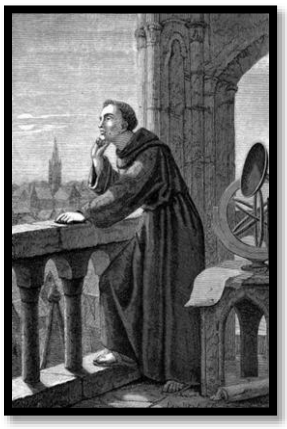
ATRIUM TOUR

Friar Roger Bacon Mural

Intertwining his Catholic faith with scientific thinking, Roger Bacon is considered one of the greatest sages of the medieval period.

Roger Bacon was an English Franciscan friar known for his contributions to philosophy and science in the 13th century. He advocated for educational reform, emphasizing the importance of mathematics, experimentation, and the study of foreign languages. While often presented as an early proponent of the modern scientific method, his work also reveals an interest in alchemy and occult traditions.

Bacon was born into a wealthy family, probably at Ilchester in Somerset, around 1220. He benefited from a good education and studied and taught in Paris before returning to Oxford University in 1247. Here, under the influence of fellow scholars, he turned his attention to experimental science, reasoning that such methods could be used to confirm the Christian faith.



Bacon described his intellectual biography as being divided into two distinct periods: a first “secular” period lasting until around 1257, during which he worked as an academic, and a second period, which he spent as a Franciscan friar “*in the pursuit of wisdom*.” As a secular scholar, Bacon pursued his academic career at two of the earliest European universities - the University of Oxford and then the University of Paris.

In or around 1257, he joined the Franciscan Order, probably in Oxford. He was a devout Christian who believed that his scientific work would aid an understanding of the world, and so of God through understanding His creation. He hoped the Franciscans would support his scholarly interests - the Oxford Franciscans had attracted prominent scholars such as Robert Grosseteste* and Adam Marsh. In the Oxford friary he continued his interest in the sciences. Study was a major part of the life of the friars, although Bacon's experimental science would have been a unique form. The friary had an excellent library so, although he was now not allowed personal possessions by the rules of the Order, he could still continue his scientific pursuits.

**Robert Grosseteste was a diocesan priest, teacher at Oxford, and later Bishop of Lincoln. He was a great friend of the friars.*

The beginning of the 1260s found Bacon again in Paris. For about 10 years Bacon had no personal contact with the outside world although he was able to correspond by

letter. Bacon's activities were restricted by a statute prohibiting the friars of his order from publishing books or pamphlets without prior approval.

In 1266, Bacon sent Pope Clement IV a letter containing proposals covering the natural world, mathematics, languages, perspective, and astrology. Bacon argued that a more accurate experimental knowledge of nature would be of great value in confirming the Christian faith, and felt that his proposals would be of great importance for the welfare of the church and of the universities. The Pope desired to become more fully informed of these projects and commanded him in June 1266 to send the work previously requested *"notwithstanding any prohibitions of his order."* Bacon began writing his *Opus Majus* (Great Work) and followed this up with his *Opus Minus* (Smaller Work) and his *Opus Tertium* (Third Work). In these works, he strongly advocated the reform of education, arguing that the best means of understanding the world's Creator was by close observation and precise measurement of the natural world.

In addition, he held that more emphasis should be placed upon the learning of languages, and the study of mathematics, alchemy, astronomy and the physical sciences. Unfortunately, Pope Clement IV died in 1268, putting an end to any immediate recognition of scientific subjects in the academic world.

After the Pope died, hope for Bacon's plans diminished, but not his enthusiasm for science. He continued to write on the value of experiment, and made remarkable predictions of what science could accomplish: powered ships and vehicles, eyeglasses and other inventions. He wrote that the earth was a sphere and that it would be possible to sail around it. He estimated the distances to stars, and encouraged mathematical rigor for good scientific work.

At age 64 (between 1277 and 1279) he was put under house arrest in the convent in Ancona, Italy by the Franciscans' Master General Jerome of Ascoli. The charge against him was that some of his doctrines contained "*certain suspected novelties*" – possibly relating to his teachings on alchemy, astronomy, experimental science, or his radical spiritual leanings. Bacon's views were sometimes controversial and led to accusations of heresy.** In Ancona, friars who had views with which their superiors disagreed were put in solitary confinement and not allowed to speak even to their guards for fear their views would have influence. They were refused confession and denied absolution - their superiors believed (and so did the imprisoned friars) they would go to hell for all eternity.

**Not only was he imprisoned, but he was also declared a "heretic." This is the key reason many of his writings in the Oxford Library were destroyed. Roger Bacon was a prolific writer and seemingly was writing something all the time. It was also a strong contributing reason why it was so difficult to gain any respect, even after his death.

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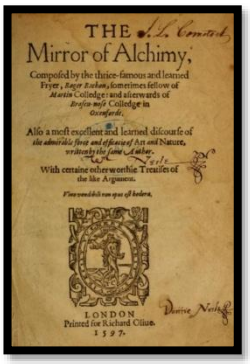
A change in the Franciscan leadership in 1290, however, saw Raymond of Guafredi take control of the Order, and he released the prisoners in Ancona. Although there is no explicit evidence that Bacon was among these men, it seems very likely that he was and he must have returned to England as soon as he could.

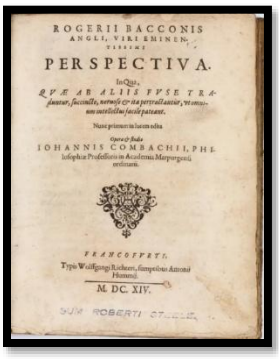
From his writings it is clear that Bacon had always argued for what he believed and against those he believed to be wrong. He continued to state his views even after suffering at Ancona – including on what was, in all likelihood, his last treatise, *Compendium Studii Theologie,* until his death in 1292 in Oxford.

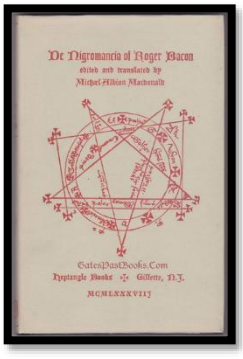
Because of his particular interest in practical science, a number of inventions have been attributed to him - such as lenses for spectacles - and he has been credited with the means of making gunpowder and of foreseeing the invention of the flying machine (with flapping wings), and the mechanically-driven ship and carriage. It is perhaps not surprising that he was thought by some to have magical powers and dubbed the scholastic accolade “Doctor Mirabili” (Wonderful Teacher) - a title that did not go well in the Church. It is now known that he gleaned many of his far-reaching ideas from others, but, nonetheless, he did make a contribution to scientific thought and his influence in this field was considerable.

Significant writings of Bacon which survived include:

- **Opus Majus (1267)– His most famous work, sent to Pope Clement IV, covering topics like optics, alchemy, and the scientific method.**
- **Opus Minus** (1267) – A summary and supplement to Opus Majus.
- **Opus Tertium** (1268) – Another follow-up to Opus Majus, providing additional insights.
- **The Mirror of Alchemy** (published in 1597) – A treatise on alchemy and its principles. It contains Bacon's thoughts on the relationship of science and religion. Bacon points out that the pursuit of knowledge is not incompatible with faith. Furthermore, he argues that science and religion could be mutually supportive. From this perspective, the "Mirror of Alchemy" can be interpreted as an early attempt to reconcile the seemingly opposing forces of science and religion.
- **Perspectiva** (published in 1614) – A work on optics and vision.
- **De Nigromancia** – A text discussing magic and necromancy.







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For a more in-depth look and the life and work of Friar Roger Bacon, click on the following links:

- Opus Majus
- Opus Minus and the “Seven Sins in the Study of Theology”
- The relationship of Religion and Science
- Scientific Method
- Gunpowder
- Magnifying Glass
- Optics
- Language
- Astronomy
- Roger Bacon – Wizard
- Astrology
- Alchemy
- Folly Bridge
- Oxford England Inscriptions – Roger Bacon; Westgate Centre
- Armillary Sphere

We are indebted to the following Roger Bacon alum who inspired the work on Roger Bacon:

Bill Broxterman ‘59

Bill Broxterman is a Cincinnati native who attended St. Bonaventure Church and grade school before enrolling at Roger Bacon High School, where he graduated in 1959. He went on to Xavier University, earning a B.S. in Chemistry in 1963 and an M.S. in 1965. He later attended Purdue University, where he earned his Ph.D. in Chemistry in 1969.

Bill began his professional career with Dow Chemical Company as a Research Chemist. Over time, his career evolved from basic research to new product development and ultimately to new business development. In 1990, he founded ChemQuest Group, an international business management consulting firm specializing in the coatings, adhesives, and sealants industries.

While a student at Roger Bacon, Bill recalls never learning much about the man for whom the school was named. Decades later, at the age of 81, his curiosity about Roger Bacon resurfaced—this time with the time and interest to explore it more deeply. What began as a casual inquiry grew into a year-long investigation. As his research progressed, Bill became increasingly fascinated by this 13th-century scholar,

recognizing him as a thinker far ahead of his time. One historian aptly described Roger Bacon as a 16th-century scientist mistakenly placed in the 13th century. Though his genius was not fully appreciated during his lifetime, later scholarship has recognized him as one of the most significant scientific minds of the Middle Ages.

At the conclusion of his research, Bill compiled his findings into a narrative and generously shared it with Roger Bacon High School for future use—an enduring contribution that reflects both his intellectual curiosity and his lasting connection to his alma mater.

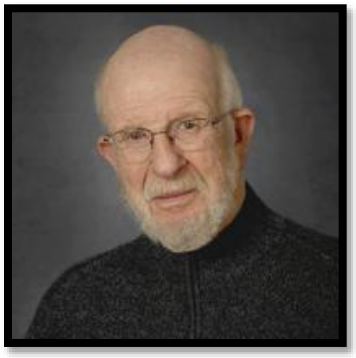
Will Schwartz ‘59

Will, a Cincinnati native, came to Roger Bacon from St. Gabriel Parish. He attended the University of Cincinnati, where he earned a Bachelor of Business Administration in 1964 and a Master of Business Administration in 1970. His undergraduate cooperative education experience focused on the economics of energy utilities, helping shape his early professional interests.

In 1964, Will joined IBM’s Cincinnati energy and communications industries unit, where he advanced through the organization and eventually led the division. In 1976, he transitioned to Prudential, joining a specialized group focused on the capital needs of energy utilities. Over time, he assumed a variety of leadership roles across finance, insurance, and real estate organizations, building a distinguished career in multiple sectors.

Will commented: *“Sputnik occurred early in my junior year. Among other things, Sputnik engendered discussions on education and how to best increase society’s knowledge base. Commenting on the latter in a History class, Brother Chris said ‘… anyone interested in the history of knowledge creation would do well to start their search with Roger Bacon.’ That sent me to libraries. My search was disorganized, intermittent, and life lone. Throughout my business career as the problems became more conceptual rather than concrete my appreciation for Doctor Mirabilis grew exponentially.”*

Donald Vieth ‘58



Donald L. Vieth was born in Cincinnati and raised in College Hill, where he attended St. Clare Parish and School. A proud member of Roger Bacon High School’s Class of 1958, he was later honored by his alma mater with the prestigious Astrolabe Award. He went on to attend the University of Cincinnati, earning a B.S. in Metallurgical Engineering in 1963 and a Ph.D. in 1972. While at UC, he was a member of Tau Beta Pi, and in 1985 the university recognized him as a Distinguished Alumnus.

ATRIUM TOUR

A professional engineer, Don devoted his career to public service and scientific leadership. He began in 1963 at the National Bureau of Standards, where he rose to become Special Assistant to the Director. In 1975, he joined the Energy Research and Development Administration, and when that agency became the U.S. Department of Energy in 1976, he continued serving in important roles related to nuclear energy.

In 1982, Don and his family moved to Las Vegas, where he became Director of the Yucca Mountain Project. In that role, he was affectionately known as “Captain Waste.” He also participated in the Presidential Executive Exchange Program from 1989 to 1990. Don continued in a number of senior leadership roles with the Department of Energy in both the Las Vegas field office and at the Richland site until his retirement in 1998. Even after retiring, he remained active in supporting the Department of Energy as a contractor on special projects.

Later in 1998, Don and his wife, JoAnn, returned to the Cincinnati area and settled in Maineville, where they enjoyed being close to family and friends. Don passed away on May 8, 2025. As a final act of love and charity, he donated his body to the University of Cincinnati College of Medicine Body Donation Program, reflecting his lifelong commitment to science, education, and service.

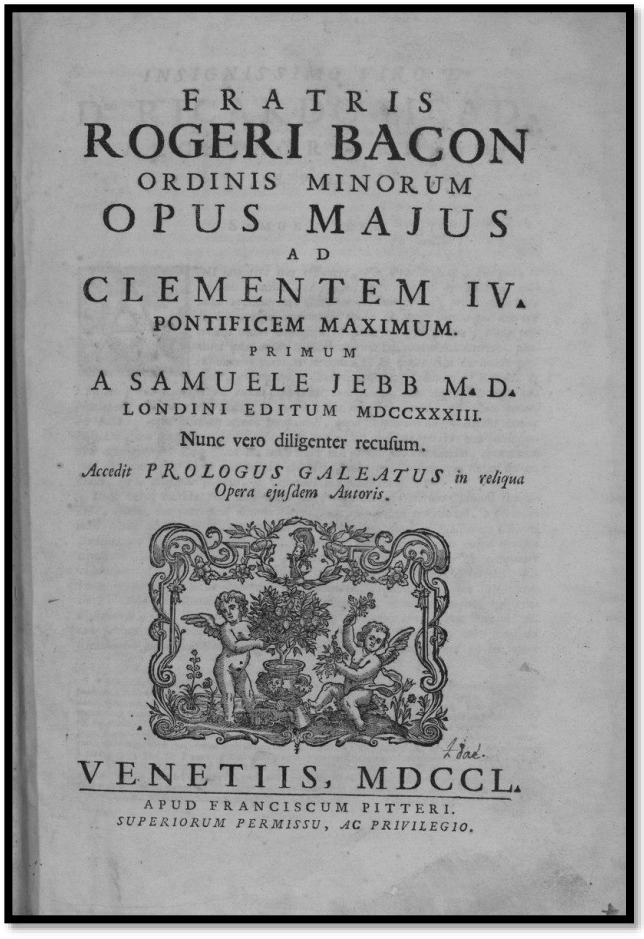
ATRIUM TOUR

OPUS MAJUS

The Opus Majus is the most important work of Roger Bacon. Written in Medieval Latin, it was sent to Pope Clement IV in 1267 to explain the work that Bacon had undertaken. Opus Majus was an encyclopedia of the known science of his day (which even included a description of how to make a telescope). He worked feverishly on this project in secret, since his superiors at the friary did not approve of it. Bacon wanted to demonstrate to the pope that science was the friend of faith and should be a worthy part of the university curriculum.

The 878-page treatise ranges over all aspects of natural science, from grammar and logic to mathematics, physics, philosophy, optics, alchemy, and the scientific method. He strongly advocated the reform of education, arguing that the best means of understanding the world's creator was by close observation and precise measurement of the natural world. In addition, he held that more emphasis should be placed upon the learning of languages, and the study of mathematics, alchemy, astronomy and the physical sciences.

Key Sections of Opus Majus



1. **Causes of Error** – Identifies four sources of human error: reliance on weak authority, influence of custom, ignorance, and the concealment of one's own lack of knowledge.

2. **Philosophy & Theology** – Theology, particularly Holy Scripture, is the foundation of all sciences.

3. **Study of Languages** – Emphasizes the importance of Latin, Greek, Hebrew, and Arabic for understanding wisdom and religious texts.

4. **Mathematics** – Discusses the flaws in the Julian calendar and the shifting of equinoxes and solstices.

5. **Optics** – Discusses the physiology of eyesight, the anatomy of the eye and the brain, and considers light, distance, position, and size, direct vision, reflected vision, and refraction, mirrors and lenses.

6. **Experimental Science** – Explores alchemy, gunpowder, celestial bodies, and anticipates inventions like microscopes, telescopes, flying machines, hydraulics and steam ships.

7. **Philosophy** - Considers moral philosophy and ethics.

Note: An incomplete version of Bacon's *Opus Majus* was published by William Bowyer in London in 1733. It was edited by Samuel Jebb from a manuscript at Trinity College, Cambridge which omitted the seventh part.

As a recent paper emphasizes, this major work cannot be usefully read exclusively in the context of the history of science and philosophy while forgetting to consider Bacon's religious commitment to the Franciscan Order. "*His Opus Majus was a plea for reform addressed to the supreme spiritual head of the Christian faith, written against a background of apocalyptic expectation and informed by the driving concerns of the friars. It was designed to improve training for missionaries and to provide new skills to be employed in the defense of the Christian world against the enmity of non-Christians and of the Antichrist.*"

ATRIUM TOUR

OPUS MINUS AND THE “SEVEN SINS IN THE STUDY OF THEOLOGY”

The Opus Minus is an abstract or summary of the main points of Opus Majus, likely intended to make Bacon's ideas more accessible to the Pope. It originally had nine parts, one of which was a treatise on alchemy and another entitled "The Seven Sins in the Study of Theology".

Roger Bacon identified "seven sins" or errors in the study of theology. These "sins" represent flawed approaches to theological inquiry and learning. Bacon believed they hindered a true understanding of God and His creation.

- The first sin was the preponderance of speculative philosophy. Bacon asserts that theology is a divine science; therefore, it must be based on divine principles.

- The second sin was ignorance of the sciences most suitable and necessary to theologians. Theologians of his day studied only Latin grammar, logic, natural philosophy (very superficially) and a part of metaphysics. Bacon believed that other sciences were more necessary: foreign (Oriental) languages, mathematics, alchemy, chemistry, physics, experimental sciences, and moral philosophy.

- The third sin was the defective knowledge of even the four sciences which theologians of his day studied. He believed that their ideas were full of errors and misconceptions, because they had no means to get at the real understanding of the authors from whom they drew all their knowledge, since their writings abounded in Greek, Hebrew, and Arabic expressions and idioms.

- The fourth sin was the preference at the universities to use the "Liber Sententiarum" and disregard the Holy Scripture. (Note: "Liber Sententiarum" refers to Peter Lombard's "Four Books of Sentences,” a seminal work in medieval theology. It's a systematic compilation of theological teachings widely used as a textbook in medieval universities.)

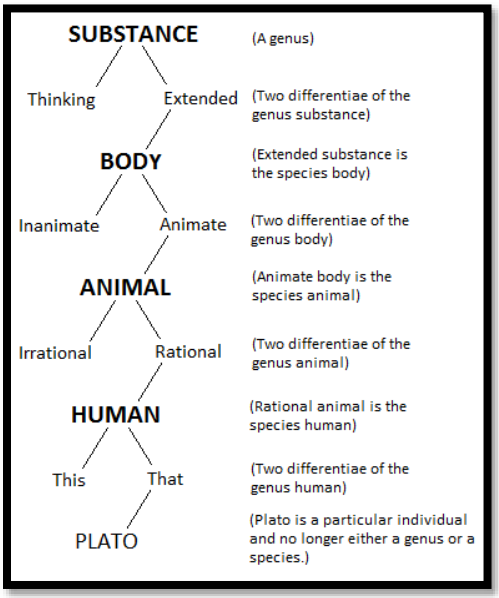
- The fifth sin was more disastrous. Bacon insisted that the text of Bible was horribly corrupted, especially the biblical text used at the University of Paris and spread by its students over the whole world. The reasons for this corruption were incorrect translations from the biblical languages.

- The sixth sin, what Bacon considered the “the worst of all sins,” was a consequence of the fifth sin. Since the literal translation of the original biblical text was corrupt, the spiritual meaning (which was based upon the literal translation) was also incorrect.

- The seventh sin was a radically false method of preaching. Instead of expounding on the commandments of God, preachers used the teachings of Aristotle.* In Bacon’s view, when prelates who during their course of study were

not instructed in preaching, when obliged to speak in church, their preaching only served to *"stimulate the hearers to all curiosity of mind, but do not elevate the affection towards good."*

*Around 520 CE, the Roman philosopher Anicius Manlius Severinus Boethius was expounding on Greek logic. To assist his students, he drew a diagram that later came to be known as the *arbor porphyriana* or *arbor porphyrii*. It is a branching diagram, starting at its top, which demonstrates a simple system of classification based on the teaching of Aristotle, proceeding from the general to the specific.



Porphyrian Tree

ATRIUM TOUR

THE RELATIONSHIP OF RELIGION AND SCIENCE

Bacon saw the foundations of science in the Bible at a time when the Bible was available only in ancient languages and read by few.

In the Medieval period, roughly 400 AD to 1500 AD, the teachings of the Bible were mingled with the teachings of the ancient Greek pagan "classical" philosophers. Classical thought consists primarily of the teachings of Plato (427-347 BC) and Aristotle (384-322 BC).

The ancient western Greco-Roman view of the material world was that the material world was chaotic and unpredictable. The ancient Greeks didn't do experimentation on nature which they saw as chaos. Plato and Aristotle largely rejected experiments on nature (scientific experimentation) as a means of gaining knowledge. The ancient Greeks did mathematics and architecture but almost no pure, experimental science. Their worldview would not allow for the scientific method. The educated Christians of western Europe saw both the Bible and nature through the teachings of Plato and Aristotle.

In medieval times all of science was primarily seen through the lens of Aristotle. Roger Bacon challenged this thinking. In his writings he began to strip away the reasoning of the ancient Greek philosophers. In doing so, he endured much opposition from church leaders. Some criticized his experiments and falsely accused him of dabbling in dark arts. Bacon did experimentation that came up with different conclusions from those taught in the writings of Aristotle. Bacon challenged Aristotle and got in trouble for it.

Bacon began a movement away from Plato and Aristotle that would take centuries to fully unfold. Roger Bacon is considered to be a true scientific pioneer. The key to his success is that he viewed the physical world from a purely Christian biblical perspective.

Three sources of knowledge in the Christian worldview are the Holy Scriptures, the natural world and the conscience. The Christian view of nature is that nature is not an illusion, nor is it random or chaotic. Furthermore, observations of nature can be inductively applied. The God of the Bible created nature; therefore, nature is subject to God's consistent physical laws. The Bible shows God as a moral lawgiver who is rational and consistent. God gives both moral laws and laws of physics. The fact that nature is orderly means that mathematics can be applied to nature in a rational way.

Roger Bacon used experimental science to study nature. In previous generations such knowledge gained from experiments was considered useless because the natural world was considered chaotic. The Christian worldview regards God as rational and orderly and therefore nature is assumed to be consistent and orderly. This in turn leads to the fundamental axiom of modern science - the regularity principle. The regularity principle is the Christian view that the universe is consistent or "regular" and therefore what is found true in one part of the universe is true in all of it.

ATRIUM TOUR

Roger Bacon believed that a deep understanding of both the natural world and theology were essential, and that true knowledge, particularly in the sciences, could enhance and support religious understanding. He advocated for the use of experience and observation in scientific inquiry as a means to better understand both the natural world and the scriptures. He also believed that a strong foundation in mathematics was crucial for understanding both the natural sciences and theology.

- **Bacon saw science not as separate from religion, but as a tool to better understand God's creation and to deepen religious understanding.**
- He emphasized the role of experimentation and observation in acquiring knowledge, a departure from the more theoretical approaches of his time.
- Bacon believed that a strong foundation in mathematics was essential for understanding both the natural sciences and theology.
- Bacon called for a reform of the educational system, particularly the liberal arts, to incorporate a greater emphasis on mathematics and natural sciences.
- He believed that a better understanding of the literal sense of the scriptures, gained through scientific inquiry, could lead to a deeper understanding of their spiritual sense.
- Bacon also envisioned that scientific knowledge could be used to alleviate human suffering and to ensure the supremacy of Christians in warfare.
- **In essence, Bacon's perspective was that the study of the natural world and the study of theology were not mutually exclusive, but rather complementary and mutually supportive paths to truth.**

Bacon repeatedly asked the readers of his works not to confuse his physics with divination, his chemistry with alchemy, and his astronomy with astrology. He willingly submitted all his writings to the judgment of the Church. He showed a reverence for the Pope and the highest veneration towards the Fathers of the Church - even when not approving their opinion. Bacon was a faithful scholar of open character who frankly uttered what he thought and was not afraid to blame whatsoever and whomsoever he believed to deserve censure.

Long after Roger Bacon passed away, the Bible became more available to the people of Europe. During the Protestant Reformation the Bible was translated into the languages of the people. In 1538, a command was given by Lord Thomas Cromwell (under Henry VIII) to have the Bible read in English in all the churches. Bible knowledge exploded across England. The Bible soon became accessible to people across all of Europe.

ATRIUM TOUR

The biblical worldview spread far and wide. Francis Bacon (1561-1626), Blaise Pascal (1623-1662), Robert Boyle (1627-1691) and Sir Isaac Newton (1642-1727) made the fundamental breakthroughs that birthed modern science.

Robert Boyle is considered to be the founder of modern chemistry. Medieval alchemy gave way to modern inductive chemistry under Boyle. Boyle was a devout believer in Christ. He left provisions in his will to fund a series of lectures titled: “Defending the Faith.”

Newton’s laws of motion revolutionized physics. Newton was also a brilliant mathematician who discovered calculus. Newton was a believer who wrote more on theology than he did on science.

Roger Bacon was the herald of modern science. Bacon's science is inseparable from his religion. His views on natural force and the value of mathematics are intertwined with his interest in alchemy and astrology. These, in turn, are part of a larger commitment to the revealed truths of Christianity. Bacon's scientific ideas were deeply intertwined with his religious beliefs. The most impressive features of Bacon's science both grow out of, and return to, his faith.

“Holy Scripture especially is an inexhaustible fountain of truth from which all human philosophers, even the heathen, drew their knowledge; therefore no science, whether profane or sacred, can be true if contrary to Holy Writ”

ATRIUM TOUR

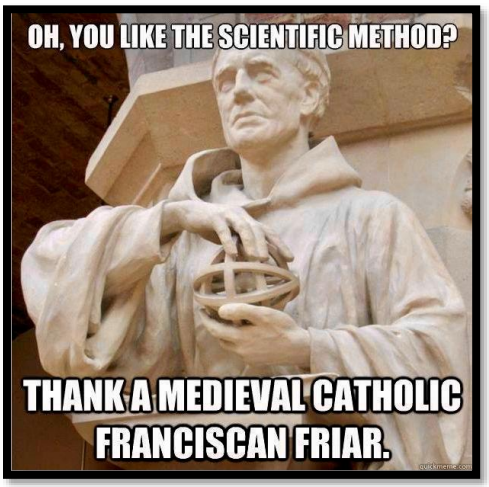
SCIENTIFIC METHOD

Roger Bacon was one of the earliest European advocates of the modern scientific method - a significant departure from the prevailing scholastic approach of his time. While some in the thirteenth century were content with superstition, habit and acceptance of authority, Bacon saw the value of glorifying God through study of the world. He believed science would draw people to faith in God. He was one of the Christian thinkers in the universities and in the monasteries who connected the dots between the Bible and science. Bacon made errors and had some superstitions of his own about alchemy and astrology (as did most people in his day), but he saw how experimental science could lead people away from the errors of superstition and magic by demonstrating how the world really works.

He advocated for a system of acquiring knowledge through observation and experimentation, rather than solely relying on established authorities or texts. His approach emphasized the importance of empirical evidence and the testing of hypotheses, laying the groundwork for the modern scientific method.

Bacon's scientific methodology can be summarized as follows:

1. Observation: Stressed the importance of making careful and unbiased observations of the natural world.
2. Hypothesis: Based on these observations, scientists should formulate testable hypotheses.
3. Experimentation: Hypotheses should be tested through carefully designed experiments.
4. Verification: Emphasized the need for independent verification of experimental results. He believed that multiple people should be able to replicate the same experiment and obtain the same results to ensure accuracy and minimize personal bias.



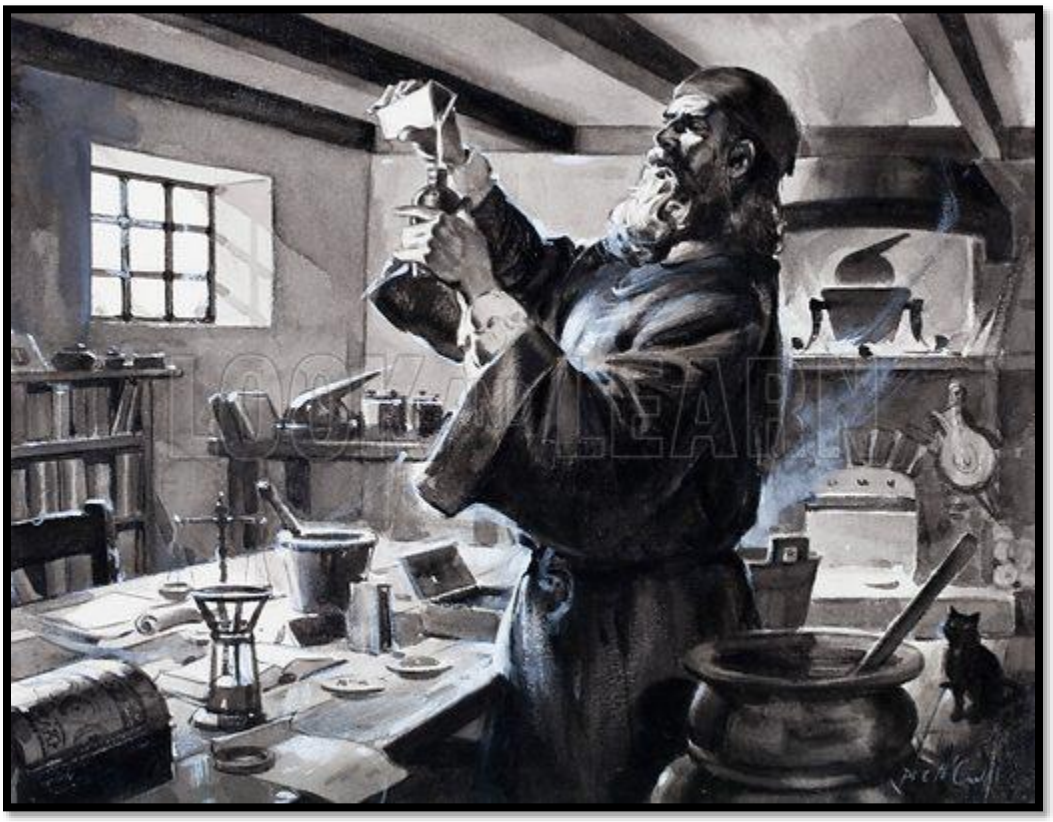
His assertions in the *Opus Majus* that "*theories supplied by reason should be verified by sensory data, aided by instruments, and corroborated by trustworthy witnesses*" were and still are considered "*one of the first important formulations of the scientific method on record.*"

"The strongest arguments prove nothing so long as the conclusions are not verified by experience. Experimental science is the queen of sciences and the goal of all speculation.'

ATRIUM TOUR

GUNPOWDER

Although gunpowder was first invented and described in China, Bacon was the first in Europe to record its formula. He is credited with being the first Western intellectual to produce gunpowder after witnessing at least one demonstration of explosives from the Mongol Empire, but he kept the formula a secret lest it be used to harm anyone.



Roger Bacon making gunpowder

ATRIUM TOUR

MAGNIFYING GLASS

The magnifying glass was invented by Roger Bacon in 1268. He adapted its use as primitive spectacles, allowing scholars with failing eyesight to continue their work.

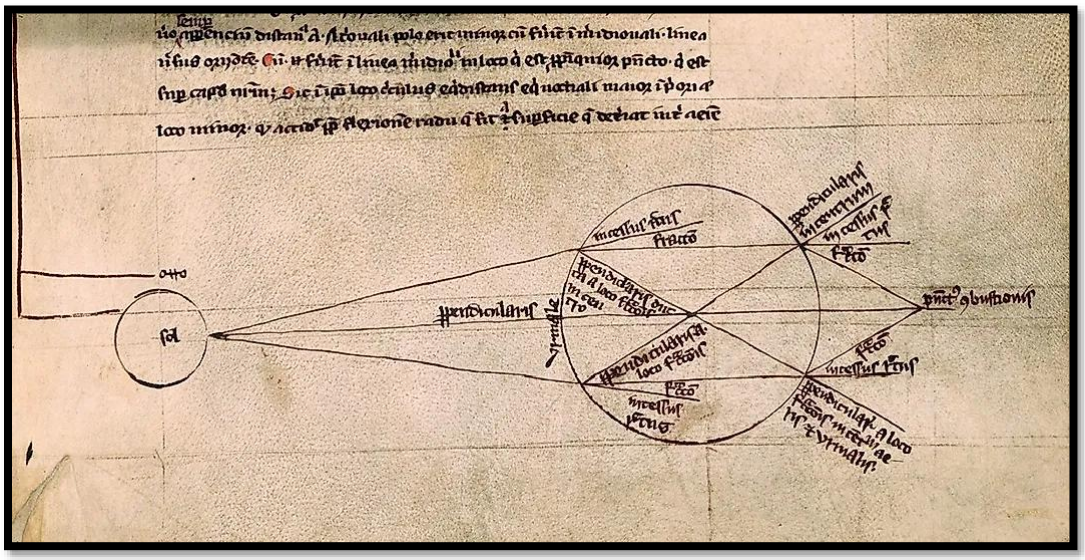
Beautiful magnifying glass created by Friar Roger Bacon

ATRIUM TOUR

OPTICS

His most important mathematical contribution is the application of geometry to optics.
He emphasized the use of lenses for magnification to aid natural vision. He carried out systematic observations with lenses and mirrors.

Bacon is the first to theorize that lenses may have applications in the correction of eyesight, and he is also the first to apply geometry to the study of optics. Bacon postulates that the colors of a rainbow are due to the reflection and refraction of sunlight through individual raindrops.



Bacon's diagram of light being refracted by a spherical container of water

"Mathematics is the door and the key to the sciences."

ATRIUM TOUR

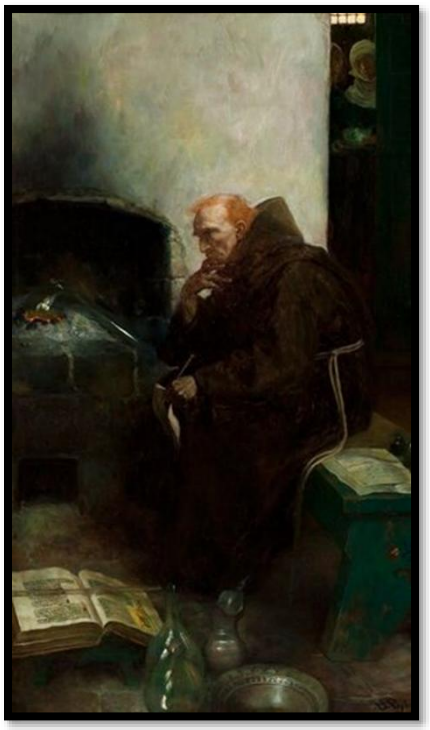
LANGUAGE

Bacon was familiar with English, French, Latin, Greek, Arabic, and Aramaic. His mastery of Greek in particular was unique in his times.

He was an early advocate of the importance of studying foreign languages, including Arabic and Hebrew, for the advancement of knowledge. Some of Bacon's greatest inspirations were Middle Eastern academics like al-Farabi, Ibn Sina, and Averroes.

He argued that, rather than training to debate minor philosophical distinctions, theologians should focus their attention primarily on the Bible itself, learning the languages of its original sources thoroughly. He was fluent in several of these languages and was able to note several corruptions of scripture, and of the works of the Greek philosophers that had been mistranslated or misinterpreted by scholars working in Latin. Bacon insisted that even in the best versions of scientific works or the Scriptures, there were still some foreign expressions impossible to express in Latin.

"The conquest of learning is achieved through the knowledge of languages."



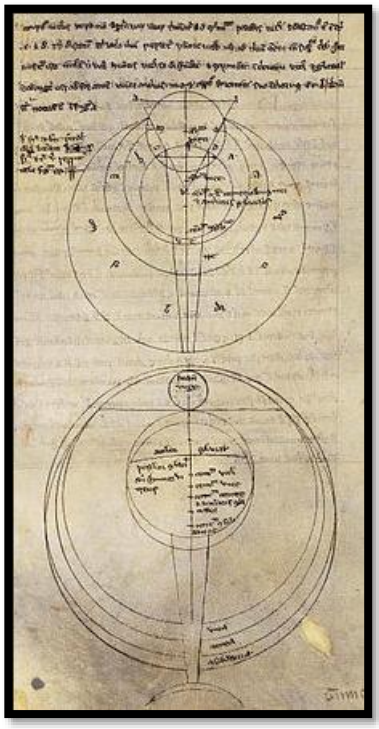
Friar Bacon in His Study (Howard Pyle - 1903)

ATRIUM TOUR

ASTRONOMY

Roger Bacon studied astronomy as part of his broader interest in mathematics, optics, and the natural sciences. Bacon's work in astronomy included proposing a calendrical reform, studying the positions and sizes of celestial bodies, and exploring the practical applications of astronomy in everyday life.

Calendar Reform. Bacon believed the calendar of his time was being used incorrectly. The Julian Calendar was the system of dating followed from 46BC onwards. It was this calendar which added one extra day in every four years (giving us our 'leap year') because it had been calculated that the earth takes 365¼ days to complete its circuit around the sun, not a straight 365 days. Unfortunately, this calculation was not entirely accurate. In fact, the sun's circuit is not exactly 365¼ days - it's approximately 11 minutes less. This may seem a very small amount, but over a large number of years the figure builds up. As a result, it emerged that the Julian Calendar was over-correcting by around 8 days each millennium. Since Bacon was a religious man, he felt that they would be celebrating holidays like Christmas and Easter on the wrong dates. Bacon proposed a calendrical reform similar to the later Gregorian calendar, criticizing the Julian calendar for its inaccuracies. He suggested dropping one day every 125 years and ceasing the observance of fixed equinoxes and solstices. Bacon soon calculated a reduction of time that led to the Gregorian calendar 100 years later that subtracted nine days from the calendar.



Bacon's Modern Calendar

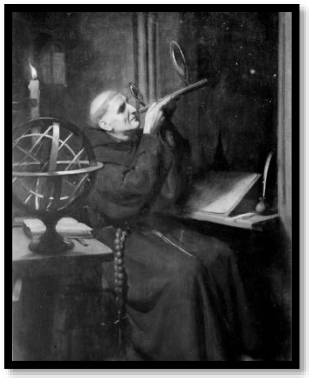
Practical Applications. Bacon emphasized the practical utility of astronomy, arguing that it had connections to daily life and could be used for navigation, timekeeping, and even predicting future events.

Empirical Approach: Bacon was a strong advocate for empirical observation and experimentation, which influenced his approach to astronomy and other sciences.

Influence of Optics. Bacon's work in optics, including his understanding of lenses and refraction, likely influenced his astronomical studies and his ideas about the potential of instruments like telescopes. In his Opus Majus, gave a proposal for a telescope:
"For we can so shape transparent bodies, and arrange them in such a way with respect to our sight and objects of vision, that the rays will be reflected and bent in any direction we desire, and under any angle we wish, we may see the object near or at a distance ..."

ATRIUM TOUR

Study of Celestial Bodies. He explored the positions and sizes of celestial objects, contributing to a better understanding of the cosmos. It was reported that Bacon "*... did sometimes use in the night season to ascend this place (his study on Folly Bridge) environed with waters and there to take the altitude and distance of stars and make use of it for his own convenience...*" He believed that the Earth was a sphere and that one could sail round it. He estimated the distance to the stars coming up with the answer 130 million miles. He used a camera obscura (which projects an image through a pinhole) to observe eclipses of the Sun.



Bacon observing the stars

Interesting Fact: Bacon is a lunar impact crater that lies in the rugged southern highlands on the near side of the Moon - this crater was named after Roger Bacon. However, since it was chosen by the German astronomer von Mädler, the crater name became modified from Bacon to Baco. On the Moon, craters are named after deceased scientists, polar explorers, astronauts or cosmonauts.

Lunar Orbiter 4 image

Note: Lunar Orbiter 4 was a robotic U.S. spacecraft, part of the Lunar Orbiter Program designed to orbit the Moon after the three previous orbiters had completed the required needs for Apollo mapping and site selection.

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ROGER BACON - WIZARD

Roger Bacon earned the moniker "Doctor Mirabilis," or "Wonderful Teacher," for his groundbreaking work in natural philosophy, optics, and experimental science. His innovative ideas and vision of the future contributed to his reputation as a "wizard" in the eyes of his contemporaries.

One reason for this perception was Bacon's belief in the potential of scientific discoveries to transform society. He advocated for the application of empirical methods, experimentation, and mathematics to understand and manipulate the natural world. This approach was highly unconventional for his time, as the prevailing scholastic tradition leaned heavily on the authority of ancient texts and theologians. Bacon's vision of using science to achieve wonders such as flying machines, automobiles, and submarines seemed fantastical, and thus, many considered him a wizard or sorcerer.

Bacon's work in optics and alchemy also contributed to his wizard-like reputation. He conducted pioneering research in the field of optics, which led to the development of lenses, mirrors, and other optical instruments. His fascination with the properties of light and color led to experiments in which he sought to manipulate them, which seemed magical to many during the 13th century.

Furthermore, his interest in alchemy, the predecessor of modern chemistry, and his attempts to uncover the secrets of nature and the cosmos were arcane and mysterious to casual observers. While Bacon did not advocate for the transmutation of base metals into gold, as some alchemists did, he did believe in the possibility of achieving a universal medicine, or panacea, capable of curing all diseases. These pursuits fueled the perception that Bacon possessed supernatural or magical powers.

In many ways Bacon was like Leonardo da Vinci, a man born centuries ahead of his time. For example, he imagined

- **a great ship being operated by one man without the need of oarsmen (steamships);**
- **a machine that would make possible the walking of men along the ocean floor (the diving bell);**
- **a vehicle that could be propelled below water (the submarine);**
- **a vehicle operating at high speeds without the need of any horsepower (the automobile), and**
- **a machine with a mechanical device in it that would make it fly above the earth (airplane).**

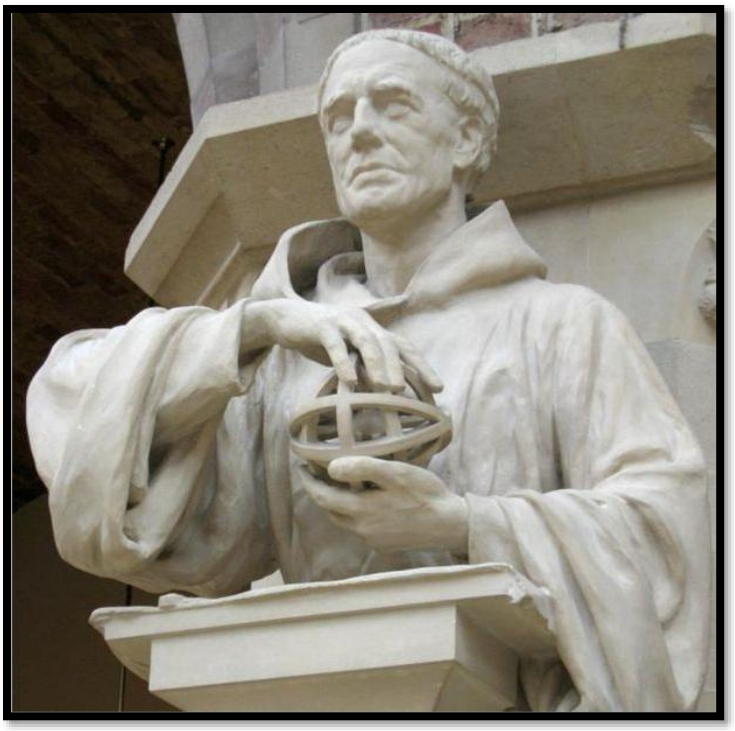
He theorized:

- ***"Someday we may read the smallest letters at an incredible distance"*** **(binoculars)**
- ***"We may cause the stars to appear wherever we wish."*** **(telescopes).**
- **As for a new technology of light, there may sometime in the future appear *"that device by which rays of light are led into any place that we wish and***

are brought together by refractions in such fashion that anything is burned which is placed there" **(laser technology).**

These inventions would all take six to seven more centuries to materialize.

While the concept of wizards as magical beings may be rooted in fantasy, the achievements of Roger Bacon during the 13th century were nothing short of remarkable.



ATRIUM TOUR

ASTROLOGY

Astronomy is a scientific discipline that studies celestial objects and phenomena, while astrology is a belief system that claims to interpret the influence of celestial bodies on human affairs and events on Earth. The difference between Astronomy and Astrology is similar to the difference between Chemistry and Alchemy. Astronomy and Chemistry are natural sciences. Astrology and Alchemy are pseudoscience.

Roger Bacon viewed astrology as a science that could be used to understand and even predict aspects of the natural world and human affairs. While he acknowledged the potential for astrology to be misused, he saw its study as valuable within the broader context of his experimental science.

He considered astrology, along with astronomy, as part of the mathematical sciences. He believed it could be used to understand the influence of celestial bodies on earthly events and human lives, though he also recognized the limits of its predictive power. Bacon was critical of deterministic astrology, which claimed that all events are predetermined by celestial influences. He believed that human free will played a role and that astrology should be understood as revealing probabilities rather than certainties.

Bacon sought to integrate astrology into his broader scientific framework, which emphasized observation, experimentation, and mathematical reasoning. He believed that astrology, when studied rigorously, could contribute to a deeper understanding of the natural world.

Bacon's interest in astrology, along with his other unconventional ideas, contributed to his being viewed with suspicion by some of his contemporaries, including members of the Franciscan order. In 1277, Bacon was placed under house arrest in the convent in Ancona, Italy, partly due to his views on astrology - particularly his belief that the birth of Christ and the advent of Christianity were influenced by a planetary conjunction. Some scholars believe Bacon's imprisonment was also influenced by his unorthodox views on magic and his emphasis on experimental science.

Despite the controversy surrounding his views on astrology, Bacon is recognized as a significant figure in the history of science and philosophy. His emphasis on experimental observation and his attempts to integrate various fields of knowledge, including astrology, contributed to the development of scientific thought. Bacon's work on optics, mathematics, and language also laid the groundwork for future scientific advancements.

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ALCHEMY

Bacon's alchemical pursuits were largely driven by the desire to find ways to prolong human life, even to extreme lengths. He envisioned that alchemy, particularly when combined with his understanding of medicine, could achieve this through the creation of potent and safe medicines.

Bacon distinguished between practical alchemy, which involved the manipulation of substances through techniques like distillation and sublimation, and speculative alchemy, which focused on understanding the fundamental nature of the four elements and their interactions.

Bacon believed that the four elements (fire, air, water, and earth) combined to form the four humors (blood, phlegm, yellow bile, and black bile). He thought that by understanding how these elements and humors interacted, one could manipulate them to create beneficial medicines and potentially achieve a state of incorruptibility – the idea that materials could be made resistant to decay. He believed that an "elixir" or medicine of equal complexion could restore a body's balance, making it resistant to disease and aging, and potentially even extending life.

Bacon's alchemical ideas were influenced by the medical practices of his time, particularly Galenic medicine, which focused on the balance of humors. He also drew inspiration from the Franciscan order's belief in the innate goodness of the physical body and the possibility of spiritual and physical union with God.

His Opus Majus suggests that alchemical wisdom would supply gold to fund armies and could devise large-scale weapons: diseases that spread through contact and might destroy an enemy without an army, or explosions of fire that burned even in water, or mirrors that could confound an enemy at a distance, or even incantations that might bring down heavenly power on an enemy’s head. Many came from the *Secret of Secrets*, an advice manual for princes translated from the Arabic tradition, and these earned Bacon much of his later reputation as a conjuror.

Roger Bacon conducting an alchemical experiment in a vaulted cloister (right)

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FOLLY BRIDGE

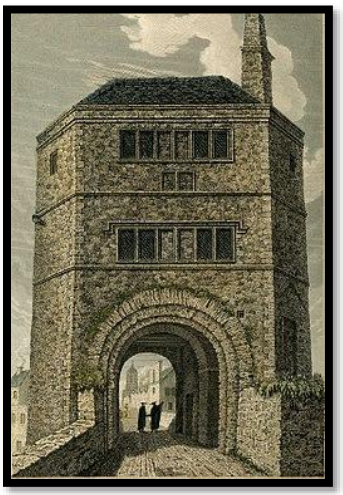
Folly Bridge is a stone bridge over the River Thames carrying the Abingdon Road south from the center of Oxford, England. Erected in 1825–27, the bridge is in two parts separated by an island. The origin of the name is uncertain although it has been suggested that it originated about 1650 after a tenant of Bacon's study.

The bridge apparently stands at the site of the ford over which oxen could be driven across the Isis, the ancient name of the Thames in the Oxford area. The first known stone bridge on the site was built by Robert d'Oilli in around 1085, but there was believed to be a wooden bridge in the time of Ethelred of Wessex.

Until the late 17th century the bridge was known as South Bridge, and formed part of a long causeway known as Grandpont, which stretched along most of the line of Abingdon Road. In the 13th century, Friar Roger Bacon lived and worked at "Friar Bacon's Study" which stood across the north end of the bridge until 1779, when it was removed to widen the road. In Oxford lore, Roger Bacon is credited as the namesake of Folly Bridge for having been placed under house arrest nearby.

Samuel Pepys visited Bacon's study in 1669, noting: *"So to Friar Bacon's study: I up and saw it, and gave the man 1 shilling."*

A toll-booth gateway tower used to straddle the approach to the bridge, which was on the Abingdon to Banbury turnpike. The former bridge and "Bacon's Tower" were drawn by many artists.



The old "Friar Bacon's Study"

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OXFORD INSCRIPTIONS: ROGER BACON, WESTGATE CENTRE

The tablet to Roger Bacon (below) with an inscription in Latin followed by an English translation, was installed in 1917 on the city wall at King's Terrace in St Ebbe's.

The Great Philosopher
ROGER BACON
Known as the Wonderful Doctor
Who by the Experimental Method
Extended marvelously the realm of science
After a long life of untiring activity
Near this place
In the home of his Franciscan brethren
Fell asleep in Christ
A.D. 1292

In 1976 when most of St Ebbe's was demolished, the plaque was moved to the old Westgate Centre on the north side of Old Greyfriars Street. It was then moved again to the new Westgate Centre which opened on October 24, 2017.

A nearby lane is also named after Bacon (see sign, right)

ATRIUM TOUR

ARMILLARY SPHERE

An armillary sphere (variations are known as spherical astrolabe, armilla, or armil) is a model of objects in the sky (on the celestial sphere), consisting of a spherical framework of rings, centered on Earth or the Sun, that represent lines of celestial longitude and latitude and other astronomically important features, such as the ecliptic. With the Earth as center, an armillary sphere is known as Ptolemaic. With the Sun as center, it is known as Copernican.

It was invented separately, in ancient China possibly as early as the 4th century BC and ancient Greece during the 3rd century BC, with later uses in the Islamic world and Medieval Europe.

Armillary spheres were among the first complex mechanical devices. Their development led to many improvements in techniques and design of all mechanical devices.

Renaissance scientists and public figures often had their portraits painted showing them with one hand on an armillary sphere.

Statue of Roger Bacon carrying an armillary sphere in the Oxford University Museum of Natural Science