - 2) Jordanus de Nemour (early 13th c.) is familiar with the content of some of the problems.
 - 3) Various bibliographic sources suggest the existence of a Latin mechanics of Aristotle
 - a) In an export license from Bologna (1413) for books there appears the title “Repertorium super mechanica Aristotilis”²²

¹⁹ Reference due to Istvan Bodnar (2011), who points out that Athenaeus thus must have had access to both Strato’s and Aristotle’s writings on mechanics, which would certainly speak against Strato’s possible authorship of the *Mechanical Problems*. See D. Whitehead and P.H. Blyth, *Athenaeus Mechanicus On Machines*. (Περὶ μηχανημάτων), Wiesbaden: Steiner 2004, pp. 44–45: “This, you see, is how anyone setting about a practical treatise should have benefited: having carefully understood himself on the basis of the famous Delphic precept, rather than the works of Strato and Hestiaeus and Archytas and Aristotle and the others who have written works similar to theirs. For younger devotees of knowledge they would be useful [as a training] in elementary principles; but for those already wanting to *do* something they would be altogether irrelevant and detached from practical thinking.”

²⁰ T.N. Winter in the introduction to his translation of the *Mechanical Problems* (*The ‘Mechanical Problems’ in the Corpus of Aristotle*, [Faculty Publications, Classics and Religious Studies Department, University of Nebraska - Lincoln Year 2007] <http://digitalcommons.unl.edu/classicsfacpub/68>) argues that since Vitruvius (allegedly) had the actual text of the *Mechanical Problems* and knew its author, the author can’t be Aristotle – otherwise he would have been mentioned. Winter (p. iv) takes Vitruvius’ list (Book 7, Intro §14) of people who wrote about machines to be his actual sources on machines and by a process of elimination of 11 of the 12 predecessors of (Diades, Archytas, Archimedes, Ctesibios, Nymphodorus, Philo Byzantius, Diphilos, Democles, Charias, Polyidos, Pyrrhos, Agesistratos) he arrives at Archytas as the probable author. The argument is not particularly convincing, since the *Mechanical Problems* is not about building machines but rather about theoretically reducing them to the lever, balance and circle. The context of the list is also somewhat peculiar: Book 7 is not about the construction or analysis of machines, but about floors, the design of façades and wall colors. Archytas is in principle a candidate for authorship because he is said to have been the first to base mechanics on mathematical principles. But even that is based on reconstruction: the actual text of Diogenes reports, unfortunately, that Archytas based mechanics on *mechanical* principles – whatever those are – and the editor, Long (and the experts support him here) emended the text to say ‘mathematical’ instead. Furthermore, according to Carl Huffman’s new book on *Archytas* (2005, p. 31) the genuine fragments that we possess from Archytas are written in Doric dialect (and he was later taken “as a model of Doric prose”) – which would seem to exclude him as author of the Attic *Mechanical Problems*. Nonetheless, if Vitruvius did indeed have access to something like our text and if this text was at the time attributed to Aristotle, then it is puzzling that he did not mention Aristotle in Bk 10. The same puzzlement is justified for Hero of Alexandria a century later.

²¹ See Mohammed Abattouy “Nutaf Min Al-Hiyal: A Partial Arabic Version of Pseudo-Aristotle’s ‘Problemata Mechanica’,” *Early Science and Medicine*, 6, No. 2 (2001), pp. 96-122.

²² Marshall Claggett, “Three Notes,” *ISIS* 48 (1957) 182–83.

- b) A book list at the University of Padua, from 1401 lists a “Liber mechanicorum” under Aristotle.
- c) Henricus de Villena (1384–1434)²³ had two books of “Mechanicas” catalogued under Aristotle in his library.
- d) A Statute of the University of Paris for 1366²⁴ lists a „librum Mechanicae“ among the required Aristotle texts for a degree in the Faculty of Arts. However, a different source reads “Metaphysice”.
- D Two “mathematical” problems (1 and 24), on which almost all arguments against Aristotle’s authorship are based, are anomalous.
- 1) the (not very convincing) proof of the composition of motions plays no role in the rest of the work and interrupts the argument of the program of reduction.
 - 2) Problems 1 and 24 are much longer than any others: three and two times as long as the next longest Problem (23) and 6 and 4 times the mean.
 - 3) Problems 1 and 24 do not begin with “dia ti” but with a different (though equivalent) expression.
 - 4) Problem 23, the third longest, is also about the geometry of moving points. And Problem 5 is fourth in length because it is interrupted by a geometrical argument. Thus more than one third of the treatise, as we have it, is mathematical, not mechanical
- E *ad hominem*: none of the scholars who originally disputed the authenticity of the *MP* were aware of the Arabic tradition or of the evidence for a lost Latin tradition. Even after Duhem, none of them seem to see the program of reduction in the first three problems.

Remaining problems

²³ See J.E. Brown, The 'Scientia de ponderibus' in the later middle ages, Diss.Univ. of Wisconsin, 1967, p.203. The Spanish library in Madrid is supposed to have possessed a mss of two books of mechanics listed under Aristotle (Emilio Cotarelo y Moro, *Don Enrique de Villena, su vida y obras*, Madrid 1896, p. 157) – a friend has looked for them in the library in Madrid but did not find them.

²⁴The Papal Legates, the Cardinals, Giles de Montaigu and John de Blandy imposed a body of Statutes on the University of Paris in 1366, which included the following passage: “Item quod nullus admittatur ad Licentiam in dictâ Facultate [Artium], nec in examine B[eate] Mariae, nec in examine B. Genovesae, nisi ulterius praedictos libros audiverit Parisius, vel in studio Generali librum Physicorum, de Generatione et Corruptione, de Coelo et Mundo, Parva Naturalia, videlicet libros de sensus & sensato, de somno & vigilia, de memoria & reminiscencia, de longitudine & brevitate vitae, librum Mechanicae, vel qui actu audiat eundem, et quod aliquos libros Mathematicos audiverit.” (Bulæus iv, 390 [César Egasse Du Boulay, *Historia universitatis parisiensis* ... Paris 1668, vol. 4 (Reprint: Frankfurt/M. Minerva 1966f)]). See Hastings Rashdall, *The Universities of Europe in the Middle Ages*, vol 1. Salerno, Bologna, Paris (Reprint: Oxford: Clarendon Pr., 1987) p. 437. Istvan Bodnar has pointed out to me that in another source (*Chartularium universitatis Parisiensis* (ed. H. Denifle) vol. 3, Paris: Delalain, 1850–1894, p. 145), which is otherwise almost word for word the same, has “librum Metaphysice” instead of “librum Mechanicae” – which does make somewhat more sense, especially if the final book in the list is not parsed as being part of the parva naturalia.

1 Manuscript tradition: two of the mss in Bottecchia's stemma [F 1.10 and a T. 9. 21 (76)] are not Aristotle Manuscripts but copies of Pachymeres' *Philosophia*. The manuscript tradition is clarified by Joyce van Leeuwen's dissertation (2012).

2. The Arabic translation of the Prologue and Problem 1 is *mathematically* a better text than our Greek: It is more precise, more parsimonious; but it does not summarize or paraphrase, for the most part it presents a *selection* and literal translation of passages from the Greek: EITHER the translator selected *whole sentences and clauses* from the Greek and excluded extraneous sentences and was thus a better mathematician than the author [he was also lucky enough not to have to *rewrite* any sentences, he only had choose the necessary ones and exclude the superfluous ones], OR he had a different (better) text – for which there is however *no other evidence*.

The Arabic text itself is from the 12th century (the content from the 11th c.) and thus older than any Greek text we have. It does not contain the long proof of the composition of motions. And, given that the mathematical terminology of the proof in the Greek Pr. 1 is pre-Euclidean, there would have to have been an independent tradition of the proof from Aristotle's time onward. If these passages were later interpolated into the *Mechanical Problems* by some Byzantine scholar, he was using fourth-century-B.C. material – a very shaky speculation.

One possible solution (speculative, but not quite as wild as the above) would be to distinguish among the problems based on their content. Although the problems all seem to deal with motion (usually but not always, circular motion) we can distinguish four different "collections" within the treatise: (a) the reduction program of technical devices to the lever-balance-circle (1, 2, 3, 4, 6, 9, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 26, 27, 29); (b) the geometry of moving points (*most* of 1, *part* of 5, 23, 24, 25); (c) increasing (starting) the motion of things that are already in motion (that *tend* to motion) (7, 8, 10, 11, 31, 35); (d) projectile motion (33, 34, 35). It is possible that the results of several minor collection projects in the peripatetic school were joined together in this work. (What do we do with 18 and 28?)

More likely two problem collections – one mathematical and one mechanical – were later integrated

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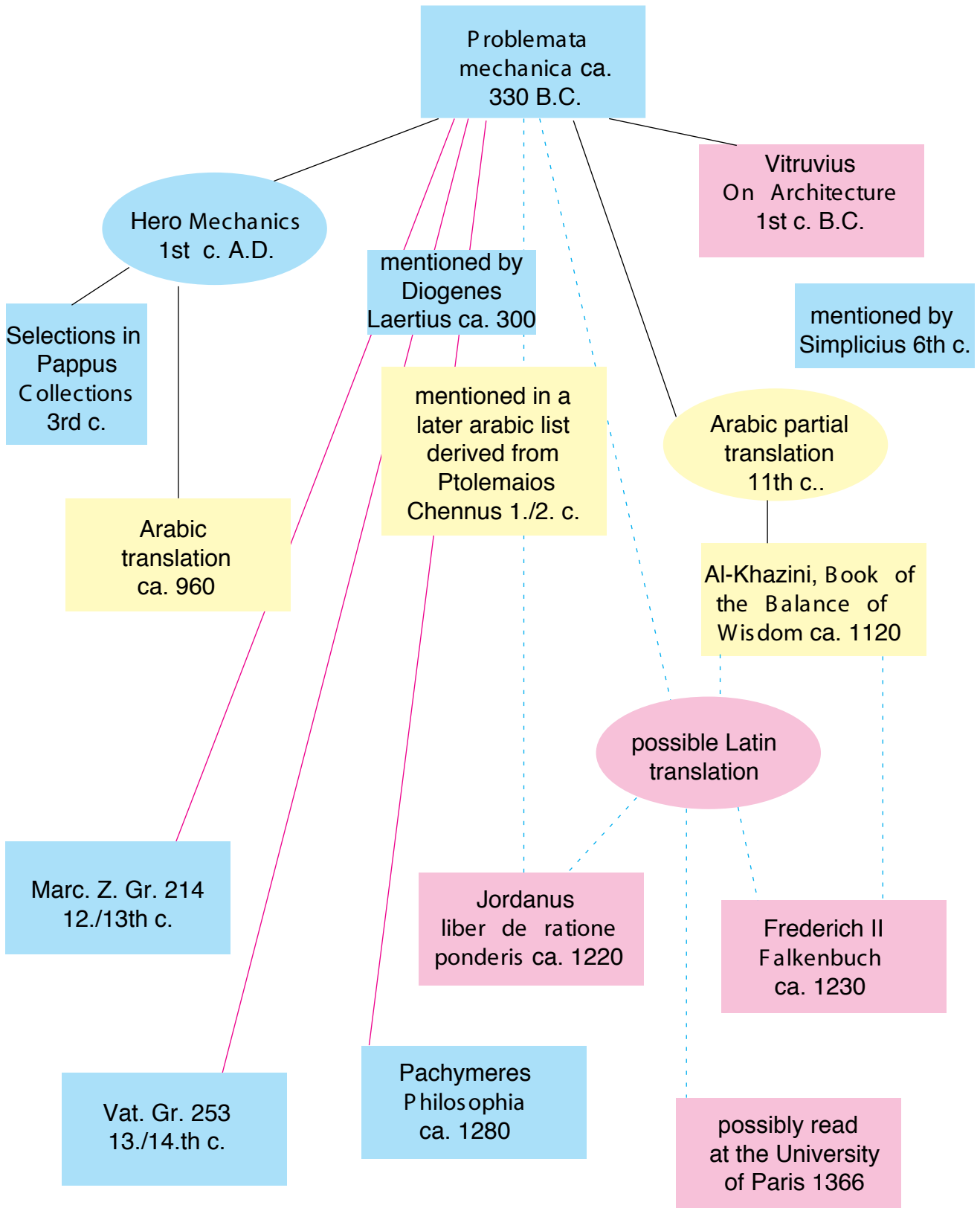
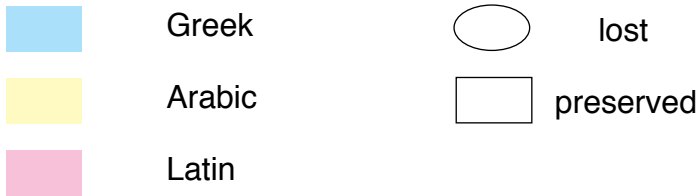
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Aristotle's Mechanics in the Renaissance

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- 1517 Vittore Fausto, Latin translation
- 1525 Niccolò Leonico Tomeo, Latin translation + commentary (many reprints)
- 1545 Diego Hurtado de Mendoza, Spanish translation ms (perhaps of Pachymeres' *Philosophia*) (publ. 1898)
- 1546 Niccolò Tartaglia, *Quesiti* Bk. 7
- 1547 Piccolomini, Latin commentary (2nd ed. 1565)
- 1554 Matthaeus Christianus, *De mechanicis questionibus* (ms)
- 1560 Filippo Bechio, Latin translation (as part of Pachymeres' *Philosophia*)
- 1564/65 Petrus Ramus lectures on the Mechanica
- 1566 Pedro Nuñez, partial Latin commentary (boat questions)
- 1569 Francesco Maurolico (1494-1574), abridged translation + Latin commentary + additions (publ. 1613)
- 1570 Girolamo Cardano, *Opus novum de proportionibus*
- 1570f Pietro Catena lectures on the Mechanica
- 1573 Antonio Guarino (1504-1590) Italian translation from Greek
- 1574 Antonio Guarino (1504-1590) Italian commentary
- 1576 Giuseppe Moletti, ms Dialogues on Mechanics (publ. 2000)
- 1577 Guidobaldo del Monte, *Liber mechanicorum*
- 1580 Bernardino Baldi, Latin commentary (publ. 1621)
- 1581 Giuseppe Moletti, *In librum mechanicorum* (ms) (Bibl. Ambr. Milan)
- 1581 Filippo Pigafetta, Italian translation of del Monte
- 1582 Oreste Vannocio Biringucci, Italian translation of Piccolomini
- 1585 Giovanni Battista Benedetti, *Speculationum* (section on mechanics)
- 1590 Francesco Buonamici lectures on the Mechanica
- 1594 Galileo Galilei, *Le Mecchanice*
- 1597 Niccolo Stelliola, *De gli elementi meccanici* (ms)
- 1598 Galileo lectures on the Mechanica
- 1599 Henry Monantheuil Greek text + Latin translation and commentary (2d ed. 1600)
- 1615 Giuseppe Biancani (Blancanus) Latin commentary
- 1626 Marin Mersenne, *Synopsis mathematica* (partial Latin paraphrase [not yet seen])
- 1627 Giovanni de Guevara, Latin commentary
- 1629 Daniel Mögling, German translation/paraphrase? of Baldi's commentary.
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- 1644 Marin Mersenne, *Universae geometriae, mixtaeque mathematicae synopsis* Paris: Bertier



- Greek
- Arabic
- Latin
- Latin (renaiss.)
- Vernacular

- Text
- Commentary
- Lost

