



# THE CONTRIBUTION OF Muslims TO GLOBAL CIVILISATION IN Science & Technology

By Cec White

<https://pixabay.com/en/islamic-prayer-dusk-sun-man-bird-3710002/>

## Introduction

I have previously written a number of articles and given a number of talks on the contributions to global civilisation of Western Asia, China and Asia as a whole. All of these have tended to concentrate on Science and Technology, because that is my field of expertise. However, having watched the recent excellent two-part television documentary on the ABC entitled 'When the Moors ruled in Europe' by Bettany Hughes, the Oxford Historian, showing the enormous contribution of the Muslim civilisation radiating from Spain, Sicily, etc. I have been inspired to further update my histories, even though I have always given some coverage to the Muslim contribution. Hughes goes so far as to say that the contribution of Islam to global civilisation 'has been deliberately written out of history'. I personally agree with her. Certainly, when I went to school, about all I was taught was that it was a great thing that the Christians were able to throw the Moors out of Spain, to enable them to get on with, that blot on Christianity, the Inquisition. Also, basically we were taught that the Renaissance came exclusively through Greece and Rome, which appeared to be confirmed by an ABC documentary only a few years ago (Civilisation). This view of history is slowly being recognised as completely incorrect.

Another area of importance in global history was recently covered by Donald Johnson in his article written for the excellent US magazine *Education About Asia*. His article was entitled 'Rethinking the rise of European Hegemony: Asia in World History, 1450-1770'. It concerns what he calls the Indian Ocean Trading Network, involving India, China and many other nations around the Indian Ocean and also involving 'The Spread of Islam in Asia'. He says that Asians, of course, are usually grouped together, with other non-European nations, in what Eric Wolfe defines as 'people without history'. In 20<sup>th</sup> century textbooks, anything to deal with the Indian Ocean came from what the authors defined as 'The Age of Discovery' or 'The Age of Exploration', which, naturally but short-sightedly, featured only European explorers and expansion. This is the second subject which I wish to update. As the editor of *Education About Asia* says: 'Johnson and subsequent contributors make a strong case that Asia, from 1450-1770, was much more a part of global commerce, cultural interactions, and power politics than most of us ever imagined, especially when most of us came of age in an era where the terms 'World' and 'European' history were virtually synonymous.

I think it is interesting to note that William H McNeill, author of one of the most famous world

histories *The Rise of the West*-conceived in 1936, commenced in 1954 and published in 1963-found it necessary to begin the 1991 edition with a 16-page article entitled 'The rise of the West after twenty-five years'. He felt it necessary to do this because, as he says, the writing of history is approached by historians as from a 'moving platform' of their own times. He sees his original book as being based on 'the post-war imperial mood in the United States' whereas, in the period of only twenty-five years, increasing sophistication of global history made his major work, quote, 'fundamentally outmoded and in need of replacement'. So, historians, and teachers, need to continually update their view of history.

## The contribution of Muslims to global civilisation, especially in the fields of Science and Technology

Europe and Western Asia, during the period after the collapse of Rome, virtually lived in an intellectual vacuum. It needed a new stimulus. This came unexpectedly from another region of Western Asia: Arabia. It was here, at the beginning of the seventh century, that Muhammad (570-632) founded the new religion, and indeed, the new civilisation of Islam. During the century following



the death of Muhammad, Islam expanded at a remarkable rate, eventually breaking out of Western Asia and, by the ninth century, taking over North Africa, Sicily, Spain and even parts of France.

The prophet Muhammad in the *Qu'ran* places great emphasis on the importance of learning, education, observation and the use of reason in Islam. Some of the traditions from Muhammad are: 'Seek knowledge, even though it be in China'; 'The acquisition of knowledge is compulsory for every Muslim, whether male or female'; 'To listen to the words of the learned and to instill unto others the lessons of science is better than religious exercises'; etc. It was such traditions that were responsible for the enormous contribution of Muslims to global civilisation, especially in the fields of science and technology. Let us now consider the history of these contributions, which Bettany Hughes and other modern Western scholars consider to have been 'written out of history'.

Within two centuries the Muslims had founded the city of Baghdad (circa 762) on the Tigris River in Western Asia; and within only a couple of generations made it into the greatest centre of learning in the contemporary medieval world—and indeed, the most important educational institution in the world since the Museum in Alexandria in the third century BCE. This was because the caliphs who controlled the city sent not only Arabs but also Jews and Christians to every corner of the known world to seek out all the knowledge of the ancient world, especially from the widespread empire of Alexander the Great and the subsequent Hellenistic Greek world, which would have covered the history of not only Greece but also ancient Mesopotamia, Persia, Pergamum, Palestine and India, together with knowledge that had filtered through from China and the Far East. This was all written down in Arabic and placed in the great library

in Baghdad.

Baghdad, under the wise caliphs, al-Rashid and al-Mamun of the Abassid dynasty, not only saw the establishment of great libraries and translation centres there, but also research facilities and observatories to encourage scientific research. And so, in addition to their important work on translating and recording previous knowledge, Muslim scholars and scientists made many original contributions.

Perhaps the earliest of the great Muslim scientific figures was the alchemist known in the West as Geber (740-828), whose Muslim name was Jabir Ibn Haiyan. He is generally recognised as the Father of Chemistry. He practiced alchemy and medicine in Kufa in present-day Iraq around 776 CE, where he composed the first pharmacological treatise. According to Hitti, author of the treatise *A History of the Arabs from Earliest Times to the Present Day*, 'Muslims actually established the first apothecary shops, founded the first pharmacy school and compiled the first pharmacopoeia'. Geber's contributions of fundamental importance to global science include perfection of the important techniques of crystallisation, distillation, calcination, sublimation and evaporation. Among his many breakthroughs were the first preparation of nitric, hydrochloric, citric and tartaric acids. By insisting on actual experimentation and the development of reproducible methods, Geber helped evolve alchemy into the science of Chemistry. It is widely believed that the development of the science of Chemistry in Europe can be traced back directly to the contributions of Jabir Ibn Haiyan.

The principal figure in early Arab mathematics was al-Khwarizmi (circa 780-850), born in Baghdad, who is described by Professor Hitti as one of the greatest scientific minds of Islam, who influenced mathematical thought to a greater extent than any other medieval writer. Initially

he drew on both Greek and Indian thinking. His book, from the ninth century, aptly entitled *Algebra* was the principal mathematical textbook in European universities until well into the sixteenth century, and served to introduce the science and the actual name of 'Algebra' into Europe. In this book he also described the Hindu-Arabic numerals which we use today. He also was involved in astronomy and is credited with drawing up the first Arabic astronomical tables using the Arabic numerical system for calculating the position of heavenly bodies. In addition, he wrote a very accurate treatise on Geography. After his major works were translated into Latin in the twelfth century, they had an immense influence on the development of mathematical sciences in Europe.

Al-Kindi (circa 800-73) spent his long career in Baghdad where he wrote 240 books on such diverse subjects as philosophy, astronomy, physics, medicine, geometry, arithmetic, logic, music, numbers and psychology. He especially introduced Greek Aristotelian philosophy into Arab thinking which later had such a profound effect on Christian Europe.

Qurrah (836-901), from presentday Turkey, was one of the earliest Christian-Arab theologians who did much to encourage Christian-Muslim tolerance and dialogue.

It is fascinating to note that two Muslims in Spain actually studied flight long before Leonardo da Vinci. The first was Armen Finnan from Cordoba who, in 850 CE constructed a wing-like cloak with the (rather unsuccessful) intention of using it as a glider. The other was Abbas Ibn Fimas, also from Cordoba, who in 875 CE designed and used a more successful glider. Even though he badly injured himself, he did have an influence on later thinking in this important field. He particularly emphasised that you need a 'tail' on an aircraft to control it, which had not been realised before his flight.

Al-Tabari (838-70), despite





his relatively short life, wrote one of the first medical encyclopedias, which greatly influenced later Muslim medical thinking.

Al-Battani (858-929), foremost among world astronomers of the ninth century, was famous for the originality and precision of his work. For example, he determined the length of the year to 365 days, 5 hours, 46 minutes and 24 seconds.

The two most outstanding Muslim medical scientists were al-Razi (865-925) and ibn-Sina (980-1037), also known as Avicenna, whose portraits adorn the great hall of the School Medicine at the Sorbonne in Paris.

Perhaps the most remarkable of all al-Razi's many achievements was to produce an encyclopedic treatise on all known Greek, Persian, Hindu and Arab medical knowledge that was to be reprinted for the next 600 years exercising, what Hitti describes, as 'a remarkable influence over the minds of the Latin West'. Ibn-Sina wrote at least ninety-nine major works on philosophy, medicine, geometry, astronomy, theology, philology and art. His greatest work was a complete codification of all Greek-Arabic medical thought, which became the standard textbook for European medical schools for at least five centuries. George Sarton, 'the father of the history of science', describes Avicenna as 'one of the most famous exponents of Muslim universalism and an eminent figure in Islamic learning . . . For a thousand years he has maintained his original renown as one of the greatest thinkers and medical scholars in history'.

Abu'l Wefa (940-98) made the brilliant discovery of the variation of the moon, an astronomical phenomenon, which has been mistakenly attributed to the Dane, Tycho Brahe six centuries later.

Another remarkable Muslim scientist of the tenth century was Ali Ibn Isa, who wrote a treatise on ophthalmology, still in print to this day.

Omar Khayyam (*circa* 1045-1123), the famous Arab poet, was also an outstanding mathematician. He did most to establish the solution of algebraic equations by intersecting conics which Cajori, the noted historian of mathematics, regards as the greatest achievement of the Arabs in algebra. These eleventh-century Arabic mathematical methods remained unknown in the West until the eighteenth century, when Descartes and Thomas Baker had to independently reinvent them.

Nasir Al-din Al-Tusi (1201-74), according to Cajori, elaborated trigonometry to such great perfection in the thirteenth century that, had Europeans known of his work, they could have been spared their work in the fifteenth century.

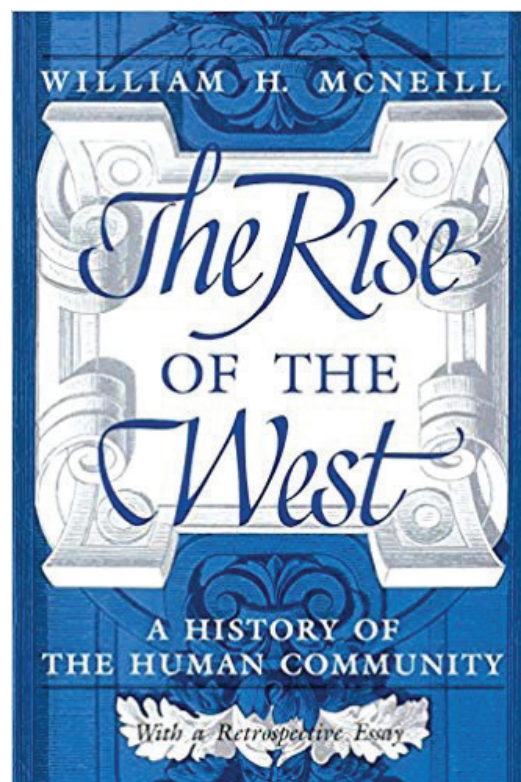
Let us now move over to Europe and consider the Muslim contribution there.

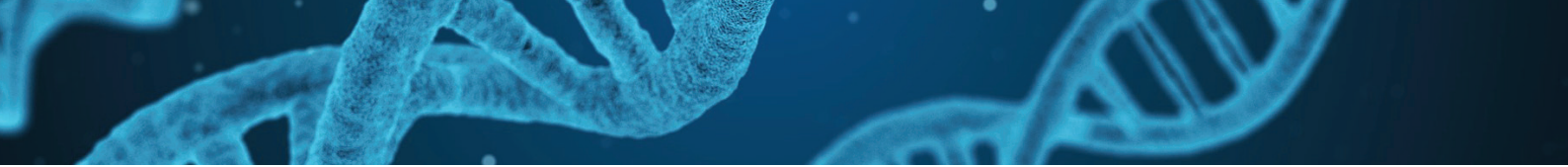
Having already overrun Persia and conquered the whole of North Africa south of the Mediterranean, the Muslims crossed the twelve kilometres of sea from Morocco and, within five years, made a relatively easy conquest of Spain from the Visigoths. They renamed the country Al-Andalus (land of the vandals) and set up their capital Cordoba, which soon became the most advanced city in Europe.

When the Muslim caliphate in Spain assumed greater importance after about the eleventh century, copies of all the important documents in the Arabic language were transferred from Baghdad to the major libraries in Spain,

especially at Toledo. This whole intellectual operation was greatly assisted by the knowledge of papermaking from China. In the year 751, Turkestan, a country previously controlled by China, was invaded by Arabs, who captured several skilled paper-makers. Manufacture of paper spread rapidly throughout the new Muslim empire, especially to Baghdad (793 CE) and later to Spain, where the first European paper mill was established by the Muslims in *circa* 1150 CE.

Nearly all the Muslim scholars and scientists mentioned above lived in Western Asia. The Muslim scholar who made the greatest direct contribution to the intellectual Renaissance in Europe lived in Spain. His name was Averroes (or Ibn Rushd), who lived from 1126-89. As McNeill, author of *The Rise of the West*, says: 'Averroes' importance for the history of ideas lay in his stimulating effect upon Latin Christian theologians who knew him as a fascinating





and heretical, but far from negligible, thinker. Aristotle, of course, had always been known to Muslim philosophers; but his doctrine had, from late Roman antiquity, been curiously regarded as "pagan". Averroes' great intellectual achievement was to abstract Aristotle from this alien dress, thus permitting theologians in Paris to start their revolution of Christian theology from a more or less Aristotelian basis . . . Thus, in the Latin West where men were only just beginning to explore the subtleties and complexities of intellectual life, the logical method and systematic reasonableness of Aristotelian philosophy had all the force of fresh revelation.' This revolution in thinking was the spark needed to produce the Western intellectual Renaissance some two or three centuries later. It was largely due to Averroes, that Toledo, with its incredible library, was to become the intellectual centre of Europe at the time, and from here this knowledge was transferred, directly and through Sicily, to Paris which largely as a result of this became the cradle of the intellectual Renaissance in the West.

So, in addition to Spain, another area often ignored by historians, which supplied a huge Muslim intellectual contribution to the Renaissance, was Sicily. In 827 Muslims from Tunis in North Africa invaded the island and, after a bloody period of seventy-five years, subdued the local population. Then began a 200-year period of Muslim leadership with tolerance shown to Christians and Jews. At the end of this period, Sicily was conquered by the Normans from France about the same time they conquered England in 1066.

The Normans were amazed and fascinated by the Muslim culture in Sicily. The court there adopted the Arabic language (whereas the Norman court in England adopted the French language). Muslim architecture was even used to build Christian churches, some of which contained prayers to Jesus in Arabic. Italian poetry, including that of Dante, was largely based on Islamic culture and some scholars regard Sicily as the cradle of Italian intellectual culture. Under the Norman King Roger II, not only Muslim arts but also science and mathematics were studied. It was during this period that the famous *Book of Roger* was published. This was the greatest work on geography at the time. It especially showed maps of the earth as a globe, while Europe in general still considered the Earth to be flat. Roger died in 1154 and in 1194 the island was taken over by the Holy Roman Emperor Frederick II, who still encouraged Muslim intellectual pursuits. With his support, much literature was brought over from the amazing library in Toledo by Scottish scholar Michael Scott, who had worked there with the outstanding Muslim thinker Averroes. Scott and Frederick were responsible for spreading Muslim knowledge, and especially the revolutionary teachings of Averroes, to European cities as far away as Paris, making Paris 'the intellectual capital of Europe', two hundred years before the height of the Western Renaissance.

As Bettany Hughes demonstrates in her documentary, Muslim science, mathematics and logical thinking also had a direct effect on England. You don't have to be a mathematician to realise that multiplying and dividing large

numbers using Roman numerals was so complex it was virtually impossible. Arabic numerals simplified calculations immensely, even in building design. Hughes shows pictures of the roof beams in Salisbury Cathedral, which was constructed in 1230, five years after Magna Carta. The beams are all numbered with Arabic numerals rather than earlier buildings which of course had Roman numerals. A further example is shown by the fact that the Archbishop of Oxford, who wanted to make his city into a university city, greatly appreciated the knowledge brought directly from Spain by English scholars, which facilitated this ambition. Oxford was already an important centre of learning by 1096, but developed rapidly after 1167 when a disagreement between England and France stopped English students from attending university in Paris. Teachers from mainland Europe, including Spain, who had all been affected by Muslim thinking, settled in the town. The first Chancellor at Oxford was appointed in 1201 and the masters at Oxford were recognised as a corporation or *universitas* in 1231. It is interesting that today The Oxford University Centre for Islamic Studies is the main academic centre in the West 'for the dispassionate and objective study of the Islamic world'. under the patronage of the Prince of Wales. It publishes *The Journal of Islamic Studies* which pays particular attention to 'works dealing with history, geography, political science, economics, anthropology, sociology, law, religion, philosophy, international relations, environmental and developmental issues, as well as ethical questions related to





scientific research. The Journal seeks to place Islam and the Islamic tradition as its central focus.

When Toledo, the old Spanish capital, fell to the Christians in 1085, the process of translating the remarkable contents of the Muslim libraries in Spain from the Arabic language into Latin, which had begun sporadically a century or more before, now began in earnest and continued for over 200 years.

Following the loss of Toledo, Muslim influence in Spain moved to Granada. It was here they built the wonderful Alhambra, possibly the greatest Muslim complex ever constructed. It was a palace, a fortress, a study centre and a magnificent garden, with a fantastic irrigation system bringing water from the Sierra Nevada many kilometres away-and still operating today! It reminds us that the Muslims were also responsible for many agricultural advances in Spain including the introduction of fruits and vegetables not previously grown. If you visit Spain today, many of the old Muslim contributions to art and architecture in Cordoba, Granada, Seville and elsewhere are still there for you too see. This is despite the fact that 250,000 Muslims were cruelly ejected from Spain in 1609 by the Roman Catholic Church.

It is fortunate that the Muslim contributions to Europe in art, poetry, architecture, mathematics, medicine, science, engineering and agriculture were transmitted to the West before Spain sank into the narrow-minded morass of the Christian Inquisition.

As Bettany Hughes points

out, the Renaissance (meaning 'rebirth') was not really a rebirth as we have been taught. On the contrary, it was a *continuation* of ancient history, ancient knowledge and the use of reason which was greatly facilitated and enhanced by Muslim scholars and scientists.



<https://pixabay.com/en/qoran-quran-book-islam-book-holy-842571/>

# EXAMPLES OF THE ISLAMIC CONTRIBUTIONS TO WORLD KNOWLEDGE

## NSW Curriculum document

### Compiled by Di Dunlop

- Invention of zero and the refining of the decimal numeration system
- The Hindu Arabic numeration system
- The Invention of the astrolabe (an instrument used to measure the position of stars and planets) in the 17<sup>th</sup> century and the first microscope.
- The Pharmacy-a large range of remedies and made up prescriptions. The beginnings of the use of method.ical experiments.
- Algebra and Trigonometry
- Treatment of eye diseases
- The relationship between diet, climate and health.
- Public hospitals
- Ibn Al-Haytham's early research into what causes rainbows.
- Ibn Al Nafis was responsible for the first map of blood circulation.
- Ibn Sina (known as Avicenna) wrote a medical encyclopedia at the beginning of the 10<sup>th</sup> century which was used as the standard European medical text up until the 17<sup>th</sup> century.
- Ibn Al-Khatib observed during the 14<sup>th</sup> century that disease came from infection.
- Al-Razi was the first to tell the difference between smallpox and measles.
- Al-Khwarizmi, a mathematician and astronomer compiled the first Arabic atlas.
- Omar Khayyam well known for his poetry also devised an extremely accurate Muslim calendar.
- Al-Idrisi compiled an atlas for Roger II Christian King of Italy.
- Floral and calligraphic design, especially the use of calligraphical inscriptions of the Qur 'an in mosques.
- Intricate geometric patterns generally referred to as arabesques, used as designs for mosques.
- Fine ceramics, metalwork and textiles with elaborate designs, Persian rugs, etc.
- Beautiful gardens (the English word 'paradise' comes from the Arabic for garden)
- Mosques: Taj Mahal, Dome of the Rock Mosque in Jerusalem, Al-Aqsa Mosque, Ibn Tulun in Cairo, Great
- Mosque in Delhi, Cordoba mosques and the Alhambra Palace in Granada
- The academic universities of Al-Azhar in Cairo, Al-Qairawan in Tunisia and Al-Qarawiyyin in Morocco are the oldest in the world.
- During the 10<sup>th</sup> and 11<sup>th</sup> centuries many Europeans came to the Islamic universities to study the Arabic translations of the ancient classics. These were then translated to Latin and studied extensively in Europe.
- Approximately 10000 words of Arabic origin have found their way into the English language and many other world languages which suggests further the significance of the Islamic contribution.

## ACTIVITIES

1. Construct a timeline which shows significant scientific achievements in the Muslim world.
2. Research ONE of the mosques listed above. Make a drawing of the mosque and label its significant features. Outline the role of the sections of the mosque.
3. Prepare a profile on Omar Khayyam. Read and discuss some of his poetry.



# WEST IN THE PARK ON MUSLIM WORLD'S BRIG-HT IDEAS

BY JIM AL-KHALILI

**Editor's note:** This is a very interesting piece, which briefly touches on how extensive is the scientific tradition in the Islamic world.

There is no such thing as Islamic science, because science is the most universal of human activities. But the means to facilitate scientific advances have always been dictated by culture, political will and wealth. What is only now becoming clear to many in the West is that during the dark ages of mediaeval Europe, incredible scientific advances were made in the Muslim World.

Geniuses in Baghdad, Cairo, Damascus and Cordoba took on the works of ancient Egypt, Mesopotamia, Persia, Greece, India and China, developing 'modern' science. New disciplines emerged—algebra, trigonometry and chemistry, as well as major advances in medicine, astronomy, engineering and agriculture. Arabic texts replaced Greek as the fonts of wisdom, helping shape the scientific revolution of the Renaissance. Here are some of the best discoveries of this forgotten age.

## Al-Zahrawi's Surgical instruments

Al-Zahrawi was a 10<sup>th</sup>-century surgeon who practised in Cordoba. His work was hugely influential in Europe and many of his instruments are still in use. His best-known inventions are the syringe, the forceps, the surgical book and needle, the bone saw and the lithotomy scalpel.

## The elephant clock

The centrepiece of the 1001

*Inventions Exhibition* that opens in New York in December is a three-metre-high replica of an early 13<sup>th</sup>-century water clock—one of the engineering marvels of the mediaeval world. It was built by al-Jazari and gives physical form to the concept of multiculturalism. It features an Indian elephant, Chinese dragons, a Greek water mechanism, an Egyptian phoenix and wooden robots in Arabian dress. The timing mechanism is based on a water-filled bucket hidden in the elephant.

## The camera obscura

The greatest scientist of the mediaeval world was a 10<sup>th</sup>-century Arab by the name of Ibn al-Haytham. Among his many contributions to optics was the first correct explanation of how vision works. He used the Chinese invention of the camera obscura (or pinhole camera) to show how light travels in straight lines from the object to form an inverted image of the retina.

## Al-Idrisi's world map

Large reproductions have been made of a famed 12<sup>th</sup>-century map by the Andalusian cartographer al-Idrisi (1100–66). It was produced in Sicily and is regarded as the most elaborate, complete description of the world made in mediaeval times. It was used by travellers for centuries and contained detailed descriptions of the Christian north, the Islamic world, Africa and the Far East.

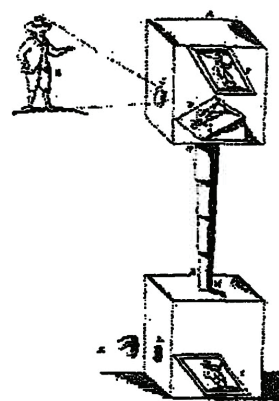
## The Banu Musa brothers' inventions

These 3 brothers were celebrated mathematicians and engineers in Baghdad. Their *Book of Ingenious Devices*, published in 850, was an illustrated work on mechanical devices that included automata, puzzles and magic tricks and other devices similar to today's executive toys.

## Ibn Firnas's glider

Abbas Ibn Firnas was a legendary 9<sup>th</sup>-century inventor and the Da Vinci of the Islamic world. He is honoured on Arabic postage stamps and has a crater on the moon named after him. He made his famous attempt at controlled flight when, aged 65, he built a rudimentary hang-glider and launched himself from the side of a mountain. Some accounts claim he remained airborne for several minutes before landing badly and hurting his back.

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*Guardian News & media*  
from *Sydney Morning Herald*  
21 October 2010



At first ... Ibn al-Haytham used a camera obscura to prove light travels in straight lines.  
Photo: Getty Images