

INSPIRED BY ISLAM - MUSLIM INVENTIONS

"If there is much misunderstanding in the West about the nature of Islam, there is also much ignorance about the debt our own culture and civilisation owe to the Islamic World. It is a failure, which stems, I think from the straight jacket of history, which we have inherited. The medieval Islamic world, from Central Asia to the shores of the Atlantic, was a world where scholars and men of learning flourished. But because we have tended to see Islam as the enemy of the West, as an alien culture, society and system of belief, we have tended to ignore or erase its great relevance to our own history."

Prince Charles in a speech "Islam and the West", Oxford, 27th October 1993

Muslims distinguished themselves not only as theoretical scientists and scientific thinkers, but contributed through innumerable inventions to the growth of the modern sciences. Though the mediaeval Muslims had very meagre resources at their command as compared to those of the present age, they achieved a great deal. They replaced the old speculative method of the Greeks with an experimental method, which in later periods formed the basis of all scientific investigations.

1. The Watch

The first watch was made by *Kutbi*, a renowned watch-maker of his time. During the Abbasid period, which lasted between 750-1258 the use of a watch became quite common. Abbasid is the dynastic name generally given to the caliph of Baghdad, the second of the two great Sunni dynasties of the Islamic empire, that overthrew the Umayyad caliphs from all but Spain. Harun al-Rashid, whose reign of the Abbasid dynasty brought the "Golden Age" to the Abbassids, once despatched a watch as a gift to his celebrated contemporary, the French Emperor Charlemagne. At that time a watch was considered a novel thing in Europe and was regarded as an object of wonder.

Mustansariya, the well-known university of Baghdad had a unique clock with a dial blue like the sky and a sun which continually moved over its surface denoting the time. Maulana Shibli, the famous Urdu litterateur, has described a watch of Damascus in the following words:

"The watch was kept in the door of a wall. It contained copper plates and twelve doors. There was an Eagle standing in the 1st and the last plate. At the end of each hour, these two eagles lay down on the copper plates and hence a sound was produced to show the time. At twelve all the doors were closed. This system was being repeated continuously".

The construction of water clocks was also common in Islamic Countries.

2. Astronomy and Navigation

Giralda or "The Tower of Seville", was the first observatory in Europe. It was built in 1190 A.D., in the Spanish town of Seville under the supervision of the celebrated Mathematician, Jabir Ibn Afiah. It was meant for the observation of heavenly bodies. It was later turned into a bell tower by Christian conquerors, who, after the expulsion of the Moors, did not know how to use it.

The many references to astronomy in the Qur'an and hadith, and the injunctions to learn, inspired the early Muslim scholars to study the heavens. They integrated the earlier works of the Indians, Persians and Greeks into a new production. Muslims were inspired to investigate and study the Earth, the features of the land, methods of mapping and so on. Many new stars were discovered, as we see in their Arabic names - *Algol*, *Deneb*, *Betelgeuse*, *Rigel*, *Aldebaran*. Astronomical tables were compiled, among them the Toledan tables, which were used by Copernicus, Tycho Brahe and Kepler. These works were used to determine the direction of Makkah from various locations, to improve navigation and surveying, and establishing correct time keeping and calendars. Using longitude and latitude, calculating the circumference of the Earth within a few hundred miles, the Muslim geographers greatly improved on Ptolemy's famous '*Almagest*', that it is not certain how much of the work actually belongs to the famous Greek, and how much was added to successive copies.

Muslim astronomers were the first to establish observatories, like the one built at Mugharah by Hulagu, the son of Genghis Khan, in Persia, and they invented instruments such as the quadrant and astrolabe, which led to advances not only in astronomy but in oceanic navigation, contributing to the European age of exploration.

Other instruments used by muslim astronomers and navigators were the quadrant and the planisphere, a large, complicated device for plotting stars. Observatories were set up in desert locations where the best observations could be made. Accurate measurement of time used very similar mathematical skills to those needed for navigation. Al-Biruni, a famous Muslim scholar of the 11th century, wrote a mathematical treatise on shadows that helped regulate sundials accurately. What's more, Al-Biruni, worked out that the earth is round and calculated its circumference. He also stated that the earth spins on its axis and rotates around the sun, nearly six hundred years before Galileo.

3. Mathematics

Bold experiments and unique innovations in the field of mathematics were carried out by Muslim mathematicians who developed this science to an exceptionally high degree. Their contributions stretched from the end of the eighth century to about the middle of the fifteenth century. The regions from which the "Muslim mathematicians" came was centred on Iran/Iraq but varied with military conquest during the period. At its greatest extent it stretched to the west through Turkey and North Africa to include most of Spain, and to the east as far as the borders of China.

Algebra may be said to have been invented by the Greeks, but according to Oelsner, "it was confined to furnishing amusement for the plays of the goblet". Muslims developed it and applied it to higher purposes. Thus, the first great Muslim mathematician, the Persian *Al-Khawarizmi*, invented the subject of algebra (al-Jabr), which gave mathematics a whole new dimension and development path so much broader in concept than before. Another important aspect of the introduction of algebraic ideas was that it allowed mathematics to be applied to itself in a way which had not happened before.

Al-Khawarizmi also introduced a method similar to long division to extract the square root (jithr) of a number. He was the first to introduce the concept of mal (power) for the squared unknown variable. He perfected and developed the Hindu geometric representations of quadratic equations having two variables, e.g the circle, ellipse, parabola and hyperbola (conic sections) etc. Al-Khawarizmi's work, in Latin translation, brought the Arabic numerals along with the mathematics to Europe, through Spain. The word "algorithm" is derived from his name. The Muslims invented the symbol for zero (The word "cipher" comes from Arabic sifr), and they organized the numbers into the decimal system - base 10.

They invented spherical trigonometry, discovered the tangent and were first, "to introduce the sine of arc in Trigonometrical Calculations" Zero is an invaluable addition made to mathematical science by the Muslims. They have also shown remarkable progress in mathematical geography.

4. Medical Sciences

The Muslims have made a lasting contribution to the development of Medical Science. *Al-Razi (Rhazes)*, *Ibn Sina (Avicenna)*, and *Abu Ali al-Hasan (Alhazen)* were the greatest medical scholars of mediaeval times.

Abū Bakr Muhammad ibn Zakarīya al-Rāzi is known in the West as Rhazes. According to al-Biruni, a great Muslim scientist, he was born in Rayy, Iran in the year 865 AD (251 AH), and died there in 925 AD (313 AH)

Al-Razi was a versatile Persian physician, philosopher, and scholar who made fundamental and enduring contributions to the fields of medicine, alchemy, and philosophy, recorded in over 184 books and articles in various fields of science. He was well versed in Greek medical knowledge and added substantially to it from his own observations. He was unquestionably one of the greatest thinkers of the Islamic World, and had an enormous influence on European science and medicine.

He was the inventor of "*Seton*". 'Seton' is the thread or similar object inserted beneath the skin to provide drainage or to guide subsequent passage of a tube, in surgery. Further more he was the author of '*Al-Judari wal Hasbak*', authentic book dealing with measles and small pox, describing how to distinguish them from each other. Seen as one of the greatest physicians in the world in the Middle Ages, Al-Razi stressed empirical observation and clinical medicine and was unrivalled as a diagnostician. He also wrote works on hygiene in hospitals.

The 10th century surgeon al-Zahrawi was the first to develop sophisticated surgical tools for operations. He also made plaster to help broken bones heal. Al-Zahrawi developed pioneering operative techniques, including the caesarean section.

Avicenna wrote '*Al-Qanun Jil Tib known as Cannon*', which was the most widely studied medical work of mediaeval times and was reprinted more than twenty times during the last 30 years of the 15th century in many different languages. The book remained a standard textbook even in Europe, for over 700 years.

The contagious character of *the plague and its remedies* were discovered by *Ibn Katina*, a Moorish Physician.

Other significant contributions were made in pharmacology, such as Ibn Sina's '*Kitab al-Shifa*' (Book of Healing), and in public health. Every major city in the Islamic world

had a number of excellent hospitals, some of them teaching hospitals, and many of them were specialized for particular diseases, including mental and emotional. The Ottomans were particularly noted for their building of hospitals and for the high level of hygiene practiced in them.

5. Development of chemistry

Besides medicine, astronomy and mathematics, chemistry is the fourth major science in which Muslims have made the greatest contribution. Until as recently as the 17th century, they were considered authorities in this science. Among the long list of great Muslim chemists we find two names, Jabir Ibn Hayyan and Zakariya Razi, reaching distinction. Writing in his illuminating History of the Arabs, the French historian and Arabist Philip K. Hitti acknowledges the greatness of Arabs in this branch of science when he says, "After materia medica, astronomy and mathematics, the Arabs made their greatest scientific contribution in chemistry. In the study of chemistry and other physical sciences, the Arabs introduced the objective experiment, a decided improvement over the hazy speculation of Greeks."

Jabir Ibn Hayyan (722 CE - 815 CE), is unanimously considered as the founder of chemistry. He identified many new acids, alkalines and salts. He devised and perfected chemical processes such as sublimation, crystallization, distillation, evaporation, and filtration. He initiated the classification of materials into spirits and metals. Ten centuries before John Dalton, Jabir Ibn Hayyan defined chemical combinations as a union of the elements together, in too small a particle for the naked eye to see, without loss of character.

Al-Kindi (801-873) from Kufah (Iraq) is another scholar who made a lasting impact on the development of chemistry. His book Kitab Kimiya' al-'Itr (Book of the Chemistry of Perfume and Distillations), signalled by H. Ritter in an Istanbul manuscript and edited in 1948 by Karl Garbers, contains more than 100 recipes for fragrant oils, salves, aromatic waters and substitutes or imitations of costly drugs. We will talk more about his work in the section on Perfumes.

Al-Razi (born in 850 CE) established the firm foundations of modern chemistry by setting up, for the first time, the laboratory in the modern sense, designing, describing and using more than twenty instruments, many parts are still in use today. Such as a crucible, decensory, cucurbit or retort for distillation, and the head of a still with a delivery tube (ambiq, Latin alembic), various types of furnace or stove. As an alchemist, Razi is credited with discovering Sulphuric acid, and the basic notions of modern chemistry and chemical engineering. He also discovered ethanol and its refinement and use in medicine. What's more, he classified substances into mineral, vegetable and animal.

6. KIOSKS

If you've ever been to a shopping centre or train station you've probably been to a kiosk. But the kiosk as a building type is not a new invention. As a building type it was first introduced by the Seljuqs (a Muslim dynasty of Oghuz Turkic descent that ruled parts of Central Asia and the Middle East from the 11th to 14th centuries) and

was a small building attached to the main mosque. It consisted of a domed hall with open arched sides, gradually evolved into a summer house used by Ottoman sultans, perhaps the most famous of these kiosks are the Cinili koshk (kiosk in Turkish) and Baghdad koshk. The first was built in 1473 by Mohammad al-Fatih at the Topkapi Palace, Istanbul, and consists of a two storey building topped with a dome and having open sides overlooking the gardens of the palace. The Baghdad Koshk was also built at the Topkapi Palace in 1638-39, by Sultan Murad IV. The building is again domed offering direct views onto the gardens and park of the Palace as well as the architecture of the city of Istanbul.

Sultan Ahermd III (1703-1730) also built a glass room of the Sofa kiosk at the Topkapi Palace incorporating some Western elements, such as the gilded brazier designed by the elder John Claude Duplessis which was given to the Ottoman Ambassador by King Louis 15th. The first English contact with Turkish Kiosk came through Lady Wortley Montagu (1689-1762), the wife of the English ambassador to Constantinople, who in a letter written in 1 April 1717 to Anne Thistlethwayte, mentions a kiosk describing it as raised by 9 or 10 steps and enclosed with gilded lattices" (Halsband, 1965 ed.).

Historic sources confirm the transfer of these kiosks to European monarchs. The king of Poland, and the father in law of Louis 15th, Stanilas of Lorraine built kiosks for himself based on his memories of his captivity in Turkey. These kiosks were used as garden pavilions serving coffee and beverages but later were converted into band stands and tourist information stands decorating most European gardens, parks and high streets.

7. Scales in music

Did you know that the basic scale in music today comes from Arabic syllables do, re, mi, fa, sol, la and ti? The Arabic alphabet for these notes is Dal-Ra-Mim-Fa-Sad-Lam-Sin.

The notation, which consists of the syllables (known as solmisation); do, re, mi, fa, sol, la and ti, is widely known as Latin, borrowed from the syllables of the Hymn of St. John. The Italian musician, Guido of Arezzo (c.995-1050) is commonly credited with its invention in 1026. However Villoteau, (d.1839) took the position of the French historian Laborde, admitting the Muslim influence on the theory of music. From comparing Guido's music scale with that of the Muslims, he found striking resemblances, which led him to believe that the former had adopted his theory from the Muslims. He commented: "according to all appearances it is this latter which served as the model for that of Guido of Arezzo".

How did Guido know about Muslim work?

Soriano revealed that Guido had studied in Catalunya, in Spain. Hunke established that these Arabic syllables were found in an eleventh century Latin treatise produced in Monte Cassino, a place which had been occupied by the Muslims a number of times, and was the retiring place of Constantine Africanus, the great Tunisian scholar who migrated from Tunis to Salerno and then to Monte Cassino. It is doubtful that such work could have escaped the attention of Guido.

8. COFFEE

Most Americans and Europeans, think that Muslim food and cuisine are confined to Curry, Biryani, Kebabs, Chapati and Pitta and sweets such as Kulfi and Baklava. They are not aware of the numerous other foods and drinks, supposedly western, which are of Muslim origins. An example of these is coffee, which has invaded every household's breakfast.

The earliest cup of coffee was made in Yemen by a group of Sufis, who boiled the beans and drunk it to help them stay awake all night in prayers and remembrance of God (Allah) as early as 9th century. A group of their students took it to Cairo using it in their study circles at the al-Azhar university. From there the habit of drinking coffee took off in most Middle Eastern countries and by 13th century it reached Turkey.

Europe did not taste coffee until the 16th century first landing at Italy imported by Venetian merchants, who traded with Muslims in North Africa, Egypt and the East. The merchants first introduce the drink as a luxurious beverage destined for Venetian rich, charging them a considerable amount of money. This is how coffee first appeared in 1570 in Venetian ports quickly spreading to Venetian markets.

5. Perfumes from the East

People have enjoyed perfume for centuries. The hard work of two talented chemists, Jabir ibn Hayyan (born 722) and al-Kindi (born 801) helped lay the foundations and established the perfume industry. Jabir developed many techniques, including distillation, evaporation and filtration, which enabled the collection of the odour of plants into a vapour that could be collected in the form of water or oil.

Al-Kindi was the real founder of the perfume industry as he carried out extensive research and experiments in combining various plants and other sources to produce a variety of scented products. He elaborated a vast number of recipes for a wide range of perfumes, cosmetics and pharmaceuticals. His work in the laboratory is reported by a witness who said 'I received the following description, or recipe, from Abu Yusuf Ya'qub b. Ishaq al-Kindi, and I saw him making it and giving it an addition in my presence.' The writer goes on in the same section to speak of the preparation of a perfume called ghaliya, which contained musk, amber and other ingredients which reveals a long list of technical names of drugs and apparatus.

Musk and floral perfumes were brought to Europe in the 11th and 12th centuries from Arabia, through trade with the Islamic world and with the returning Crusaders. Those who traded for these were most often also involved in trade for spices and dyestuffs. There are records of the Pepperers Guild of London which go back to 1179; their activities include trade in spices, perfume ingredients and dyes.

9. Laying down the red carpet

Did you know that the carpet industry originated in the Muslim world, developing this ancient industry into very sophisticated designs. The Muslim carpet has long been a luxury commodity sought by textile museums, rich collectors and wealthy merchants

all over the world. The fame of the flying carpet of 'Al'a Al-Din added some mystery to its already exceptional beauty and tangible quality. It is not surprising that carpets still represent one of the most valuable art items obtained by museums and wealthy families of the West.

Carpet making has long been an old tradition, even before Islam, among the Bedouin tribes of Arabia, Persia and Anatolia who used it as a tent sheltering them from the sand storms, a floor covering providing great comfort for the household, wall curtains protecting privacy and many other useful items such as blankets, bags, and saddles.

Historic sources reveal that the Caliphate in Cordoba who came up with the idea of using carpets for formal events which became part of the custom of rolling out carpets for visits from royalty and ambassadors, which was adopted in Europe in the 12th century.

10. The World's First Soft Drink

Sherbet, a juice of crushed fruit, herbs, or flowers has long existed as one of the most popular beverages from and of the Muslim world, winning over Western figures such as Lord Byron. Muslims developed a variety of juices to make their Sharab, an Arabic word from which the Italian sorbetto, French sorbet and English sherbet were derived.

Today, this juice is known by a multitude of names, is associated with numerous cultural traditions, and is produced by countries ranging from India to the United States of America.

The medieval Muslim sources also contain a lot of recipes for drink syrups that can be kept outside the refrigerator for weeks or months.

11. Sight savers

Did you know the first operation to remove cataracts was carried out as early as the 10th century in Iraq. Muslims also established the first apothecary shops and dispensaries, founded the first medieval school of pharmacy, and wrote great treatises on pharmacology.

Muslim inherited two explanations of vision. Ptolemy and Euclid both believed that vision was produced by the emission of light from the eyes, but their theory did not provide a reasonable explanation of perspective, the effect whereby the apparent size of an object depends upon its distance from the observer. Aristotle, Gallen and their followers stood for the so called 'intromission,' something entering the eyes representative of the object, but again did not provide proper empirical explanation.

Al-Kindi was the first to question Euclid's theory of emission and to put some alternative suggestions, for example, asserting that a visual cone is not formed of discrete rays as Euclid has stated, but appears as a volume of continuous radiations. Rays are three dimensional and form a continuous radiant cone, a critique which prepared the way for Ibn al-Haytham's distinction between light rays and the straight lines along which they are propagated. He also explained how the light rays come in a straight line. His two works on geometrical and physiological optics were used by the English Roger Bacon (1214-1292) and the German physicist Witelo.

The proper scientific explanation had to wait until the arrival of Ibn al-Haitham (965-1039 CE), known in the West as Al-Hazen, who once and for all explained how we see, through light reflecting off an object and entering the eye. He backed this up with many rigorous experiments, establishing the scientific foundations for modern optics, combining the 'mathematical' approach of Euclid and Ptolemy with the 'physical' principle favoured by the natural philosophers.

During his light and vision experiments, Ibn Al-Hayhtam discovered the camera obscura phenomenon. He went to explain that we see objects upright and not upside down, as the camera does, because of the connection of the optic nerve with the brain which analyses and defines the image.

12. First bold attempt at flight

Did you know that the first really scientific attempt to fly in the Muslim World was made in the 9th century? Abul Qasim Ibn Firnas, who lived in the Spanish city of Cordoba, built a glider which was capable of carrying a human being.

Since antiquity, flying has always been a human dream as early civilisations could only watch and admire the gracefulness of flying birds. In 852 C.E., Abbas Ibn Firnas, or Armen Firman in Latin, a Moor (a Muslim of the mixed Berber and Arab people inhabiting N Africa) from Cordoba, constructed a wing-like cloak that he could glide on. He survived an attempt jumping from a tower in Cordoba with only minor injuries as his wing-like garments caught enough air to break his fall. This fall came to be known as the parachute fall. After watching birds, he realized that he had not added a tail to his glider.

Another Muslim, Hezarfen Ahmet Celebi (1609-1640) flew successfully from one side of the Bosphorus in Istanbul to the other during the reign of the Turkish Sultan Murad IV, in 1633.

13. The first windmill

Did you know that the first windmill was constructed as early as 7th century? One thing the vast deserts of Arabia had was wind, when the seasonal streams ran dry, and these desert winds had a constant wind direction. For about one hundred and twenty days the wind blew regularly from the same place.

The windmill was so simple yet effective that it quickly spread all over the world from its 7th century Persian origins. After this, wind-power became widely used to run mill stones for grinding corn, and also to draw up water for irrigation. This was first in the Persian province of Sistan, and al-Mas`udi, an Arab geographer who lived in the 10th century, described the region as a country of wind and sand. He also wrote, a characteristic of the area is that the power of the wind is used to drive pumps for watering gardens. Most historians believe that it was the crusaders who introduced windmills to Europe in the 12th century.

14. From bucket to bike

Did you know that Muslim engineer Al-Jazari came up with an ingenious device for lifting huge buckets of water without lifting a finger? It was grandly called the crank-

connecting rod system. This was his most important contribution to engineering, and had a huge impact on the development of technology. This simple device started a revolution in engineering that has found its highest form of expression in the bicycle.

In his fourth water raising machine, Al-Jazari produced the first demonstration of useful work by the crank. The machine uses a slider crank mechanism to provide the repetitive motion of the flume ladle. The crank is considered as one of the most important mechanical discoveries made, since it permits the transmission of rotary motion to linear motion. This is central to much of the machinery in the modern world, not least the internal combustion engine. His manuscript shows he also invented or refined the use of valves and pistons, devised some of the first mechanical clocks driven by water and weights, and was the father of robotics. The book contained a staggering number of 50 other inventions including the combination lock.

Sarton commented on this work, "This treatise is the most elaborate of its kind and may be considered the climax of this line of Muslim achievement". The book is rich in minute description of various kinds of devices.

The late Donald Hill, who translated the manuscript, maintains "It is impossible to over-emphasize the importance of Al-Jazari's work in the history of engineering. Until modern times there is no other document from any cultural area that provides a comparable wealth of instructions for the design, manufacture and assembly of machines". He adds further: Al-Jazari did not only assimilate the techniques of his non-Arab and Arab predecessors, he was also creative. He added several mechanical and hydraulic devices. The impact of these inventions can be seen in the later designing of steam engines and internal combustion engines, paving the way for automatic control and other modern machinery. The impact of Al-Jazari's inventions is still felt in modern contemporary mechanical engineering. They were the predecessors of today's mechanical engineers.

15. Modelling the Stars

From the beginnings of human awakening people have pondered at the amazing canopy of stars and at the movement of everything in the sky. Clearly there was order in the heavens. Many attempts were made to identify the patterns in this order. This had great significance to life, since through these observations and derivations of rules we have the beginnings of predictive science. We can predict the position of the Sun in the sky, the Moon, the timing of eclipses, the changing position of the planets and the stars. In an attempt to make these predictions easier, people from many great Civilisations have built different kinds of models reflecting in a physical form what they have seen. These models were built based on the perspective of the earth with a sphere of stars surrounding the earth. There were several kinds of models:

1. Celestial Globes
2. Astrolabes
3. Armillary Spheres

Muslim Astronomers took much from Greek astronomical calculations and models and improved on them in several ways making the measurements and predictions more and more accurate.

16. Using an Astrolabe

Al Sufi, one of the most famous astronomers of the Islamic world was writing in Isfahan (in modern day Iran) in the 10th century. In his writings he outlined over 1000 uses of an astrolabe. Accounts of the astrolabe as a scientific instrument range from the very earliest given by the Greek astronomer Hipparchus in around 150BC through writings from the Islamic world to modern day descriptions by historians and curators and all emphasise that the astrolabe is an extremely versatile instrument.

The fundamental operation of astrolabes has varied little in their long history, all use the relationship between the apparent movement of the stars, as seen from a particular latitude on Earth, and time – allowing them to be used to find the time from the stars or Sun, and the position of the stars and Sun at a particular time (a feature particularly useful when casting horoscopes). All similarly have the flexibility to be used as both an observational instrument and as an aid to mathematical calculation.

An astrolabe is made up of 4 main pieces:

- the mater or base plate
- the rete or top web-like plate which shows the fixed stars, the ecliptic (the zodiac constellations and part of the sky across which the Sun travels) and certain naked eye stars
- the plates, each of which is made for a different latitude. Each plate has engraved on it a grid marking the zenith (point directly over head), the horizon and all the altitudes in between
- the alidade or rule with sights used for making observations and reading off scales.

The rete and plates are designed to fit into the mater.

17. The Pendulum

The Pendulum was invented by *Ibn Yunus*, a genius in science who lived in the reign of Aziz Billah and Hakim bi-Amr-illah, the Fatimid monarchs of Egypt. The invention of the Pendulum led to the measurement of time by its oscillations. His outstanding work *Sijul Akbar al-Hakimi*, named after his celebrated patron Hakim bi-Amr-illah, was acknowledged to be the masterpiece on the subject replacing the work of Ptolemy. It was translated into Persian by Omar Khayyam in 1079.

18. The Mariners Compass

The invention of Mariners Compass, which revolutionised sea borne commerce and oceanic shipping and enabled the Arabs to roam over the stormy seas in quest of new lands and additional markets for their commodities, is essentially a contribution of the Muslims to the world of science.

Knowledge about the properties of the needle, can no doubt be traced to Chinese sources, but putting it into working shape, in the form of a mariners' compass, was

the achievement of Muslim scientists. The compass was probably invented for the purpose of finding out the Qibla for Prayers.

19. Braille

Did you know that well before braille was invented that some 600 years before a Syrian muslim had created his own system? The distinguished blind Arab professor, Zain-Din al Amidi in the 14th century improvised a method by which he identified his books and made notes. Although blind soon after birth, he led a studious life, interesting himself particularly in jurisprudence and foreign languages.

20. Toothbrush

While the toothbrush may appear a modern invention the Prophet Mohammed made popular the use of a piece from the Meswak tree to clean the teeth and freshen the breath! It was recently proven that Meswak contains substances similar to that found in modern tooth paste which help protect teeth and freshens the breath.

The Swiss pharmaceutical company Pharba Basle Ltd carried out experiments on extracts of Meswak, botanically known as *Salvadora Persica*. It was found that it contains antibacterial substances which destroy the harmful germs in the mouth which cause gum infections and tooth decay. Independent tests conducted on the Meswak extracts in the Departments of Chemistry, Riyadh University, Saudi Arabia and Indiana University, Indiana, USA, have confirmed its anti-inflammatory and antibiotic activities.

21. Soap

Medieval times are generally renowned for their lack of cleanliness and hygiene. However, only a few who know that Muslims, as early as the 7th century, developed a sophisticated hygienic lifestyle that was as popular among the ordinary masses as it was with the nobles and royals.

Perhaps one of the great manifestations of Muslim cleanliness is the invention of soap. They made soap by mixing oil (usually olive oil) with al-qali (salt-like substance), which was boiled to achieve the right mix, and left to harden before using it at home or in the hammams or bath houses. Different recipes for different types of soap were written by various scholars including Al-Razi. A recently discovered manuscript from the 13th century details more recipes for soap making; take some sesame oil, a sprinkle of potash, alkali and some lime, mix them all together and boil. When cooked, they are poured into moulds and left to set, leaving hard soap.

22. Cosmetics

One of the leading cosmetologists was the famous physician and father of surgery, Abu al-Qassim al-Zahrawi, or Abulcassis (936-1013 CE). He wrote a monumental work, a medical encyclopaedia entitled *Al-Tasreef*, in 30 volumes, which was translated into Latin and used as the main medical textbook in most Universities of Europe.

In the 19th volume of *Al-Tasreef* a chapter was devoted completely to cosmetics and is the first original Muslim work in cosmetology. Zahrawi's contribution in medicated cosmetics include under-arm deodorants, hair removing sticks and hand lotions. Hair dyes are mentioned turning blond hair to black and hair care is included, even for correcting kinky or curly hair. He even mentioned the benefits of suntan lotions, describing their ingredients in detail.

Zahrawi considered cosmetics a definite branch of medication (*Adwiyat al-Zinah*). He deals with perfumes, scented aromatics and incense. There were perfumed stocks rolled and pressed in special moulds, perhaps the earliest antecedents of present day lipsticks and solid deodorants. He used oily substances called *Adhan* for medication and beautification. There are many a hadith of the Prophet (pbuh) which refer to cleanliness, management of dress, and care of hair and body. On this basis, Zahrawi described the care and beautification of hair, skin, teeth and other parts of the body, all within the boundaries of Islam.

23. Gunpowder

Mir Fatehullah Khan is known to history as the inventor of the gun and gunpowder. The presumption that gunpowder was first made by the Chinese does not stand the test of historical research. Writing in his book *Arab Civilization*, the author says that "gunpowder was a great invention of the Arabs who were already using guns". Guns were used by Arabs in 1340 A.D. in the defence of *Al-Bahsur*, when *Franzdol* besieged it. The statement of Dr. Leabon about the invention of gunpowder by the Arabs is further corroborated by Mr. Scott in his well-known work, *History of the Moorish Empire in Spain*.

24. The impact of Muslim learning on the West

Did you know that between the 7th and 12th centuries, when religion dominated European culture that Muslim educational institutions led the way? As the results of their progressive education reached the West through Muslim works covering everything from medicine to history they helped encourage the revival of learning in Europe.

An important aspect of Islam is to seek knowledge which motivated and led the Muslims to develop a systematic way of teaching and spreading knowledge in purpose built structures. At first the mosque combined both religious performance and learning activities. By the tenth century, the Seljuks (ruled between 11th and early 14th centuries), introduced the first *Madrassa*, a proper school built independently from the mosque.

Under the Ottomans (ruled 15th-20th centuries), learning was given a new dimension as the towns of *Bursa* and *Edirne* took over as the main centres of learning. The Ottoman system of *Kulliye*, a building complex containing a mosque, a hospital, *madrassa*, and public kitchen and dining areas, was indeed revolutionary making the leaning accessible to a wider public though its free meals, health care and sometimes accommodation.

The first university was also developed from the mosque, usually of central location and of primary functional importance. Great university mosques such as al-

Qarawiyyin (859 CE, Fez), Al-Azhar (956 CE, Cairo) and Cordoba (8th century) were the Oxford and Cambridge of Medieval times

25. Turning clay to gold

As far back as the 8th century potters working in what is now Iraq developed a mysterious process called lustre. This was described as an 'extraordinary metallic sheen, which rivals even precious metals in its effects, all but turning objects of clay to gold'.

Lustre provided the right ingredients for producing such vessels in a cheaper and acceptable way as Islam prohibits the use of gold and silver vessels. It was produced from applying a thin glaze prepared from the oxides of silver and copper before the vessel being in a reducing furnace. When silver is used, a paler yellow or golden and silvery effect was obtained. In case of copper the produce of it is of a darker and redder colour.

The technique involved preparing pigments by mixing silver or copper oxides with an earthy vehicle such as ochre, and then vinegar or grape juice were added as medium. This pigment was then painted onto the glassy surface of the vessel, which had been glazed and fired once. The vessel was then fired for a second time in a reducing kiln, and then the ochre was rubbed away to reveal the gold lustre.

26. Pioneering plastic surgery

Did you know that way back in the 10th century Muslim doctor Al-Zahrawi pioneered plastic surgery. In fact it was his practice of using ink to mark the incisions that has now become a standard procedure. Most of the instruments Al-Zahrawi invented are still used today. In his al-Tasrif book, he talked about surgery for nose polyp removal and dealt with obstetrics and the surgery of eyes, ears, and teeth and gave detailed description of their surgical instruments.

27. Calligraphy and reform of the Arabic language

As the teachings of Islam spread beyond the boundaries of the Arabian Peninsula, an enormous number of people worldwide became Muslims. The new Muslims interpreted the art of writing as an abstract expression of Islam, each according to their own cultural and aesthetic systems. The influx of this cultural diversity led to two major events: the birth of regional calligraphic schools and styles such as Ta'liq in Persia and Deewani in Turkey, and the need to reform of the Arabic language. A clear and universal language with legible script was needed if the non-Arab Muslims were to learn Arabic and become part of the Islamic melting pot.

The first movement to reform the Arabic language and writing system came during the Umayyad era. Abul Aswad ad-Du'ali was the prophet and legendary founder of Arabic grammar and is credited with the invention of placing diacritical points to distinguish between certain identical consonants such as the 'gaf' and 'fa' in the Arabic alphabet. This system of diacritical marks is known as Tashkil (vocalization). Different colors also were introduced to differentiate between these marks--black for the diacriticals and red or yellow for the vocalics.

The powerful and energetic Umayyad viceroy al-Hajjaj Ibn Yousuf al-Thaqafi (694-714), took on the responsibility of solving problems concerning diacriticals. He commissioned Nasr and Yehya to refine the Tashkil system. They introduced the use of dots and certain vowel signs as differentiating marks. The dots were placed either above or beneath the letter, either single or in groups of two or three.

Unfortunately, for many people and scribes the system was unclear and confusing. A more sophisticated system was needed. The second reform movement was undertaken around 786. Khalil Ibn Ahmad al-Farahidi, the famous Arab philologist and lexicographer, was entrusted with devising a new Tashkil system. Al-Farahidi introduced vowel signs inspired by the initial shape or parts of certain letters. The sign 'hamza,' for example, is part of the letter 'ayn' (without its end-tail).

The new system gained wide popularity throughout the Muslim world. And Arabic calligraphy acquired the characteristics of beauty, sanctity, and versatility. Arabic calligraphy was used administratively, on architecture, on coins, to pen impressive epistles, and to produce elegant books, especially the Holy Qur'an, miniatures, and other literary works.

28. Manufacturing of Paper and Cloth

The first paper in Islamic countries was manufactured in 794 A.D. in Baghdad by *Yusuf Bin Omar*. The paper manufactured in Arab countries was of superior quality than that made in Europe.

By further developing the technique, they managed to produce paper on a larger scale. A paper mill was established in Baghdad, and soon paper replaced parchment (skin of animals) and papyrus ('paper' made from plants). The development of paper made knowledge and learning easier, for more people were able to have access to it. As the use of paper increased, vast numbers of books were produced. The industry spread further West, eventually reaching Europe.

In the manufacture of cloth, Muslims particularly in Spain exhibited marvellous skill and taste. Their woven cloth captured almost all the big markets of the world and was considered to be the finest as well as extremely durable.

29. The Agricultural Revolution

As early as the ninth century, a modern agricultural system became central to economic life and organization in the Muslim land.

The great Islamic cities of the Near East, North Africa and Spain, Artz explains, were supported by an elaborate agricultural system that included extensive irrigation and an expert knowledge of the most advanced agricultural methods in the world.

The Muslims reared the finest horses and sheep and cultivated the best orchards and vegetable gardens. They knew how to fight insect pests, how to use fertilizers, and they were experts at grafting trees and crossing plants to produce new varieties.

Glick defines the Muslim agricultural revolution in the introduction of new crops, which, combined with extension and intensification of irrigation, created a complex and varied agricultural system, whereby a greater variety of soil types were put to

efficient use; where fields that had been yielding one crop yearly at most prior to the Muslims were now capable of yielding three or more crops, in rotation; and where agricultural production responded to the demands of an increasingly sophisticated and cosmopolitan urban population by providing the towns with a variety of products unknown in Northern Europe.

Whilst for Scott, the agricultural system of the Spanish Muslims, in particular, was 'the most complex, the most scientific, the most perfect, ever devised by the ingenuity of man.'

Fertilisers, in their variety, were used according to a well-advanced methodology; whilst a maximum amount of moisture in the soil was preserved.

Soil rehabilitation was constantly cared for, and preserving the deep beds of cropped land from erosion was, according to Bolens, again, 'the golden rule of ecology,' and was 'subject to laws of scrupulous careful ecology.'

The rise of productivity of agricultural land and sometimes of agricultural labour owe to the introduction of higher yielding new crops and better varieties of old crops.

Irrigation, from Andalusia to the far East, from the Sudan to Afghanistan, remained central, 'the basis of all agriculture and the source of all life.'

The Muslims repaired them and constructed new ones; besides devising new techniques to catch, channel, store and lift the water, and making ingenious combinations of available devices.

30. Agriculture: Water Management

Water, so precious a commodity in a more Islamically aware age, was managed according to stringent rules, any waste of the resource banned, and the most severe economy enforced. Thus, in the Algerian Sahara various water management techniques were used to make the most effective use of the resource.

The Foggaras, a network of underground galleries, conducted water from one place to the other over very long distances so as to avoid evaporation. Although the system is still in use today, the tendency at present is for over-use and waste of water. Still in Algeria, in the Beni Abbes region, in the Sahara, south of Oran, farmers used a clepsydra (water regulator) to determine the duration of water use for every user in the area.

This clepsydra regulates with precision, and night and day, the amount going to each farmer, timed by the minute, throughout the year, and taking into account seasonal variations. Each farmer is informed of the timing of his turn, and summoned to undertake necessary action to ensure effective supply to his plot.

In Spain, the same strict management was in operation. The water conducted from one canal to the other was used more than once, the quantity supplied accurately graduated; distributing outlets were adapted to each soil variety, two hundred and twenty four of these, each with a specific name.

All disputes and violations of laws on water were dealt with by a court-whose judges were chosen by the farmers themselves, this court named The Tribunal of the Waters, which sat on Thursdays at the door of the principal mosque. Ten centuries later, the same tribunal still sits in Valencia, but at the door of the cathedral.

EXTRA

Chess

In the 8th century, Muslims brought chess to Spain, and it spread to Western Europe.

Gardens

By the 8th century botanical gardens could be found in Cordoba, Baghada, Cairo and Fez. Numerous herbs and drugs were grown, experiments were conducted, and of course, they were places of relaxation and beauty as well.

Libraries

Book stalls began to crop up all over Muslim lands by the 9th and 10th Centuries. The proliferation of books also meant that libraries became widespread.

Geography

It was al-Idrisi that drew the first detailed scientific map of the world in the 12th century. He also wrote a book on the geography of the world called "The book of Roger", named after his patron, Roger the Second, the Norman King of Sicily.

Travelling

Muslim sailors, merchants and explorers travelled far and wide. In the 14th century Ibn Battuta spent 28 years of his life travelling. His journeys took him from Morocco to China.

Architecture

The 15th and 16th centuries were also a golden age of architecture in the Muslim world. The Alhambra Palace in Spain in the 14th century, the Sulemaniyye Mosque built by Mimar Sinan in Istanbul in 1558, the Taj Mahal, constructed by Shah Jahan in the 17th century in India, are all examples of the splendour of Muslim architecture.

<http://www.1001inventions.com>

http://www.geocities.com/mutmainaa/history/muslim_inventors.html

<http://www.muslimheritage.com/>