ISSUES BRIEFINGS

ISLAM & SCIENCE

For more than 600 years, the Islamic world was the font of scientific discovery. It was called the Islamic Golden Age for good reason. From 750 C.E. until mid-way through the 13th century C.E., scholars across the region translated into Arabic the teachings of the Indians, Assyrians, Persians and the Greeks. That compendium of knowledge formed the foundation for an explosion of scientific discoveries.

This flowering of knowledge emerged from what is known to history as *Dar al Hikmat*, the House of Wisdom, in Baghdad, seat of the Abbasid caliphs. It began under the patronage of the legendary Caliph Harun Al Rashid.

The list of achievements is compelling. Especially when one considers that Europe at the time was cloaked in the Dark Ages.

http://musham.wordpress.com/2008/09/19/islamic-science-and-development-historyin-quran-view/

USAID من الشعب الأمريكي

THE AMERICAN UNIVERSITY IN CAIRO
الجامعة الأمريكية بالقاهرة

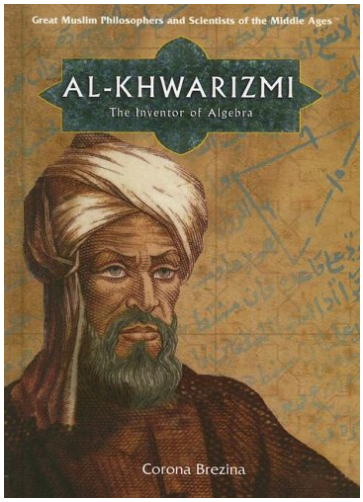
Created by the Kamal Adham Center for Journalism Training and Research, 2009

SPREAD OF SCIENCE

Within a few decades, Arabic became the language of science. The scholars themselves represented the many faces of the Islamic empire: Arabs, North Africans, Assyrians and Persians, along with Christians, Jews and others who lived in the Muslim world – from Spain to Central Asia – but who followed other faiths. But, according to the philosopher and historian Ibn Khaldun (see below), the Persians led this explosion of knowledge:

> [T]hey invented rules of (Arabic) grammar … great jurists were Persians … only the Persians engaged in the task of preserving knowledge and writing systematic scholarly works. Thus the truth of the statement of the prophet becomes apparent, 'If learning were suspended in the highest parts of heaven the Persians would attain it' … The intellectual sciences were also the preserve of the Persians, left alone by the Arabs, who did not cultivate them. (*Al-Muqaddimah).*

Mathematics, astronomy, medicine and chemistry were just some of the fields in which Muslim scholars made huge strides.



Source: Rosen Central, 2006

MATHEMATICS

Schoolchildren in the West still use the "Arabic" numbering system and algebra, both of which trace back to Abu Jafar Muhammad ibn Musa al-Khwarizmi, a Baghdad scholar whose name gives us the word algorithm. His book on the Indian numbering system, which would come to be called Arabic, was later translated into Latin as *Algoritmi de numero Indorum*, from whence we take the term algorithm. But al-Khwarizmi is most famous for giving the world algebra, a term derived from *al-jabr*, which is what he called the process of moving a sum from one side of an equation to another.

For al-Khwarizmi, who also gave us the concept of absolute zero, numbers were a practical tool for "modern" Arab society:

> That fondness for science...has encouraged me to a compose a short work on *Hisab al-jabr w'al muqabala* , confining it to what is easiest and most useful in arithmetic, such as men constantly require in cases of inheritance, legacies, partition, law-suits [all based on the Qur'an], ...the measuring of lands, the digging of canals, and geometrical computations.[1]

As al-Khwarizmi was pioneering new ways to think about numbers, Yemeni scholar Jabir Ibn Hayan was elevating chemistry from the realm of embalming, leather tanning and alchemy, to a process of scientific inquiry. As the great Islamic scholar Ibn Khaldun wrote:

> The pioneer in chemistry was Jabir Ibn-Hayan, they even attribute the science to him and say 'the science of Jabir', and he wrote seventy books on chemistry.

The roots of chemistry lay in alchemy, the medieval obsession with turning ordinary metal into gold. Alchemy migrated to the Islamic world in the works of Greek, Indian, Egyptian and other writers. It arrived wrapped in mystic/religious beliefs.

Islamic alchemists such as Ibn Hayan and his teacher Ja'far al-Sadiq believed that individual metals contained specific properties and through exposure to the elements and to other elements would Trans mutate. Their search for the elusive "philosopher's stone" – the element that would trigger the transformation, led them into elaborate experiments to examine the properties of various elements, which eventually led them and their successors to set aside the elusive mystic search in favor of the more practical field of study that would become chemistry.

[1] McKeague, Charles P. Intermediate Algebra. Books/Cole, Belmont, CA 2008.

ASTRONOMY

Astrolabe. Futurismic.com

The study of astronomy and mathematics in the Islamic world are inextricably linked. The critical roles they play are presaged in the Qur'an:

> It is He who has made the Sun a radiant lamp and moon a light, and has determined for it phases so that you might know the number of years and the computations [10:5].

Navigation across the growing empire, accurately determining the times of prayer, finding the direction of Mecca, all these things depended on the ability to understand the skies and calculate the movement of the stars.

Most fundamentally, they depended on understanding the place of the earth in the cosmos. Centuries before Europeans abandoned the idea of a flat Earth, the Arab world had determined the Earth was round, and to cope with that reality emerged the field of spherical geometry. To help with these complicated calculations, the Arabs perfected the astrolabe, a tool first developed in rudimentary form by the Romans and Greeks centuries before.

The evolution of the astrolabe is emblematic of the fact that the scholars of the Islamic Empire had much help in its intellectual exploration of astronomy, mathematics and other fields. They drew heavily on Ptolemy's *Almagest*, written in 150 CE, and works from India, such as the *Brahma Sphuta Siddhanta*, or *Opening of the Universe,* written by a 7th century Indian mathematician-astronomer.

And part of the brilliance of the Abbasid caliphs' approach to facilitating this explosion of knowledge was that they assembled in Baghdad scholars from the outer reaches and beyond the borders of their empire.

MEDICINE

The Canon of Medicine

One of the most famous works of medicine of the Golden Age is the 14-volume *Canon of Medicine* and *The Book of Healing*, both written by the Persian scholar known to the West as Avicenna. They are two of more than 40 works on medicine attributed to Avicenna, some of which were used in European medical schools until the 18th century.

The diagnosis and treatment of tuberculosis, diabetes and a host of contagious diseases are discussed in these vast works, along with the manner in which drugs can be tested and administered. From Avicenna comes the term retina to describe the lining of the eye, the idea that emotions affect health, and the link between physical well-being and exercise:

> Since the regimen of maintaining health consists essentially in the regulation of: (1) exercise (2) food and (3) sleep, we may begin our discourse with the subject of exercise.

But Avicenna was far from alone in transforming the way in which the sick were diagnosed and treated.

The modern science of ophthalmology can be traced back to Baghdad's House of Wisdom, where scientists who specialized in the treatment of illnesses of the eye can first be found. It was there that the first syringes were developed to remove cataracts.

The Polished Book on Experimental Ophthalmology, a work by the 13th century medical doctor and Islamic scholar Ibn al-Nafis, became a standard text of the field.

Another famous 12th century author of medical works during that period is Abul-Walid Muḥammad bin Aḥmad bin Rusd, known to the West as Averroes. Like so many of his compatriots, Averroes was a "polymath," known today as a Renaissance Man, with a mastery of a vast range of subjects, from Islamic jurisprudence and Greek philosophy to music, mathematics and geography.

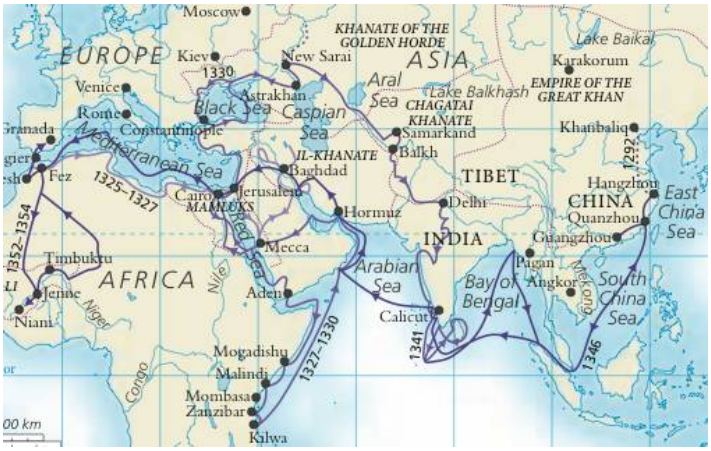
GEOGRAPHY

Qatar Foundation

The conclusion that the Earth was round naturally led to the question if its size. Caliph Al Mamun (813-833) ordered his scholars to find an answer. Their answer is a testament to the skills that had emerged from the House of Wisdom. Their calculation of the Earth's diameter missed the actual figure determined by 21st century tools by just 23 miles and their estimate of the distance around the equator was a mere 71 miles in error.

From the work of these geographer-mathematicians came the first Arab map of the world and the first Arab globe. Among them was the mathematician al-Khwarizmi, who not only accurately calculated the length of the Mediterranean, but also revolutionized the idea of the Atlantic and Pacific Oceans, but proving that they were open bodies of water, not landlocked seas as previously thought.

And while some scholars of the Golden Age focused on their calculations, others roamed the known world for knowledge. Among the most famous was the man known to some as the Arab Marco Polo, Ibn Battuta (1304-1368), also called the first Arab tourist.



The travels of Ibn Battuta (Source: Internet Medieval Sourcebook)

When he left Tangiers at the age of 20, Ibn Battuta thought he was embarking on the *hajj* pilgrimage to Mecca. He would wander the known world for more than a quarter of

a century, exploring Africa and India, Russia and China, serving as an Islamic judge, ambassador to Beijing and envoy to the Mongol Golden Horde.

In all, he reportedly traveled more than 75,000 miles, three times that of the more famous Marco Polo. His account of those journeys, dictated to an Andalusian writer shortly before his death and published as *A Gift to Those Who Contemplate the Wonders of Cities and the Marvels of Travelling,* remains the most compelling anthropology of the Muslim empire in the late Medieval period and offers this advice to the traveler: "never, if possible cover any road a second time."

THE CODIFICATION OF KNOWLEDGE

There is no greater name in the history of knowledge in the Golden Age of Islam than that of Ibn Khaldun (1322-1406), whose full name was Abdurahman bin Muhammad bin Muhammad bin Muhammad bin Al-Hasan bin Jabir bin Muhammad bin Ibrahim bin Abdurahman bin Ibn Khaldun.

Born in Tunis to a Yemeni family, Ibn Khaldun roamed the length and breadth of the Islamic world gathering knowledge. His epic work, *Al-Muqaddimah*, is a breathtaking "universal history" of the greatest ideas of his day. At heart a work of history and philosophy, *Al-Muqaddimah* not only casts a spotlight on the greatest ideas of the age, but also shows the ways in which earlier concepts of magic, numerology and astrology gave way to chemistry, mathematics and astronomy.

Over the course of his life, Ibn Khaldun was a judge, counselor to royalty and diplomat, negotiating with the great Central Asian conqueror Tamelane. But most of all, he was a keen observer of humankind. In *Al-Muqaddimah*, he shows himself both a scribe, chronicling the achievements of his compatriots, and the leading philosopher of the day – and, perhaps, Arab history. He ruminates on the sociology of the Arab tribes, the formation of governing structures, and the history of the civilization. They are ideas that continue to resonate through history.

THE FUTURE OF ISLAM & SCIENCE

Istanbul Museum of the History of Science and Technology in Islam (Creative Commons)

The Arab world today is often criticized for its failure to build upon the achievements of the Golden Age. Critics charge that, in the realm of science and technology, the Arab and Islamic worlds have been intellectually stagnant for more than eight centuries.

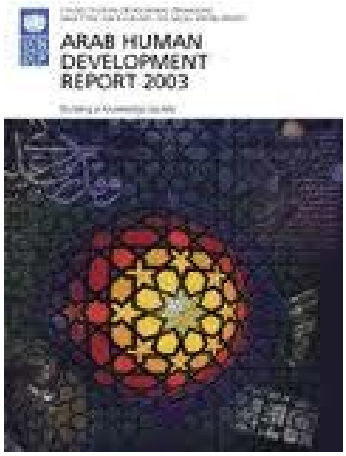
The region saw a brief flowering of cultural expression in the late 19th and early 20th centuries, but that was never matched by a new vigor in the area of scientific exploration. And even that renaissance of the arts gave way to what scholars and journalists like the late Samir Kassir call the Arab malaise, characterized by political paralysis, intellectual decay, and identity crisis.

Some 21st century Muslim scholars, such as Seyyed Hossein Nasr, argue that this turn in intellectual inquiry was a natural outgrowth of the Islamic notion of Divine Unity, the interrelatedness of all that exists. Once Islamic scholars had codified and built upon the world's knowledge and established the interrelatedness of things,

> [T]he main interest turned away from change and "adaptation." The arts and sciences came to possess instead a stability and a "crystallization" based on the immutability of the principles from which they had issued forth; it is this stability that is too often mistaken in the West today for stagnation and sterility.[2]

However, the need for a new commitment to science and technology, freeing the Arab world from dependence on Western innovation, has been a repeated theme of the UN Development Program's *Arab Human Development Report* in recent years.

[2] Nasr, Seyyed Hossein. *Science and Civilization in Islam*. New American Library. NY 1968.



The 2003 report was dedicated to the development of a "knowledge society" in the region. Its goals included:

> Embedding science in Arab society, broadening the capacity for research and development and joining the information revolution decisively.

Several broad initiatives to revitalize Arab/Muslim scientific endeavor and reestablished the *Dar al Hikmat* (House of Wisdom) have been launched in recent years:

Saudi Arabia

Saudi Arabia is developing the King Abdullah University of Science and Technology (KAUST), with the goal of making it one of the world's top science and technology universities by 2020.

Qatar

Qatar inaugurated Education City in 2001 and immediately attracted several of the world's leading universities, which established Doha campuses. The initiative, supported by the Qatar Foundation, is closely tied to a major effort to fund science and technology research in the Gulf.

The Organization of the Islamic Conference

In 2004, the Organization of the Islamic Conference launched Vision 1441H, a 17-year initiative "utilizing and advancing science and technology to enhance the socioeconomic well-being" of the Islamic world and transform it into a knowledge-driven society. The target year, 1441H, coincides with 2020 on the Gregorian calendar and referred to the goal of having OIC member countries produce 14 percent of the world's scientific output, produce 1441 scientists, and contribute 1.4 percent of the GDP to research and development. The initiative also included establishment of a $500 million research fund under the Islamic Development Bank.

THE MEDIA

In recent years, there has been an explosion of new books on the intersection of Islam, the Arab world and science and technology. Histories by Muslims, such as Ehsan Masood's *Science and Islam*, and works by Western scholars, such as House of Wisdom by Jonathan Lyons, who argues that the Arabs transformed Western civilization.

Documentaries, magazine stories and web articles all provide a wealth of information about the history of science and technology in the region and its evolution today.