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LESSONS FOR CLASSICS FROM THE HISTORY OF MATHEMATICS

Abstract: Presented here are examples of two problems set by ancient Greek mathematicians that engaged scholars for centuries and could be included in a course on Greek civilization. Also presented are samples from mathematical works published in Latin and some Latin anagrams produced by mathematicians and scientists, all of which could be introduced into the Latin classroom.

The Teaching Innovation Program at the University of Mary Washington provided the opportunity for a Teaching Partner Exchange that granted two faculty members in different disciplines a course release to attend one another's classes. The faculty members were to engage themselves fully, doing all the work, side by side with the regular students. The anticipated results included a greater awareness of another discipline and a healthy reminder of what it means to be a student. Participating in this program, the mathematician among us took *Elementary Latin* and the classicist *The History of Mathematics*.¹ With a continued interest in the intersection of our disciplines, we have sought ways to build on those interdisciplinary connections. While the importance of ancient Greece to the history and development of mathematics is common knowledge, and while most classicists are aware that mathematical treatises were published in scholarly Latin into the Renaissance and beyond,² it is rare to see the history of mathematics incorporated into either courses in classical civilization or Latin classes. We therefore offer some examples from the history of mathematics and science that could reasonably be inserted into Classics courses at the high school or college level.

Plato and the Three Classical Construction Problems

Plato's impact on the development of mathematics cannot be overstated. While he developed little original mathematics himself, he used the subject to train the intellect, and his insistence on its importance produced an environment in which the discipline flourished.

¹ The textbook used in the latter course, Burton (2007), is an excellent reference for the history of mathematics, especially in antiquity.

² Mathematical works published in Latin, in addition to Barrow (1655), Cardano [1663] (1967) and Heiberg (1883–6) discussed below, include Newton's *Philosophiae Naturalis Principia Mathematica* (1687) and Fibonacci's *Liber Abaci* (1202). No copy of Fibonacci's work from 1202 is extant. See Boncompagni (1857–62) for Fibonacci's 1228 edition.

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Legend has it that Plato even affixed a sign over the doors of his Academy with the warning, “Let no man ignorant of geometry enter here.”³ His personal inclination, however, was to value theoretical mathematics and to display contempt for applying the subject to any practical use. Instead, Plato believed that all mathematics should be created from the ideal forms of circles and lines, and he accordingly restricted the tools allowed to a straightedge (a ruler with no grid for measuring) to draw lines, and a compass to construct circles with any center and radius.⁴

Over the course of the centuries, mathematicians realized that three mathematical problems, called the Three Classical Construction Problems, were unsolvable under Plato’s limitations, but were solvable with looser restrictions. These problems are Squaring a Circle (constructing a square with the same area as a given circle), Trisecting a General Angle (dividing an arbitrary angle into thirds) and Duplicating a Cube (constructing a cube with double the volume of a given cube). Figure 1 illustrates the essence of the cube duplication problem. The cube on the left with edge a will have a volume of a^3 , whereas the cube on the right with edge x will have a volume of x^3 , which will be double the volume of the first cube if x^3 equals $2a^3$.

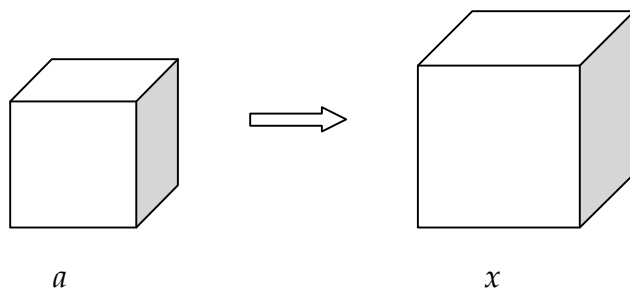


Figure 1: The cube on the right has volume $x^3 = 2a^3$ if its volume is double the volume of the left cube. The solution $x = \sqrt[3]{2}a$ is a length that is impossible to construct with straightedge and compass, as Pierre Wantzel proved in 1837 using techniques of abstract algebra.⁵

Doubling a cube’s volume has its origins in two different legends. This doubling is often called the Delian Problem because, according to Theon of Smyrna in his writings on Eratosthenes’ *Platonicus*, an oracle advised the Delians that to end a plague they must double the altar. Plato’s comment was that “the god had given this oracle, not because he wanted an altar of double the size, but because he wished,

³ Tzetzes, *Chiliad* 8.972 in Kiessling (1826); Heath (1921) 24.

⁴ Heath (1921) 284–8; Burton (2007) 123, 138.

⁵ Burton (2007) 128.

in setting this task before them, to reproach the Greeks for their neglect of mathematics and their contempt for geometry.”⁶

The other supposed origin of the doubling problem derives from King Minos’ desire to build a larger cubical tomb for his son Glaucus, who died by falling into a vessel containing honey. According to Eutocius, Eratosthenes, in a purported letter to King Ptolemy, quoted Minos: “Small indeed is the tomb you have chosen for a royal burial. Let it be double.”⁷ Minos suggested doubling the length, width and height of the tomb, but the volume of the resulting cube would have been larger by eightfold, instead of the desired twofold.

In any case, the Three Classical Construction Problems, and in particular the duplication of the cube problem, are impossible to solve under Plato’s restrictions. This impossibility can be explained as follows. Lines, drawn with straightedges, have equations of the form $y = mx + b$, while circles, drawn with compasses, have equations of the form $(x - h)^2 + (y - k)^2 = r^2$. No matter how one solves these equations simultaneously to determine intersections of lines and circles, all solutions will involve the processes of addition, subtraction, multiplication, division and square roots, used a finite number of times. For example, in duplicating the cube one needs to take the cube root of 2 (i.e. $\sqrt[3]{2}$), which is impossible with straightedge and compass, to find the solution for the length of the doubled cube’s side $x = \sqrt[3]{2}a$.⁸

Archimedes and the Cattle of Helios Problem

In addition to the Three Classical Construction Problems, other mathematical problems from antiquity gained notoriety when mathematicians were unable to solve them until modern times. Such is the case with Archimedes’ Cattle of Helios Problem, which resisted solution until the invention of computers. The Cattle Problem is clearly based on a reference in Homer’s *Odyssey*.⁹ Advising Odysseus not to harm the livestock on the island Thrinacia, where the cattle of Helios graze, Circe tells him that there are seven herds of oxen with fifty oxen per herd on the island, and that the same is true of the flocks of sheep; multiplication thus dictates a result of 350 oxen and 350 sheep, for a total of 700 heads of livestock.

⁶ Theon of Smyrna, in Thomas (1951) 1: 256–7. Thomas’ two volumes serve as a handy compilation of ancient Greek mathematical sources.

⁷ Eutocius, *Commentary on Archimedes’ Sphere and Cylinder*, in Thomas (1951) 1: 256–9; here and elsewhere in this article, Thomas’ translation is slightly modified.

⁸ Hawking (1988), in the acknowledgments to his popular *A Brief History of Time* (p. vi), wrote “Someone told me that each equation I included in the book would halve the sales.” We hope that we have not just substantially reduced our readership. The mathematics in this article will appeal to a variety of skill levels.

⁹ 12.127–30.

Archimedes allegedly sent an epigram in the 3rd century BCE to Eratosthenes and the other Alexandrian mathematicians, challenging them to determine the number of cattle grazing on Thrinacia (which he identified with Sicily), and stipulating that the numbers of bulls and cows of four different colors had to adhere to certain prescribed conditions. Archimedes stated this problem in two parts. Anyone clever enough to solve the first part, he claimed, “would not be called unskilled or ignorant of numbers, but not yet would you be numbered among the wise.”¹⁰ He then raised the level of difficulty in the second part by adding two more conditions, saying “If you are able, O stranger, to find out all these things and gather them together in your mind, giving all the relations, you will depart crowned with glory and knowing that you have been adjudged perfect in this species of wisdom.”¹¹

Archimedes occasionally sent his contemporaries false problems or exceptionally difficult ones to test their mettle,¹² and his Cattle Problem was no exception. Indeed, no solution was effected until 1965, when researchers at the University of Waterloo used an IBM computer to determine that the smallest possible solution is a number with over 200,000 digits.¹³ When written out, this number extends to over $\frac{1}{2}$ of a mile long, and so many cattle could not exist together, much less be grazed, on the island of Sicily. Moreover, as David Burton wryly observes, “there are 1397 bulls for each cow, a ratio that could lead to serious difficulties in herd management.”¹⁴

Mathematical Texts in Latin

The use of mathematics in Classics programs need not be limited to the exploration of famous problems from antiquity. Sample pages from works in Latin such as the *Ars Magna* by Girolamo Cardano (or Jerome Cardan) on the subject of algebra should delight students as they see how swiftly they can read the Latin versions of topics already familiar to them. First published in 1545, the influential *Ars Magna* appeared over subsequent years in several editions, including in volume 4.4 of Cardano’s collected works. This *Opera Omnia* of 1663 was reprinted in 1967 and is readily available in libraries throughout the country as well as on the Internet.¹⁵

¹⁰ Archimedes(?), *Cattle Problem*, in Thomas (1951) 2: 202–5.

¹¹ Archimedes(?), *Cattle Problem*, in Thomas (1951) 2: 204–5.

¹² Cf. Archimedes, *On Spirals*, preface.

¹³ Williams, German and Zarnke (1965) 671–4.

¹⁴ Burton (2007) 226.

¹⁵ Cardano [1663] (1967). The *Opera Omnia* of 1663 is available on-line at <http://www.filosofia.unimi.it/cardano/testi/opera.html>. Witmer (1968) provides an excellent translation of the *Ars Magna*.

Figure 2: Reference Guide to Familiar Mathematical Topics in Cardano's *Ars Magna* from (Latin) Cardano [1663] (1967); and (translation) Witmer (1968).

Topic	Commentary	Example from Cardano
Negative Solutions Title of Cardano, Ch. 1.3: "De duabus aequationibus in singulis Capitulis" Witmer, pp. 10–11: "On Double Solutions in Certain Types of Cases"	Here Cardano allows that an equation may have solutions (roots) that are negative, despite finding negative roots puzzling and calling them <i>ficta</i> ("fictitious"). Even though Cardano realizes the existence of negative roots, he mostly avoids them in later sections of the book.	Cardano explains that the solutions of $x^2 = 9$ are the positive and negative square roots of 9. Thus, $x = 3$ or -3, because the square of either number results in 9.
Complex Numbers Title of Cardano, Ch. 37: "De Regula fallsum ponendi" Witmer, pp. 219–20: "On the Rule for Postulating a Negative"	In Rule II Cardano addresses the perplexing concept of complex numbers, which result when taking the square root of negative numbers. Perhaps in jest, Cardano uses a Latin phrase <i>dismissis incruciationibus</i> with dual interpretations, either "the cross-multiples having canceled out" or "putting aside the mental tortures involved." (Witmer p. 219 n. 5.)	Cardano solves the problem of dividing 10 into two parts that have a product of 40. He gives the two parts as $5 + \sqrt{-15}$ and $5 - \sqrt{-15}$, which when added yield 10. When multiplied with the FOIL Method (First, Outside, Inside, Last), then $(5 + \sqrt{-15})(5 - \sqrt{-15}) = 25 - 5\sqrt{-15} + 5\sqrt{-15} + 15 = 40.$
Quadratic Formula Title of Cardano, Ch. 5.4: "Ostendit aestimationem Capitulum compositorum minorum, quae sunt quadratorum, numeri, & rerum"	The modern treatment to solve $Ax^2 + Bx + C = 0$ is with the Quadratic Formula $x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}.$ Cardano separates quadratic equations into three types. Rule I: $x^2 = ax + N$ with solution $x = \sqrt{\left(\frac{1}{2}a\right)^2 + N} + \frac{1}{2}a$	For an example of Rule I: To solve $x^2 = 10x + 144$, take half of the coefficient a of x, here $\frac{1}{2}a = \frac{1}{2}10 = 5.$ Square the 5 to get $\left(\frac{1}{2}a\right)^2 = 25$, and add to $N = 144$ to get $\left(\frac{1}{2}a\right)^2 + N = 169.$

Witmer, pp. 36–9: “Showing the Solution of Cases Composed of Mi- nors, Which Are the Square, Con- stant, and First Power”	Rule II: $x^2 + ax = N$ with solution $x = \sqrt{\left(\frac{1}{2}a\right)^2 + N} - \frac{1}{2}a$ Rule III: $x^2 + N = ax$ with solution $x = \frac{1}{2}a \pm \sqrt{\left(\frac{1}{2}a\right)^2 - N}$ Thus Cardano gives three formulas for the solution of a quadratic equation, compared to only one modern Quadratic For- mula. Cardano also provides a clever, if highly abbrevi- ated, mnemonic for recall- ing the three formulas. In Latin: <i>Querna, da bis</i> <i>Nuquer, admi</i> <i>Requan, minue dami</i> In Witmer’s translation: Squeaxno, adtwix Noesquax, adsub Axesquuno, subadsub Meaning: If square equals ax and number, then add twice. If number equals square and ax, first add then sub- tract. If ax equals square and number, then subtract, both adding and subtract- ing.	Take the square root to get $\sqrt{\left(\frac{1}{2}a\right)^2 + N} = 13$. Add to $\frac{1}{2}a = 5$ for $x = \sqrt{\left(\frac{1}{2}a\right)^2 + N} + \frac{1}{2}a$ $= 13 + 5 = 18.$ Once again Cardano omits the negative so- lution $x = -8$. Rules II and III are solved in a similar manner.
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Note that much of the rest of Cardano’s *Ars Magna* involves solving polynomial equations of the form:

$$Ax^3 + Bx^2 + Cx + D = 0 \quad \text{or} \quad Ax^4 + Bx^3 + Cx^2 + Dx + E = 0$$

and other higher power polynomial equations. While Cardano’s methods are generally correct and give the first demonstrations of how to solve these equations, modern students learn simpler solution techniques such as Synthetic Division.

Perhaps of even greater interest to students would be selections from Cardano's infamous *Liber de Ludo Aleae*, a work entirely devoted to games of chance, complete with advice on cheating.¹⁶

Figure 3: Reference Guide to Key Topics concerning Gambling and Mathematics in Cardano's *Liber de Ludo Aleae* from (Latin) Cardano [1663] (1967) and (translation) Gould in Ore (1953). Cardano's methods are generally correct and give the first demonstrations of how to calculate probabilities. However, such an early treatise is bound to have mistakes, some of which Cardano catches but unfortunately does not correct in earlier chapters. For a thorough treatment of Cardano's accomplishments and limitations, see Ore (1953) 143–77.

Topic	Commentary	Example from Cardano
When one may gamble Title of Cardano, Ch. 2: "De Ludorum conditionibus" Gould/Ore, pp. 185–6: "On Conditions of Play"	Cardano explains the circumstances under which one may gamble and states that gambling is permissible as a distraction during difficult times. He also compares gambling to other, more socially acceptable, pastimes. Among the games Cardano discusses in <i>Liber de Ludo Aleae</i> are dice, card games such as primero, and board games such as backgammon.	<i>quod quam sumunt excusationem de leniendo taedio temporis, utilius id fiet lectionibus lepidis, aut narrationibus fabularum, vel historiarum, vel artificiis quibusdam pulchris, nec laboriosis.</i> "As for the excuse made by some that [gambling] relieves boredom, this would be better done by pleasant reading, or by narrating tales or stories, or by one of the beautiful but not laborious arts."
Probability Title of Cardano, Ch. 9: "De unius Aleae iactu" Gould/Ore, pp. 192–4: "On the Cast of One Die"	Cardano, inspired by his frequent gambling, is the first mathematician to articulate a theory of random chance. Cardano is also the first to recognize that for a fair die each side has an equal probability of landing face up. Because each side of a six-sided die is marked with a number from one to six, each number has an equal likelihood of appearing in a die toss.	<i>exemplum, tam possum proicere unum tria quinque, quam duo quatuor sex. Iuxta ergo hanc aequalitatem pacta constant, si Alea sit iusta.</i> "For example, I can as easily throw one, three, or five as two, four, or six. The wagers are therefore laid in accordance with this equality if the die is honest."

¹⁶ The *Liber de Ludo Aleae* appears in Cardano [1663] (1967) vol. 1.10, available online at <http://www.filosofia.unimi.it/cardano/testi/opera.html>. Ore (1953) contains a useful translation by Sydney Henry Gould.

Probability Title of Cardano, Ch. 11: "De duarum Aleorum iactu" Gould/Ore, pp. 195–6: "On the Cast of Two Dice"	Cardano counts the number of possible outcomes from casting two dice. Since each die has six sides, there are $6 \times 6 = 36$ possible outcomes, as may also be seen by counting the pairs (1,1), (1,2), ..., (6,6). Note that the pair (1,2) = (1 on first die and 2 on second) is a different outcome from the pair (2,1) = (2 on first die and 1 on second). Cardano defines the probability of an event to be the fraction of the number of favorable outcomes divided by the total number of outcomes. He calculates the probability of having at least one die showing a one when two dice are cast to be $11/36$.	<i>Unius puncti casus undecies est in circuitu.</i> "The number of throws containing at least one ace is eleven out of the circuit of thirty-six."
Cheating Title of Cardano, Ch. 17: "De dolis in huius modi Ludis" Gould/Ore, pp. 210–12: "On Frauds in Games of This Kind"	Cardano enumerates methods by which one can cheat at cards, either by marking them, dealing cards from the bottom of the deck or soaping the cards to make them slick. He also gives advice to ward against deception.	<i>At qui adulterinis chartis utuntur, alii subtus, alii superius, alii a lateribus signant.... Sunt qui speculis in annulis positae contemplantur formam chartae.</i> "As for those who use marked cards, some mark them at the bottom, some at the top, and some at the sides.... Some players examine the appearance of a card by means of mirrors placed in their rings."
Knucklebones Title of Cardano, Ch. 31: "De Ludotalorum" Gould/Ore, pp. 237–40: "On Play with Knucklebones"	Cardano numbers the four sides of an astragalus with the values 1, 3, 4, and 6, and he lists various types of throws with four astragali. What Cardano calls the Venus throw (1,3,4,6), where all the astragali have a different face, is consistent with the ancient sources. He calculates the probability of the Venus throw to be 24 favorable outcomes over $4 \times 4 \times 4 \times 4 = 256$ total outcomes or $24/256 = 3/32$.	<i>Inter hos nobilissimus est Venus...</i> "Among all these the most fortunate is the Venus, which consists of the dice presenting the natural position of the numbers, namely, one, three, four, and six, which is unique in knucklebones. But if it be compared to the total, it can happen in 24 ways.... But for the Venus the 24 cases is about $1/11$ [$= 3/33 \approx 3/32$], that is, it will happen that the Venus is thrown more often."

One of the easiest, most satisfying and most surprising mathematical treatises in Latin must be Euclid's *Elements*. "Easiest," because the Definitions that make up the first part of the *Elements* consist of short, simple sentences with verbs in the present indicative, suitable even for "Latin One" students. "Satisfying," because the Definitions are drummed into us all when we first take geometry in junior high or middle school, and so form an immediate connection between the mathematics the student already knows and the Latin he or she is learning. Finally, Euclid's *Elements* is certainly one of the "most surprising" mathematical treatises in Latin just because it *is* in Latin. Although Euclid wrote in Greek, his work circulated in Latin for centuries. Isaac Barrow, a versatile scholar who was both Regius Professor of Greek and the first to hold the Lucasian Chair of Mathematics at Cambridge University, produced an especially influential 17th-century translation into Latin.¹⁷ The sample below is taken from Heiberg's Latin edition, published in 1883 but accessible today via the Internet.¹⁸

1. *Punctum est, cuius pars nulla est.*

"A point is that of which there is no part."

2. *Linea autem sine latitudine longitudo.*

"A line, moreover, is length without breadth."

3. *Lineae autem extrema puncta.*

"The ends of a line, moreover, are points."

4. *Recta linea est, quaecunque ex aequo punctis in ea sitis iacet.*

"A straight line is whatever line lies evenly with the points situated on it."

5. *Superficies autem est, quod longitudinem et latitudinem solum habet.*

"A surface, moreover, is that which has length and breadth only."

6. *Superficiei autem extrema lineae sunt.*

"The edges of a surface, moreover, are lines."

7. *Plana superficies est, quaecunque ex aequo rectis in ea sitis iacet.*

"A plane surface is whatever surface lies evenly with the straight lines situated on it."

¹⁷ Barrow (1655). Later editions followed, including a posthumous one corrected by Barrow's student, the second Lucasian Chair, Isaac Newton. Students may be interested to learn that the current holder of the Lucasian Chair is Stephen Hawking (see n. 8, above) and that a future holder of the chair, at least according to the Star Trek saga, will be Commander Data.

¹⁸ Heiberg (1883–6), available at www.wilbourhall.org/index.html#euclid. The translations are our own.

8. *Planus autem angulus est duabus lineis in plano se tangentibus nec in eadem recta positus alterius lineae ad alteram inclinatio.*

"A plane angle, moreover, is the inclination of one line to another with the two lines touching in a plane and not placed in the same straight line."

9. *Ubi uero lineae angulum continentes rectae sunt, rectilineus adpellatur angulus.*

"When, indeed, the lines containing the angle are straight, the angle is called rectilinear."

10. *Ubi uero recta super rectam lineam erecta angulos deinceps positos inter se aequales efficit, rectus est uterque angulus aequalis, et recta linea erecta perpendicularis adpellatur ad eam, super quam erecta est.*

"When, indeed, a straight line set up on a straight line makes the adjacent angles equal to one another, each equal angle is (a) right (angle), and the straight line set up (on the other) is called perpendicular to that on which it was set up."

Latin Anagrams

Another way to insert mathematics into the Latin classroom is to introduce Latin anagrams produced by Galileo, Isaac Newton and other famous mathematicians and scientists. In the 17th century, scientists sometimes published the conclusion to their work in the form of a word-puzzle in order to establish a claim to priority for their discovery until such time as they could publish the results in full. When Galileo's anagram from 1610, *Haec immatura a me iam frustra leguntur oy*, ("these unripe things are now read by me in vain, Oy!") is unscrambled, it stands for a second Latin sentence, *Cynthiae figuras aemulatur Mater Amorum*, or "The Mother of Love imitates the forms of Cynthia." In short, Galileo wanted to lay claim to his observation that the planet Venus ("the Mother of Love") imitates the forms of Earth's moon ("Cynthia," a common epithet of Diana, goddess of the moon)—as indeed it does, by appearing to increase and decrease just as the moon appears to wax and wane. It should be understood that such anagrams were not meant to be decoded by others but to encrypt the discovery until the scientist was ready to reveal it. In this instance, Galileo sent the anagram to (among others) the ambassador of Florence in Prague, followed by the solution three weeks later.¹⁹

Earlier in 1610, Galileo produced an odd mix of letters, *smaismrmilmepoetalevmibvnenvgttaviras*, which he ultimately solved as *altissimum planetam tergeminum observavi* ("I have observed the highest planet to be threefold"). The "highest" planet was Saturn, and although Galileo did not fully understand what he was seeing, his anagram shows that he was the first to observe Saturn's rings. A few

¹⁹ Galileo's anagram appeared in his letter to Giuliano de' Medici, 11 Dec. 1610, published in Favaro (1890–1909) vol. 10, 483. Its solution appears in his letter to the same, 1 Jan. 1611, in Favaro (1890–1909) vol. 11, 12. For this anagram and its purpose, see McMullin (1985) 18–19; Westfall (1985) 23–30.

decades later, Christiaan Huygens recognized that the phenomenon affecting the appearance of Saturn was a ring, and he published *aaaaaaa ccccc d eeeee g h iiiiii llll mm nnnnnnnnnn oooo pp q rr s tttt uuuuu*, an orderly enough presentation, but meaningless until reassembled as *annulo cingitur, tenui, plano, nusquam cohaerente, ad eclipticam inclinato*—"it is surrounded by a thin, flat ring, nowhere attached (to its surface), [and] inclined to the ecliptic." As one more example among many, in 1676 Isaac Newton produced *6a 2c d ae 13e 2f 7i 3l 9n 4o 4q 2r 4s 9t 12v x* in an attempt to establish priority for the invention of calculus. His puzzle may be solved as *data aequatione quocunque fluentes quantitates involvente, fluxiones invenire, et vice versa*—"after an equation has been given, involving any number of fluent quantities, to find the fluxions, and vice versa."²⁰ These anagrams offer the Latin student not only some interesting word-puzzles and another peek into the connection between mathematics and Latin, but also the potential for an entertaining assignment; why not have students practice a spot of Latin composition and then produce their own anagram?

In conclusion, in this day of Standards of Learning exams in the K–12 sequence, and in the bid for greater connections between disciplines at all stages of learning, we urge a return to, or at least an echo of, the days of Isaac Barrow, when the lead professor in Greek at an institution could also be the lead professor in mathematics. By inserting mathematics and science into the Classics curriculum, we can reinforce one discipline while enriching the other.

University of Mary Washington

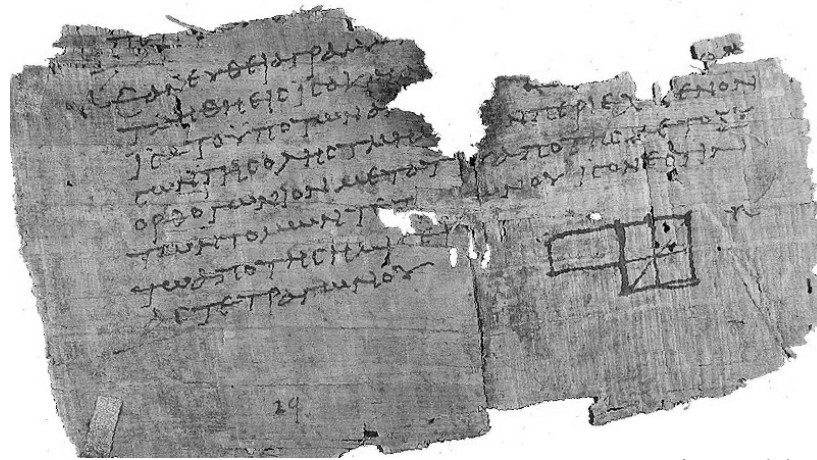
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AND SUZANNE SUMNER

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²⁰ Burton (2007) 421–2. For Galileo, see Kepler (1611) preface, 15; Galileo's letter to Giuliano de' Medici, 13 Nov. 1610, in Favaro (1890–1909) vol. 10, 474; Van Helden (1974) 105, 120 n. 3; McMullin (1985) 18; Westfall (1985) 23. In this instance Kepler did labor over the anagram, only to derive an incorrect solution featuring the planet Mars. For Huygens, see Sarton (1936) 136–7. For Newton, see Sarton (1936) 138; More [1934] (1962) 190. Note that typographical errors abound in the literature on Newton's anagram.

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Fragment from Euclid II.5