Pioneers in Optics: Alhazen and Roger Bacon

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Alhazen (965-1040)

Born in Iraq as Abu Ali Hasan Ibn al-Haitham, the great Arab physicist is more often known by the Latinized version of his first name, Alhazen. Although he was to eventually become a profound intellectual specializing in mathematics and optics, Alhazen's early education was geared towards religion and prepared him for a career as a minister. However, apparently unhappy in his religious pursuits, Alhazen later decided to devote himself to the study of science and became particularly intrigued by Aristotle.

Many details of Alhazen's life have been lost over time and the stories that remain are often contradictory depending on the historian relating them. Nevertheless, it is generally held that Alhazen went to Egypt at some point in his life with a scheme to control the waters of the Nile. Invited to engineer the plan by al-Hakim, who was to become known as the Mad Caliph, Alhazen realized the impossibility of the feat. However, although he failed, al-Hakim rewarded him with an official government post, a gift that was not to be envied. As al-Hakim's behavior became increasingly erratic, Alhazen is believed to have feared for his life, feigning madness in order to be relieved of his position. Consequently, he was largely confined to his house until al-Hakim's death in 1021. Such a situation provided him with large amounts of free time with which he could conduct experiments and write, but he may have also been busy copying manuscripts in order to support himself.

Alhazen
(965-1040)

The efforts of Alhazen resulted in over one hundred works, the most famous of which was Kitab-al-Manadhirn, rendered into Latin in the Middle Ages. The translation of the book on optics exerted a great influence upon the science of the western world, most notably on the work of Roger Bacon and Johannes Kepler. A significant observation in the work contradicted the beliefs of many great scientists, such as Ptolemy and Euclid. Alhazen correctly proposed that the eyes passively receive light reflected from objects, rather than emanating light rays themselves. The work also contained a detailed examination of the laws of reflection and refraction, which is accurately explained by the slower movement of light through denser substances. Furthermore, the question known as Alhazen's problem, which involves determining the point of reflection from a surface given the center of the eye and the observed point, is presented and answered through the use of conic sections.

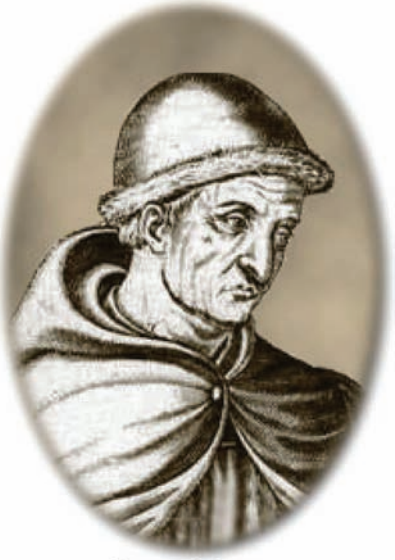
Alhazen published several other less well-known works on optics, one of which included an account of the camera obscura, as well as books in many other fields, such as astronomy, mathematics, and even evolutionary biology. Other accomplishments he is frequently credited with are the development of analytical geometry and scientific methodology. Moreover, Alhazen was greatly interested in movement and is likely the earliest person to have suggested that a body moves continuously until an outside force stops it or changes the direction of its motion, which was to later become an important aspect of Newton's First Law of Motion.

Roger Bacon (1214-1294)

Roger Bacon was an English scholastic philosopher who was also considered a scientist because he insisted on observing things for himself instead of relying on what other people had written. Bacon was born into a wealthy family in 1214 and died in 1294. He was trained in the classics, geometry, arithmetic, music and astronomy and was a student at the University of Paris as a young man where he received the degree of Doctor of Theology. Bacon spent forty years studying and lecturing on the natural sciences at Oxford University in England. For these efforts, he is considered to be the most important cultivator of the natural sciences during the Middle Ages.

Bacon's writings included treatises on optics (then called perspective), mathematics, chemistry, arithmetic, astronomy, the tides, and the reformation of the calendar. His skill in the use of optical and mechanical instruments caused him to be regarded by many as a sorcerer. Bacon was acquainted with the properties of mirrors, knew the powers of steam and gunpowder, had a working knowledge in microscopy, and possessed an instrument very much like a modern telescope. He claimed that his telescope could make the most distant object appear near, that it could make stars appear at will, and even further, that it had the power of visualizing future events.

Bacon once frightened his students by creating a rainbow by passing light through some glass beads. This demonstration marked one of the earliest attempts to duplicate a natural phenomenon in the laboratory. Bacon believed that the Earth was spherical and that one could sail around it. He estimated the distance to the stars at 130 million miles, and he used a camera that projected an image through a pinhole to observe solar eclipses. His work was so popular that it encouraged others to experiment on their own, and by so doing helped bring about the Renaissance.



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In 1266, Bacon sent a letter to Pope Clement IV suggesting improvements in the scientific curricula and installing laboratory experimentation in the educational system. He made the bold claim that the entire educational system needed to be rebuilt, and that the foundations for this revitalization could be found in his work. Bacon gave to the pope a proposal for a universal encyclopedia of knowledge and asked for a team of collaborators to be coordinated by a body in the Church to build the encyclopedia. Unfortunately, Pope Clement was unaccustomed to

receiving proposals such as Bacon's and misunderstood his request. Thinking that Bacon's encyclopedia of science already existed, the Pope demanded to see the documents. In the confusion, Pope Clement bound Bacon by a papal oath of secrecy to reveal all of his beliefs and philosophies. Because Bacon revered the pope and could not disobey, he quickly composed a three-volume encyclopedia on the sciences. These works consisted of the Opus Majus (Great Work), the Opus Minus (Lesser Work) and the Opus Tertium (Third Work), explaining to the pope the rightful role of the sciences in the university curriculum and the interdependence of all disciplines.

Unfortunately, in 1268 Pope Clement IV died. With the Pope's death, Bacon's chances of seeing the encyclopedia project through to completion vanished and even worse, a defeat for the prospect of revamping the university curriculum. Undaunted, Bacon embarked on another great project and started to write the Communia naturalium (General Principles of Natural Philosophy) and the Communia mathematica (General Principles of Mathematical Science). He never finished this work and only part of it was published.

In 1277, The Minister General of the Franciscans condemned Bacon's work because of the "suspect novelties" it contained. In response, the loyal Brothers of the Order had him imprisoned. Bacon had always submitted his writings to the judgment of the Church, and now appealed to the new Pope. The appeal was lost and Bacon was imprisoned, but the exact amount of time he served is unknown. Some sources say two years, others much longer. His last work, published the year of his death, was a stinging reproach of a corrupted Church. Although largely incomplete, Bacon's last contribution found him just as determined as any time in his life to expose ignorance. ■

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