

Jean Leurechon's *Mathematical Recreations* in the Context of Early 17th Century Europe

European thinkers in the 17th century revolutionized humanity's understanding of nature. Differing from the humanists who focused largely on works from long ago, the new wave of scientists looked ahead to great inventions based on discoveries about the world. Breaking away from the philosophy of Aristotle, thinkers such as Francis Bacon and René Descartes introduced ideas that led to the modern scientific method and spurred the later scientific revolution. Astronomers such as Galileo Galilei and Johannes Kepler put these ideas into practice, fundamentally altering humanity's understanding of the cosmos. In the midst of this scientific revolution was a humble book, *Mathematical Recreations*, originally published in French as *Récréations Mathématiques* in 1624. The book was written by Jean Leurechon under the pseudonym Hendrik Van Etten and first appeared in English print in 1633, translated by William Oughtred¹. It was printed in octavo form, with pages in sets of 16, and measured 4 inches wide and 6.5 inches tall. The book itself consisted of over 100 "problems," demonstrations of scientifically based tricks or facts. Importantly, Leurechon wrote *Mathematical Recreations* for a broad audience, likely hoping to expose people across Europe to scientific wonders. Analysis of its contents illuminates not only the early state of scientific understanding, but also the political and religious conditions of the world it helped influence.

For centuries, studying the natural world had been considered a fringe interest, only suitable for isolated scholars. The early 17th century, however, saw the beginnings of change from this view. The English philosopher and scientist Francis Bacon was at the fore in popularizing learning. In his famous *The Advancement of Learning*, published in 1605, Bacon

¹ chaaf, William. "Number Game." Encyclopedia Britannica Online. Encyclopedia Britannica. Web. 18 Apr. 2015.

defended learning for its own sake, especially study of the natural world². He considered five common worries: that learning is close to original sin, that learning leads to worry and unhappiness, that learning leads to atheism, that learning leads to an unwillingness to fight, and that learning makes people unfit for governing. Calmly but confidently, he responded to each in turn. The original sin was the desire to abandon God, not the thirst for knowledge. Applications of knowledge would lead to improvements in life, not unhappiness. While a small amount of learning might tempt a man away from God, a thorough education would bring him back to religion. If learning were so bad for fighting, how could Caesar and Alexander the Great have been educated but also great generals? Finally, Bacon argued that learning is essential for governing for the same reason that a doctor must understand the human body in order to be effective. By clearly articulating and responding to a host of concerns against learning, Bacon made learning feel more acceptable to Europeans.

The early 17th century also saw a move away from the ideas of Aristotle. Refined into scholasticism, Aristotle's philosophical methods had dominated Europe for centuries³. Bacon disliked the abstractness of scholasticism and argued instead for greater reliance on data and evidence. He asserted that this empiricism would allow for refutation of incorrect theories, so that nature could be studied inductively. Bacon also believed that scientific advances could lead to improvements for mankind, an idea that led to the later founding of the London Royal Society in 1660. Though he never made any significant scientific discoveries himself, Bacon's advocacy of empiricism and applicability was instrumental in the development of modern science⁴.

² Francis Bacon, *The Advancement of Learning*, ed. W. A. Wright (Oxford: Clarendon Press, 1880)

³ Pieper, Josef. "Scholasticism." *Encyclopedia Britannica Online*. Encyclopedia Britannica. Web. 20 Apr. 2015.

⁴ "Francis Bacon." *Bio*. A&E Television Networks, 2015. Web. 16 Apr. 2015.

The Frenchman René Descartes also contributed to the shift away from Aristotelianism. In his 1605 work *Discourse on Method*, he cautioned against accepting as true what one did not know for certain. Descartes also criticized existing philosophy, complaining that philosophers debated endlessly but agreed on nothing. He therefore argued that philosophical results could not be trusted, and he proposed a system of slow, careful reasoning in order to find statements he *knew* to be true. Since these results would be established for certain, they could be used to discover new truths without worry or hesitation⁵. The ideas of men like Bacon and Descartes initiated the development of modern science, the first steps of the European scientific revolution that would see advances in mechanics, mathematics, optics, chemistry, and more throughout the 17th century.

Mathematical Recreations, published after Bacon's *The Advancement of Learning* but before Descartes' *Discourse on Method*, likely played a similar but smaller role in the advance of science. The book contains a vast assortment of facts, tricks, and techniques, all based in math and science. These "problems," as Leurechon called them, spanned a wide range of topics such as mathematics, physics, astronomy, and even fireworks. Unlike Bacon and Descartes, Leurechon did not propose new systems of reasoning. Rather, he helped expose Europeans to scientific applications and tricks, likely increasing general scientific awareness among the educated.

Differing from the writings of Bacon and Descartes, *Mathematical Recreations* was intended to appeal to anybody with an interest in science. Leurechon himself described the book as "Fit for scholars, students, and gentlemen that desire to know the philosophical cause of many

⁵ Descartes, René. *Discourse on Method and Meditations on First Philosophy*, 4th ed. Indianapolis: Hackett, 1998. 5. Print.

admirable conclusions” (Leurechon, *Mathematical Reflections*, cover). The cover appealed to a wide audience, depicting the range of topics touched on in the book and calling them “useful and recreative.” Also to appeal to a layperson, Leurechon made a point of omitting detailed, technical explanations for the problems, stating in the introductory “By way of advertisement” section, “Those which understand the mathematics can conceive them easily; others for the most part will content themselves only with the knowledge of them” (Leurechon, *Mathematical Reflections*, “By way of advertisement”). Probably attempting to improve the casual reader’s experience, Leurechon switched rapidly between topics. Later editions of the book also included a table of contents, perhaps because the constant topic-changing made finding specific problems difficult otherwise. The reader certainly had the option of delving deeper into the science behind the demonstration, but Leurechon’s goal seems to have been to impress rather than to instruct. This appeal to a wide audience led to a commercial success: *Mathematical Recreations* went through over 30 editions by the end of the century⁶.



The cover of *Mathematical Recreations* was filled with diagrams, probably in order to entice potential readers.

This image is in the public domain.

Handwriting inside the copy of *Mathematical Recreations* found at the MIT library offers another glimpse into its appeal. We can tell that the owner, Thomas Soewitt, highly valued his copy of the book because an early page prominently displays his name. Arithmetic calculations scribbled on another page show he tried to work through some problems for himself. Despite probably being a scientific layman, he took a keen interest in the material. It seems that Thomas Soewitt found reading *Mathematical Recreations* engaging and thoughtful as well as enjoyable.

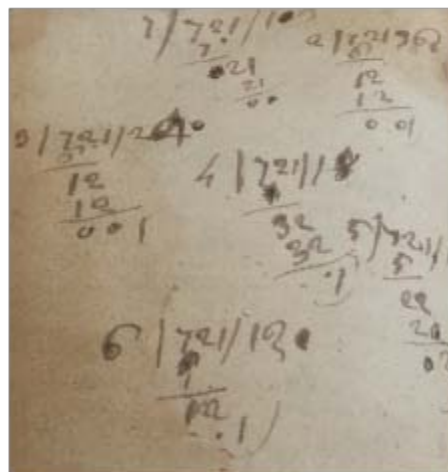
⁶ Schaaf. “Number Game.” Britannica.



Thomas Soewitt's elegant inscription of his name suggests that he valued *Mathematical Reflections* highly

This image is in the public domain.

These scribbled calculations suggest that Thomas Soewitt was an active reader



This image is in the public domain.

The book's introduction also illuminates the divide at the time between science and humanism. Humanism was an intellectual movement from the 1400's that emphasized widespread education and especially focused on ancient texts. The humanist ideas still held strong influence in Europe in the early 17th century, and many prominent scientists were humanists as well. The famous astronomer Johannes Kepler, also dabbled in poetry and history, subjects championed by the humanists⁷. Despite this, humanists and scientists took fundamentally different approaches in their studies. Humanists studied the past, striving to improve society and restore the glory of the ancient world. Scientists, by contrast, sought to invent and discover machines and ideas that were fundamentally new.

Rather than take a moderate stance, Leurechon made it clear that he preferred science to humanism. In his "Epistle to the Reader" he described *Mathematical Recreations* as "an invitation and motive to the search of greater matters, and to employ the mind in useful knowledge, rather than to be bullied in vain pamphlets, play-books, fruitless legends, and prodigious histories that are invented out of fancy, which abuse many noble spirits, dull their

⁷ Anthony Grafton. *Defenders of the Text*. Cambridge: Harvard University Press.

wits, and alienate their thoughts from laudable and honourable studies.” (Leurechon, *Mathematical Reflections*, “Epistle to the Reader”) Leurechon scathingly dismissed a great deal of humanist study as a waste of time and brainpower, asserting the superiority of “useful” scientific study. His disdain for these long-entrenched ideas is similar to that of Descartes, who in his *Discourse* expressed disenchantment with many existing fields of study.

In the book, the problems themselves span a variety of topics. Many problems consist of practical, useful tricks based in science. Problem 48 explains how to measure the weight of an unfamiliar object using a small set of known weights (Leurechon, *Mathematical Reflections*, 71). The method uses the base-3 number system and would likely have been useful to merchants. Problem 50 consists of a trick for lifting bottles: one needs simply to bend a straw, insert it into the bottle, and pull up (Leurechon, *Mathematical Reflections*, 74). The potentially very useful problem 124 showcases a trick to improve candle lifetimes. The idea is to float lit candles on water. The water absorbs the fire’s heat, slowing the wax’s melting (Leurechon, *Mathematical Reflections*, 259). Demonstrations like these would have been especially impressive to a layperson, and helped make science more relevant to the public.

Other problems were likely meant as mere curiosities without much significance at all. Problem 1 is a collection of arithmetic tricks. The first such trick, for example, can be rephrased in modern mathematical language as the identity $\frac{4x+2y}{2} - y = 2x$ (Leurechon, *Mathematical Reflections*, 21). Problem 122 simply asserts that a heated anvil can be destroyed with a gunshot (Leurechon, *Mathematical Reflections*, 259). Problem 97 points out the fact that on the surface of a sphere, triangles can have 3 right angles, even though this is impossible on a flat surface (Leurechon, *Mathematical Reflections*, 234). This last problem, interestingly, is actually highly

significant from today's perspective: the development of non-Euclidean geometry in the 19th century made such examples of lines on curved surfaces fundamentally important⁸.

Several of Leurechon's problems, seen today, illuminate the fledgling state of scientific knowledge at the time. For example, in problem 13, Leurechon explains that to find the mass of the smoke given off in a fire, all one must do is measure the lost mass in wood; the mass of the smoke produced must equal the mass of the wood consumed (Leurechon, *Mathematical Reflections*, 27). Despite the appealing logic, this reasoning is invalid because of the oxygen in the air, which contributes to the reaction of the burning and must be accounted for in any sort of calculation. Though it seems incredible today, scientists at the time had no concept of oxygen; until over a century later, scientists believed that combustible material contained a special element, *phlogiston*, that allowed for burning⁹. Problem 130 appears today as silly as alchemy or witch-craft. Explaining a method to harden metal, it begins, "Quench your blade or other instrument seven times in the blood of a male hog mixed with goose-grease" (Leurechon, *Mathematical Reflections*, 263). Such a procedure seems ridiculous given modern knowledge, but would have been seen as scientific in Leurechon's day.

The politics and religion of the time also affected Leurechon's book, in particular his writing on astronomy. For centuries before, the accepted and Church-supported position had been that the universe was centered at the Earth, with the Sun and planets orbiting it in perfect spheres. As early as 1543, Copernicus challenged this idea with a heliocentric model, arguing that the Earth revolved around the Sun, which was itself stationary¹⁰. Though little attention was

⁸ Henderson, David. "Non-Euclidean Geometry." Encyclopedia Britannica Online. Encyclopedia Britannica. Web. 18 Apr. 2015.

⁹ "Phlogiston." Encyclopedia Britannica Online. Encyclopedia Britannica. Web. 18 Apr. 2015.

¹⁰ Ross, James, and Mary McLaughlin. "The Revolutions of the Celestial Spheres." *The Portable Renaissance Reader*. New York: Viking. 583-593. Print.

given to Copernicus at first, further developments began to appear by the end of the 1500's. The Danish astronomer Tycho Brahe proposed an intermediate model called a geo-heliocentric system; in his theory, the Moon and the Sun orbited Earth while the other planets orbited the Sun¹¹. The Italian Galileo Galilei used a powerful telescope to observe Venus and the moons of Jupiter. His findings, published in the 1610 *Starry Messenger*, were inconsistent with geocentrism and lent support to Copernicus's heliocentric model¹². Brahe's student Johannes Kepler further challenged the Church's position with his explanation of the strange, sometimes backwards motion of Mars in the sky. He suggested, correctly, that this unusual orbit could be explained by a heliocentric model in which planetary orbits were elliptical rather than perfectly circular¹³.

The Church responded severely to these dissenting astronomical views. In 1616, a committee brought together by the Church declared that heliocentrism was "foolish and absurd in philosophy, and formally heretical since it explicitly contradicts in many places the sense of Holy Scripture." The Church also personally warned Galileo to stop defending heliocentrism. Galileo did not stop, and in fact published *Dialogue concerning the two chief world systems* which subtly mocked both geocentrism and the Pope himself. Infuriated, the Church brought Galileo before the Inquisition and threatened him with torture. Forced to recant, Galileo lived under house arrest until his death¹⁴. Heliocentrism, though scientifically promising, had become perilous to support.

¹¹ Hatch, Robert. "Early Geo-Heliocentric Models." The Scientific Revolution Webpage. Web. 19 Apr. 2015.

¹² Wudka, Jose. "Galileo and the Inquisition." Web. 17 Apr. 2015.

¹³ "Johannes Kepler: The Laws of Planetary Motion." Web. 20 Apr. 2015.

¹⁴ Wudka. "Galileo"

Leurechon touches on astronomy in problem 88. The problem, broken into 8 parts, attempts to convey the enormity of several astronomical distances and speeds. In the second part, he asserts that “if a bird should fly round about it [Earth] in two days, then must the motion be 450 miles in an hour” (Leurechon, *Mathematical Reflections*, 221). By expressing such a vast distance as the Earth’s circumference in terms of more familiar quantities, Leurechon hopes to impress the reader with the vast scale of the world. In other parts of the same problem, he explains the huge distances to the Sun and the Moon in similar terms.

In part 7 of problem 88, Leurechon describes the speed of the Sun, giving us an indirect glimpse of the Church’s influence on astronomy. He writes that “[The Sun] moves more than seven thousand five hundred and seventy miles in one minute of time” (Leurechon, *Mathematical Reflections*, 221). By taking the Sun’s motion for granted, Leurechon is siding with the Church’s geocentrism. Later Leurechon dismisses Copernicus’s heliocentric theory as well-intentioned but misguided, “This made Copernicus, not unadvisedly, to attribute this motion...to the earth...for it is beyond human sense to apprehend or conceive the rapture and violence of that motion being quicker than thought” (Leurechon, *Mathematical Reflections*, 222). Being well-versed in science, he would have been aware of the substantial evidence for a heliocentric model, but likely took the geocentric position to avoid the Church’s ire. The contrast with Leurechon’s dismissal of history and other subjects in the introduction further underlines the strength the Church’s influence must have had; Leurechon has demonstrated that he is not afraid to anger historians, but he still feebly submits to the Church’s threats. We can imagine that the Church’s censorship had similar effects on a great deal of other scientific writing at the time.

Despite these quirks, Leurechon's exposition is generally solid, revealing a broad understanding of scientific and mathematical principles. In part 19 of problem 85, Leurechon demonstrates an elegant trick to determine which of two fluids is denser, essentially using Archimedes' buoyancy principle (Leurechon, *Mathematical Reflections*, 206). The idea is to float a piece of wax in the first liquid, and then slowly add lead to the wax until the solid just barely floats. The resulting solid now has the same density as the first liquid, so by submerging it in the second liquid, one can compare the densities. More theoretical, problem 63 describes the ancient yet still fascinating notion of perfect numbers. Perfect numbers are equal to the sum of their factors: 6 is perfect as $6 = 1 + 2 + 3$, while 10 is not because $10 \neq 1 + 2 + 5$ (Leurechon, *Mathematical Reflections*, 92). In these problems and many more, Leurechon's presentation is completely correct and would have excited many a curious reader.

Leurechon's *Mathematical Recreations* was only a small part of the scientific revolution that swept through Europe in the 1600's. The book was published at the dawn of a plethora of exciting and new ideas and exposed many people across Europe to its scientific wonders. A product of its time, *Mathematical Recreations* also gives us a glimpse into the scientific and political state of Europe in the early 17th century.

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