

## Roger Bacon

Because he emphasized the importance of mathematics and systematic observation and experimentation in the study of natural phenomena, English philosopher and educational reformer **Roger Bacon** (1214 – June 11, 1294) is considered one of the first modern scientists. Known as *Doctor Mirabilis* (“Wonderful Doctor”), he held the unorthodox view that a study of the natural world using examination and exact measurement was the surest way to develop a true understanding of the world and its



creator. At the time, this was revolutionary thinking, as curiosity was not much encouraged during the Middle Ages. Those who thought about natural phenomena were generally members of the Church and believed that God’s will and purpose could be determined through reason. The acceptable approach to scientific inquiry was to think about it, even though to do so risked having heretical thoughts. Scholars like Bacon, who sought the superior scientific information that existed in the Arab world, were suspected of having sold their souls to the devil in order to acquire “useless” knowledge. The safest approach was that if the Church didn’t endorse a scientific idea, it was best to forget about it. Together with Albertus Magnus, Bacon is considered one of the earliest advocates of the Scientific Method. He wrote, “There are two modes of knowing – by argument and by experience: argument concludes and makes us grant the conclusion, but does not produce certainty and remove doubt, and enable the mind to rest in sight of the truth, unless if find it by way of experience.”

Most of what is known about Bacon’s life comes from autobiographical references in his writings. He was born near Ilchester, the son of wealthy royalists who sided with Henry III against the rebellious barons. As a result, most of the family’s property was confiscated at the end of the English civil wars. Passionately interested in the natural world, Bacon studied geometry, arithmetic, music and astronomy at

Oxford, which he entered at the age of twelve. In 1234 he traveled to Paris, then the intellectual center of Western Europe, to study languages and physics. Bacon received a degree (probably a master's) from the University of Paris around 1241. From 1240-1247 he lectured at Paris on Aristotle's ideas, becoming a pioneer in introducing the works of Aristotle into Western Europe. Bacon returned to Oxford as a professor at the Franciscan school, where he strove to replace logic in the curriculum by mathematical and linguistics studies. He contended that "divine mathematics" should be the foundation of a liberal education. His argument that mathematics "alone can purge the intellect and fit the student for the judgment of all knowledge" was ignored. He invested much time and energy and money in experimental research, acquiring "secret" books and constructing instruments and mathematical tables. He claims to have spent 2000 pounds on books and equipment, a remarkable amount at a time when one could purchase a fine house for two or three pounds.

From 1247 to 1257 Bacon's intellectual pursuits took him in many different directions. His investigations on the nature of light and on the rainbow are especially noteworthy. He clearly planned and interpreted his experiments very carefully, yet many that he described were never actually performed. He considered the problem of a flying machine with flapping wings and was the first person in the West to give exact directions for making gunpowder. He described spectacles, elucidated the principles of reflection, refraction, and spherical aberration, and proposed mechanically propelled ships and carriages. He observed eclipses of the Sun with a *camera obscura*. Bacon was suspected of dabbling in the black arts. This was not because of his alchemical experiments or his inclusion of astrology in his study of astronomy, because both alchemy and astrology were respectable "sciences" at the time. Rather, it was his brilliance in so many areas that led many to suspect him of witchcraft. Yet he taught that black magic was fraudulent and he rejected the "damnable practices, when men despising the Rules of Philosophy, irrationally call up wicked spirits, supposing them of Energy to satisfy their desires. In which there is vast error, [partly because it is] altogether impossible and partly because it

turns men away from God.” He attacked human superstitions and delusions, incantations, invocation of spirits and spellbinding. However, he embraced what was known as “natural magic,” phenomena that can be described by mathematics and physics.

Because experimental science was essentially unknown in his day, it was difficult to convince others of its utility. Bacon hoped to do so by his own experiments and descriptions of experiments. He strove to show that it was possible to discover the secrets of nature, which had both secular and religious values. He was convinced that through experimentation it would be possible to “find out surely what can be done through nature, what through the application of art, what through fraud, what is the purport and what is mere dream in chance, conjuration, invocations, imprecations, magical sacrifices and what there is in them; so that all falsity may be lifted and the truths we alone of the art retained.”

In 1257, due to ill health, Bacon left Oxford and became a Franciscan friar. His superiors disapproved of his continued interest and experimentation in the sciences. They forbade him to lecture or publish any work without their special permission under pain of severe punishments. Every once in a while, Bacon released a letter or treatise covering some topic and be reprimanded for doing so. He was ordered to Paris where he could be more closely supervised. But Bacon’s fame for scholarship had come to the attention of the papal legate in England, Guy de Foulques, who in 1265 became Pope Clement IV. After learning of Bacon’s assertion that all of education needed to be revised, and that the revisions could be found in his work, the pope got the mistaken idea that Bacon had already created such a work and demanded to see it. Bacon had to obey the pope’s command and so wrote the *Opus majus* (“Great Work”), the *Opus minus* (“Lesser Work”), and the *Opus tertium* (“Third Work”) in the span of only fifteen months. What made the achievement all the more remarkable was that Bacon had to work in secrecy as he was in defiance of the orders of his superiors. The *Opus majus* was divided into seven parts: 1. the cause of human ignorance, 2; the connection between philosophy and theology;

3. the study of language, 4. mathematics; 5. physics (especially optics); 6. experimental science; and 7. moral philosophy. The treatises were sent to Clement, but unfortunately the pope's death in 1268 ruined Bacon's plans for making the sciences an important part of the curriculum of the universities.

Bacon's forthright views caused Clement's successor Nicholas IV, formerly the minister-general of the Franciscans, to condemn Bacon to prison for life around 1278. Bacon was charged with using *suspected novelties* in his teaching. Although he certainly had novel ideas by the standards of the day, those who condemned his work were less interested in stifling Bacon's scientific ideas, than in reigning in his disobedience. He was released from imprisonment a year before his death. In his last work *Compendium theologiae* (1293, *Compendium of Theology*), Bacon was as feisty and aggressive as ever. Bacon's other writings of which only portions were published included the *Communia naturalium* (*General Principles of Natural Philosophy*) and the *Communia mathematica* (*General Principles of Mathematical Science*). In 1272 he completed the *Compendium philosophiae* (*Compendium of Philosophy*). Legend has it that his cell, which still can be seen at Oxford, will fall whenever a man greater than Bacon enters it.

**Quotation of the Day:** "If a man's wit be wandering, let him study mathematics" – Roger Bacon