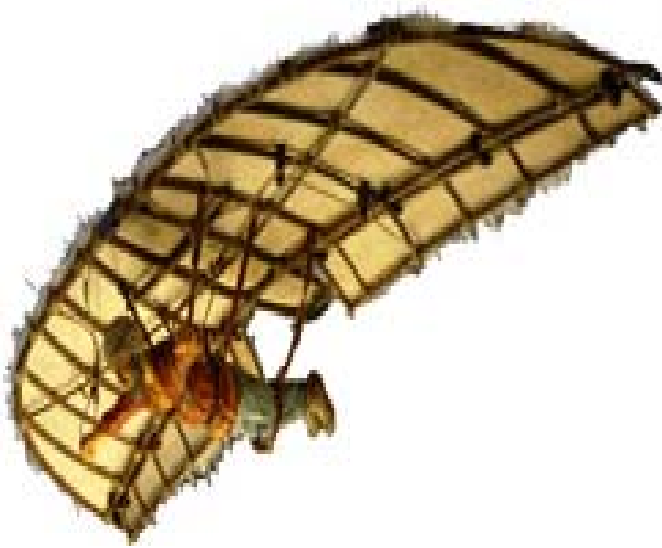


Muslim inventions that shaped the modern world



In 9th century Spain, Muslim inventor Abbas ibn Firnas designed a flying machine hundreds of years before Da Vinci drew plans of his own.

- Muslim inventions celebrate 1,000 years of "forgotten" Muslim heritage
- From coffee to cranks, items we couldn't live without today are Muslim inventions
- Modern hospitals and universities both began in 9th century by North Africa

Think of the origins of that staple of modern life, the cup of coffee, and Italy often springs to mind.

But in fact, Yemen is where the ubiquitous brew has its true origins.

Along with the first university, and even the toothbrush, it is among surprising Muslim inventions that have shaped the world we live in today. The origins of these fundamental ideas and objects, the basis of everything from the bicycle to musical scales are the focus of "1001 Inventions".

"There's a hole in western knowledge, they leap frog from the Renaissance to the Greeks."

Hospitals as we know them today, with wards and teaching centers, come from 9th century Egypt.

10 OUTSTANDING MUSLIM INVENTIONS:

1. Surgery

Around the year 1,000, the celebrated doctor Al Zahrawi published a 1,500 page illustrated encyclopedia of surgery that was used in Europe as a medical reference for the next 500 years. Among his many inventions, Zahrawi discovered the use of dissolving cat gut to stitch wounds beforehand a second surgery had to be performed to remove sutures. He also reportedly performed the first caesarean operation and created the first pair of forceps.

2. Coffee

Now the Western world's drink du jour, coffee was first brewed in Yemen around the 9th century. In its earliest days, coffee helped Sufis stay up during late nights of devotion. Later brought to Cairo by a group of students, the coffee buzz soon caught on around the empire. By the 13th century it reached Turkey, but not until the 16th century did the beans start boiling in Europe, brought to Italy by a Venetian trader.

3. Flying machine

"Abbas ibn Firnas was the first person to make a real attempt to construct a flying machine and fly," said Hassani. In the 9th century he designed a winged apparatus, roughly resembling a bird costume. In his most famous trial near Cordoba in Spain, Firnas flew upward for a few moments, before falling to the ground and partially breaking his back. His designs would undoubtedly have been an inspiration for famed Italian artist and inventor Leonardo Da Vinci's hundreds of years later, said Hassani.

4. University

In 859 a young princess named Fatima al-Firhi founded the first degree-granting university in Fez, Morocco. Her sister Miriam founded an adjacent mosque and together the complex became the al-Qarawiyyin Mosque and University. Still operating almost 1,200 years later, Hassani says he hopes the center will remind people that learning is at the core of the Islamic tradition and that the story of the al-Firhi sisters will inspire young Muslim women around the world today.

5. Algebra

The word algebra comes from the title of a Persian mathematician's famous 9th century treatise "Kitab al-Jabr Wa I-Mugabala" which translates roughly as "The Book of Reasoning and Balancing." Built on the roots of Greek and Hindu systems, the new algebraic order was a unifying system for rational numbers, irrational numbers and geometrical magnitudes. The same mathematician, [Al-Khwarizmi](#), was also the first to introduce the concept of raising a number to a power.

6. Optics

"Many of the most important advances in the study of optics come from the Muslim world," says Hassani. Around the year 1000 Ibn Al-Haitham proved that humans see objects by light reflecting off of them and entering the eye, dismissing Euclid and Ptolemy's theories that light was emitted from the eye itself. This great Muslim physicist also discovered the camera obscura phenomenon, which explains how the eye sees images upright due to the connection between the optic nerve and the brain.

7. Music

Muslim musicians have had a profound impact on Europe, dating back to Charlemagne tried to compete with the music of Baghdad and Cordoba, according to Hassani. Among many instruments that arrived in Europe through the Middle East are the lute and the rahab, an ancestor of the violin. Modern musical scales are also said to derive from the Arabic alphabet.

8. Toothbrush

According to Hassani, the Prophet Mohammed popularized the use of the first toothbrush in around 600. Using a twig from the Meswak tree, he cleaned his teeth and freshened his breath. Substances similar to Meswak are used in modern toothpaste.

9. The crank

Many of the basics of modern automatics were first put to use in the Muslim world, including the revolutionary crank-connecting rod system. By converting rotary motion to linear motion, the crank enables the lifting of heavy objects with relative ease. This technology, discovered by Al-Jazari in the 12th century, exploded across the globe, leading to everything from the bicycle to the internal combustion engine.

10. Hospitals

"Hospitals as we know them today, with wards and teaching centers, come from 9th century Egypt," explained Hassani. The first such medical center was the Ahmad ibn Tulun Hospital, founded in 872 in Cairo. Tulun hospital provided free care for anyone who needed it -- a policy based on the Muslim tradition of caring for all who are sick. From Cairo, such hospitals spread around the Muslim world.

SCIENTIFIC INVENTIONS BY MUSLIMS

By Engr. Iqbal A. Khan

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 meager 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.

Inventions

Abul Hasan is distinguished as the inventor of the Telescope, which he described to be a "Tube, to the extremities of which were attached diopters".

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.

The first watch was made by Kutbi, a renowned watch-maker of his time. During the Abbasid reign the use of a watch became quite common and the famous Harun-ar-Rashid 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 (Bat) standing in the Ist 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. "The Arabs were skilful in the construction of clepsydras and water clocks with automata," says a European writer.

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.

Mir Fatehullah Khan is known to history as the inventor of 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*.

It has been acknowledged by Joseph Hell in his book, *Arab Civilization* that the distinction of inventing photography goes to Ibn al-Hashem, who is not only credited with its invention but also its development. Muhammad Musa, a great scholar of geography, has the unique distinction of being the inventor of an instrument by which the earth could be measured. He also invented the "Astrolabe". These novel instruments invented by him have been preserved in the Museum of Madrid (Spain).

A unique instrument was invented by Abu Solet Umayya in 1134 A.D. through which a sunken ship would be raised--which greatly helped in the salvage expeditions of mediaeval times. The credit for manufacturing soap goes to Arab chemists, who introduced it to the world. 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. In the manufacture of cloth, Muslims particularly in Spain exhibited marvelous 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.

Al-Masudi who died in Cairo in 957 A.D. may be called the "Pliny of the Arabs" In his celebrated work *The Meadows of Gold*, he has described an earthquake, and the first windmill which was also invented by a Muslim. *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 belfry by Christian conquerors, who, after the expulsion of the Moors, did not know how to use it.

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

The Muslims have made a lasting contribution to the development of Medical Science. Razi (Rhazes), Ibn Sina (Avicenna), and Abu Ali al-Hasan (Alhazen) were the greatest medical scholars of mediaeval times. Al-Razi was the inventor of "Seton" in Surgery and the author of *Al-Judari Wal Hasbak*, an authentic book dealing with measles and small pox. 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. Alhazen was the world's greatest authority on "optics". The contagious character of the plague and its remedies were discovered by Ibn Katina, a Moorish Physician.

Ibn Firnas is credited with making glass from stones. He had constructed his home as a sort of planetarium where one could see stars, clouds and even lightning. According to Hitti 'Ibn Firnas was the first man in Arab history to make a scientific attempt at flight. His flying equipment consisted of a suit of feathers with wings, which, we are told carried him a long distance, in the air. When he alighted, however, he hurt himself because his suit was not provided with a tail.

The Qur'an calls upon Muslims to look around them and study the physical world, so that they might appreciate the majesty of Allah's creation:

"Behold! in the creation of the heavens and the earth; in the alternation of the night and the day; in the sailing of the ships through the ocean for the benefit of mankind; in the rain which Allah Sends down from the skies, and the life which He gives therewith to an earth that is dead; in the beasts of all kinds that He scatters through the earth; in the change of the winds, and the clouds which they trail like their slaves between the sky and the earth -- (Here) indeed are Signs for a people that are wise." (Surah Al-Baqarah 2:164). And the Prophet Muhammad (peace be upon him) told Muslims to "seek knowledge, even if it be in China." (Meaning 'seek knowledge wherever it may be found.')

Throughout Islamic history, that is exactly what Muslims have done. Particularly in the 7th-13th centuries C.E., the Islamic world was in the midst of its "Golden Age," paving the way for the growth of modern sciences. Rather than stifling science, the religion of Islam encouraged its study. Scientific inquiry was widespread, and some of the greatest scholars and scientists of the world made wondrous discoveries and inventions. Muslims led the world in the study of medicine, astronomy, mathematics, geography, chemistry, botany, and physics. They transmitted their studies to the West, where their work was built upon and further disseminated. These English words are rooted in the Arabic language, demonstrating the influence of Muslim scholars in these fields:

- alchemy
- algebra
- algorithm
- alkali
- almanac
- antimony
- average
- azimuth

- camphor
- carat
- cipher (zero)
- elixir
- nadir
- pancreas
- zenith
- zircon

So what happened? The Islamic world hit the peak of its "Golden Age," and then Muslims fell into their own Dark Age. Some say the fall coincided with the Crusades and the devastation of the Mongol invasion, when thousands of libraries and books were destroyed, and hundreds of scholars and scientists were murdered. Others point to internal division within Muslim society as the main cause.

How Islamic inventors changed the world

From coffee to cheques and the three-course meal, the Muslim world has given western many innovations that they take for granted in daily life. Paul Valley nominates 20 of the most influential- and identifies the men of genius behind them

1 The story goes that an Arab named Khalid was tending his goats in the Kaffa region of southern Ethiopia, when he noticed his animals became livelier after eating a certain berry. He boiled the berries to make the first coffee. Certainly the first record of the drink is of beans exported from Ethiopia to Yemen where Sufis drank it to stay awake all night to pray on special occasions. By the late 15th century it had arrived in Mecca and Turkey from where it made its way to Venice in 1645. It was brought to England in 1650 by a Turk named Pasqua Rosee who opened the first coffee house in Lombard Street in the City of London. The Arabic qahwa became the Turkish kahve then the Italian caffè and then English coffee.

2 The ancient Greeks thought our eyes emitted rays, like a laser, which enabled us to see. The first person to realise that light enters the eye, rather than leaving it, was the 10th-century Muslim mathematician, astronomer and physicist Ibn al-Haitham. He invented the first pin-hole camera after noticing the way light came through a hole in window shutters. The smaller the hole, the better the picture, he worked out, and set up the first Camera Obscura (from the Arab word qamara for a dark or private room). He is also credited with being the first man to shift physics from a philosophical activity to an experimental one.

3 A form of chess was played in ancient India but the game was developed into the form we know it today in Persia. From there it spread westward to Europe - where it was introduced by the Moors in Spain in the 10th century - and eastward as far as Japan. The word rook comes from the Persian rukh, which means chariot.

4 A thousand years before the Wright brothers a Muslim poet, astronomer, musician and engineer named Abbas ibn Firnas made several attempts to construct a flying machine. In 852 he jumped from the minaret of the Grand Mosque in Cordoba using a loose cloak stiffened with wooden struts. He hoped to glide like a bird. He didn't. But the cloak slowed his fall, creating what is thought to be the first parachute, and leaving him with only minor injuries. In 875, aged 70, having perfected a machine of silk and eagles' feathers he tried again, jumping from a mountain. He flew to a significant height and stayed aloft for ten minutes but crashed on landing - concluding, correctly, that it was because he had not given his device a tail so it would stall on landing. Baghdad international airport and a crater on the Moon are named after him.

5 Washing and bathing are religious requirements for Muslims, which is perhaps why they perfected the recipe for soap which we still use today. The ancient Egyptians had soap of a kind, as did the Romans who used it more as pomade. But it was the Arabs who combined vegetable oils with sodium hydroxide and aromatics such as thyme oil. One of the Crusaders' most striking characteristics, to Arab nostrils, was that they did not wash. Shampoo was introduced to England by a Muslim who opened Mahomed's Indian Vapour Baths on Brighton seafront in 1759 and was appointed Shampooing Surgeon to Kings George IV and William IV.

6 Distillation, the means of separating liquids through differences in their boiling points, was invented around the year 800 by Islam's foremost scientist, Jabir ibn Hayyan, who transformed alchemy into chemistry, inventing many of the basic processes and apparatus still in use today - liquefaction, crystallisation, distillation, purification, oxidisation, evaporation and filtration. As well as discovering sulphuric and nitric acid, he invented the alembic still, giving the world intense rosewater and other perfumes and alcoholic spirits (although drinking them is haram, or forbidden, in Islam). Ibn Hayyan emphasised systematic experimentation and was the founder of modern chemistry.

7 The crank-shaft is a device which translates rotary into linear motion and is central to much of the machinery in the modern world, not least the internal combustion engine. One of the most important mechanical inventions in the history of humankind, it was created by an ingenious Muslim engineer called al-Jazari to raise water for irrigation. His 1206 Book of Knowledge of Ingenious Mechanical Devices 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. Among his 50 other inventions was the combination lock.

8 Quilting is a method of sewing or tying two layers of cloth with a layer of insulating material in between. It is not clear whether it was invented in the Muslim world or whether it was imported there from India or China. But it certainly came to the West via the Crusaders. They saw it used by Saracen warriors, who wore straw-filled quilted canvas shirts instead of armour. As well as a form of protection, it proved an effective guard against the chafing of the Crusaders' metal armour and was an effective form of insulation - so much so that it became a cottage industry back home in colder climates such as Britain and Holland.

9 The pointed arch so characteristic of Europe's Gothic cathedrals was an invention borrowed from Islamic architecture. It was much stronger than the rounded arch used by the Romans and Normans, thus allowing the building of bigger, higher, more complex and grander buildings. Other borrowings from Muslim genius included ribbed vaulting, rose windows and dome-building techniques. Europe's castles were also adapted to copy the Islamic world's - with arrow slits, battlements, a barbican and parapets. Square towers and keeps gave way to more easily defended round ones. Henry V's castle architect was a Muslim.

10 Many modern surgical instruments are of exactly the same design as those devised in the 10th century by a Muslim surgeon called al-Zahrawi. His scalpels, bone saws, forceps, fine scissors for eye surgery and many of the 200 instruments he devised are recognisable to a modern surgeon. It was he who discovered that catgut used for internal stitches dissolves away naturally (a discovery he made when his monkey ate his lute strings) and that it can be also used to make medicine capsules. In the 13th century, another Muslim medic named Ibn Nafis described the circulation of the blood, 300 years before William Harvey discovered it. Muslims doctors also invented anaesthetics of opium and alcohol mixes and developed hollow needles to suck cataracts from eyes in a technique still used today.

11 The windmill was invented in 634 for a Persian caliph and was used to grind corn and draw up water for irrigation. In the vast deserts of Arabia, when the seasonal streams ran dry, the only source of power was the wind which blew steadily from one direction for months. Mills had six or 12 sails covered in fabric or palm leaves. It was 500 years before the first windmill was seen in Europe.

12 The technique of inoculation was not invented by Jenner and Pasteur but was devised in the Muslim world and brought to Europe from Turkey by the wife of the English ambassador to Istanbul in 1724. Children in Turkey were vaccinated with cowpox to fight the deadly smallpox at least 50 years before the West discovered it.

13 The fountain pen was invented for the Sultan of Egypt in 953 after he demanded a pen which would not stain his hands or clothes. It held ink in a reservoir and, as with modern pens, fed ink to the nib by a combination of gravity and capillary action.

14 The system of numbering in use all round the world is probably Indian in origin but the style of the numerals is Arabic and first appears in print in the work of the Muslim mathematicians al-Khwarizmi and al-Kindi around 825. Algebra was named after al-Khwarizmi's book, *Al-Jabr wa-al-Muqabilah*, much of whose contents are still in use. The work of Muslim maths scholars was imported into Europe 300 years later by the Italian mathematician Fibonacci. Algorithms and much of the theory of trigonometry came from the Muslim world. And Al-Kindi's discovery of frequency analysis rendered all the codes of the ancient world soluble and created the basis of modern cryptology.

15 Ali ibn Nafi, known by his nickname of Ziryab (Blackbird) came from Iraq to Cordoba in the 9th century and brought with him the concept of the three-course meal - soup, followed by fish or meat, then fruit and nuts. He also introduced crystal glasses (which had been invented after experiments with rock crystal by Abbas ibn Firnas - see No 4).

16 Carpets were regarded as part of Paradise by medieval Muslims, thanks to their advanced weaving techniques, new tinctures from Islamic chemistry and highly developed sense of pattern and arabesque which were the basis of Islam's non-representational art. In contrast, Europe's floors were distinctly earthy, not to say earthy, until Arabian and Persian carpets were introduced. In England, as Erasmus recorded, floors were "covered in rushes, occasionally renewed, but so imperfectly that the bottom layer is left undisturbed, sometimes for 20 years, harbouring expectoration, vomiting, the leakage of dogs and men, ale droppings, scraps of fish, and other abominations not fit to be mentioned". Carpets, unsurprisingly, caught on quickly.

17 The modern cheque comes from the Arabic saqq, a written vow to pay for goods when they were delivered, to avoid money having to be transported across dangerous terrain. In the 9th century, a Muslim businessman could cash a cheque in China drawn on his bank in Baghdad.

18 By the 9th century, many Muslim scholars took it for granted that the Earth was a sphere. The proof, said astronomer Ibn Hazm, "is that the Sun is always vertical to a particular spot on Earth". It was 500 years before that realisation dawned on Galileo. The calculations of Muslim astronomers were so accurate that in the 9th century they reckoned the Earth's circumference to be 40,253.4km - less than 200km out. The scholar al-Idrisi took a globe depicting the world to the court of King Roger of Sicily in 1139.

19 Though the Chinese invented saltpetre gunpowder, and used it in their fireworks, it was the Arabs who worked out that it could be purified using potassium nitrate for military use. Muslim incendiary devices terrified the Crusaders. By the 15th century they had invented both a rocket, which they called a "self-moving and combusting egg", and a torpedo - a self-propelled pear-shaped bomb with a spear at the front which impaled itself in enemy ships and then blew up.

20 Medieval Europe had kitchen and herb gardens, but it was the Arabs who developed the idea of the garden as a place of beauty and meditation. The first royal pleasure gardens in Europe were opened in 11th-century Muslim Spain. Flowers which originated in Muslim gardens include the carnation and the tulip.

Early Muslim Science and the Inventions – Teach Your Children

The following information is from the Islamic Homeschool Diary blog, and is reproduced with permission. It is valuable information not found in Western textbooks. Teach your children about Muslim scientists and inventions that predated their rediscovery by the West, usually without credit being given. And if anyone has any additions or corrections, please add them in the comments.

What is Taught: The first mention of man in flight was by Roger Bacon, who drew a flying apparatus. Leonardo da Vinci also conceived of airborne transport and drew several prototypes.

What Should be Taught: Ibn Firnas of Islamic Spain invented, constructed and tested a flying machine in the 800's A.D. Roger Bacon learned of flying machines from Arabic references to Ibn Firnas' machine. The latter's invention antedates Bacon by 500 years and Da Vinci by some 700 years.

What is Taught: Glass mirrors were first produced in 1291 in Venice.

What Should be Taught: Glass mirrors were in use in Islamic Spain as early as the 11th century. The Venetians learned of the art of fine glass production from Syrian artisans during the 9th and 10th centuries.

What is Taught: Until the 14th century, the only type of clock available was the water clock. In 1335, a large mechanical clock was erected in Milan, Italy. This was possibly the first weight-driven clock.

What Should be Taught: A variety of mechanical clocks were produced by Spanish Muslim engineers, both large and small, and this knowledge was transmitted to Europe through Latin translations of Islamic books on mechanics. These clocks were weight-driven. Designs and illustrations of epi-cyclic and segmental gears were provided. One such clock included a mercury escapement. The latter type was directly copied by Europeans during the 15th century. In addition, during the 9th century, Ibn Firnas of Islamic Spain, according to Will Durant, invented a watch-like device which kept accurate time. The Muslims also constructed a variety of highly accurate astronomical clocks for use in their observatories.

What is Taught: In the 17th century, the pendulum was developed by Galileo during his teenage years. He noticed a chandelier swaying as it was being blown by the wind. As a result, he went home and invented the pendulum.

What Should be Taught: The pendulum was discovered by Ibn Yunus al-Masri during the 10th century, who was the first to study and document its oscillatory motion. Its value for use in clocks was introduced by Muslim physicists during the 15th century.

What is Taught: Movable type and the printing press was invented in the West by Johannes Gutenberg of Germany during the 15th century.

What Should be Taught : In 1454, Gutenberg developed the most sophisticated printing press of the Middle Ages. However, movable brass type was in use in Islamic Spain 100 years prior, and that is where the West's first printing devices were made.

What is Taught: Isaac Newton's 17th century study of lenses, light and prisms forms the foundation of the modern science of optics .

What Should be Taught: In the 11th century ibn al-Haytham determined virtually everything that Newton advanced regarding optics centuries prior and is regarded by numerous authorities as the "founder of optics." There is little doubt that Newton was influenced by him. Ibn al-Haytham was the most quoted physicist of the Middle Ages. His works were utilized and quoted by a greater number of European scholars during the 16th and 17th centuries than those of Newton and Galileo combined.

What is Taught: Isaac Newton, during the 17th century, discovered that white light consists of various rays of colored light.

What Should be Taught: This discovery was made in its entirety by ibn al-Haytham (11th century) and Kamal ad-Din (14th century). Newton did make original discoveries, but this was not one of them.

What is Taught: The concept of the finite nature of matter was first introduced by Antoine Lavoisier during the 18th century. He discovered that, although matter may change its form or shape, its mass always remains the same. Thus, for instance, if water is heated to steam, if salt is dissolved in water or if a piece of wood is burned to ashes, the total mass remains unchanged.

What Should be Taught: The principles of this discovery were elaborated centuries before by Islamic Persia's great scholar, al-Biruni (d. 1050). Lavoisier was a disciple of the Muslim chemists and physicists and referred to their books frequently.

What is Taught: The Greeks were the developers of trigonometry .

What Should be Taught: Trigonometry remained largely a theoretical science among the Greeks. It was developed to a level of modern perfection by Muslim scholars, although the weight of the credit must be given to al-Battani. The words describing the basic functions of this science, sine, cosine and tangent, are all derived from Arabic terms. Thus, original contributions by the Greeks in trigonometry were minimal.

What is Taught: The use of decimal fractions in mathematics was first developed by a Dutchman, Simon Stevin, in 1589. He helped advance the mathematical sciences by replacing the cumbersome fractions, for instance, $1/2$, with decimal fractions, for example, 0.5.

What Should be Taught: Muslim mathematicians were the first to utilize decimals instead of fractions on a large scale. Al-Kashi's book, Key to Arithmetic, was written at the beginning of the 15th century and was the stimulus for the systematic application of decimals to whole numbers and fractions thereof. It is highly probably that Stevin imported the idea to Europe from al-Kashi's work.

What is Taught: The first man to utilize algebraic symbols was the French mathematician, Francois Vieta. In 1591, he wrote an algebra book describing equations with letters such as the now familiar x and y 's. Asimov says that this discovery had an impact similar to the progression from Roman numerals to Arabic numbers.

What Should be Taught: Muslim mathematicians, the inventors of algebra, introduced the concept of using letters for unknown variables in equations as early as the 9th century A.D. Through this system, they solved a variety of complex equations, including quadratic and cubic equations. They used symbols to develop and perfect the binomial theorem.

What is Taught: The difficult cubic equations (x to the third power) remained unsolved until the 16th century when Niccolo Tartaglia, an Italian mathematician, solved them.

What Should be Taught: Cubic equations as well as numerous equations of even higher degrees were solved with ease by Muslim mathematicians as early as the 10th century.

What is Taught: The concept that numbers could be less than zero, that is negative numbers, was unknown until 1545 when Geronimo Cardano introduced the idea.

What Should be Taught: Muslim mathematicians introduced negative numbers for use in a variety of arithmetic functions at least 400 years prior to Cardano.

What is Taught: In 1614, John Napier invented logarithms and logarithmic tables.

What Should be Taught: Muslim mathematicians invented logarithms and produced logarithmic tables several centuries prior. Such tables were common in the Islamic world as early as the 13th century.

What is Taught: During the 17th century Rene Descartes made the discovery that algebra could be used to solve geometrical problems. By this, he greatly advanced the science of geometry.

What Should be Taught: Mathematicians of the Islamic Empire accomplished precisely this as early as the 9th century A.D. Thabit bin Qurrah was the first to do so, and he was followed by Abu'l Wafa, whose 10th century book utilized algebra to advance geometry into an exact and simplified science.

What is Taught: Isaac Newton, during the 17th century, developed the binomial theorem, which is a crucial component for the study of algebra.

What Should be Taught: Hundreds of Muslim mathematicians utilized and perfected the binomial theorem. They initiated its use for the systematic solution of algebraic problems during the 10th century (or prior).

What is Taught: No improvement had been made in the astronomy of the ancients during the Middle Ages regarding the motion of planets until the 13th century. Then Alphonso the Wise of Castile (Middle Spain) invented the Aphonsine Tables, which were more accurate than Ptolemy's.

What Should be Taught: Muslim astronomers made numerous improvements upon Ptolemy's findings as early as the 9th century. They were the first astronomers to dispute his archaic ideas. In their critic of the

Greeks, they synthesized proof that the sun is the center of the solar system and that the orbits of the earth and other planets might be elliptical. They produced hundreds of highly accurate astronomical tables and star charts. Many of their calculations are so precise that they are regarded as contemporary. The Alphonsine Tables are little more than copies of works on astronomy transmitted to Europe via Islamic Spain, i.e. the Toledo Tables.

What is Taught: The English scholar Roger Bacon (d. 1292) first mentioned glass lenses for improving vision. At nearly the same time, eyeglasses could be found in use both in China and Europe.

What Should be Taught: Ibn Firnas of Islamic Spain invented eyeglasses during the 9th century, and they were manufactured and sold throughout Spain for over two centuries. Any mention of eyeglasses by Roger Bacon was simply a regurgitation of the work of ibn al-Haytham (d. 1039), whose research Bacon frequently referred to.

What is Taught: Gunpowder was developed in the Western world as a result of Roger Bacon's work in 1242. The first usage of gunpowder in weapons was when the Chinese fired it from bamboo shoots in attempt to frighten Mongol conquerors. They produced it by adding sulfur and charcoal to saltpeter.

What Should be Taught: The Chinese developed saltpeter for use in fireworks and knew of no tactical military use for gunpowder, nor did they invent its formula. Research by Reinuad and Fave have clearly shown that gunpowder was formulated initially by Muslim chemists. Further, these historians claim that the Muslims developed the first fire-arms. Notably, Muslim armies used grenades and other weapons in their defense of Algeciras against the Franks during the 14th century. Jean Mathes indicates that the Muslim rulers had stock-piles of grenades, rifles, crude cannons, incendiary devices, sulfur bombs and pistols decades before such devices were used in Europe. The first mention of a cannon was in an Arabic text around 1300 A.D. Roger Bacon learned of the formula for gunpowder from Latin translations of Arabic books. He brought forth nothing original in this regard.

What is Taught: The compass was invented by the Chinese who may have been the first to use it for navigational purposes sometime between 1000 and 1100 A.D . The earliest reference to its use in navigation was by the Englishman, Alexander Neckam (1157-1217).

What Should be Taught: Muslim geographers and navigators learned of the magnetic needle, possibly from the Chinese, and were the first to use magnetic needles in navigation. They invented the compass and passed the knowledge of its use in navigation to the West. European navigators relied on Muslim pilots and their instruments when exploring unknown territories. Gustav Le Bon claims that the magnetic needle and compass were entirely invented by the Muslims and that the Chinese had little to do with it. Neckam, as well as the Chinese, probably learned of it from Muslim traders. It is noteworthy that the Chinese improved their navigational expertise after they began interacting with the Muslims during the 8th century.

What is Taught: The first man to classify the races was the German Johann F. Blumenbach, who divided mankind into white, yellow, brown, black and red peoples.

What Should be Taught: Muslim scholars of the 9th through 14th centuries invented the science of ethnography. A number of Muslim geographers classified the races, writing detailed explanations of their unique cultural habits and physical appearances. They wrote thousands of pages on this subject. Blumenbach's works were insignificant in comparison.

What is Taught: The science of geography was revived during the 15th, 16th and 17th centuries when the ancient works of Ptolemy were discovered. The Crusades and the Portuguese/Spanish expeditions also contributed to this reawakening. The first scientifically- based treatise on geography were produced during this period by Europe's scholars.

What Should be Taught: Muslim geographers produced untold volumes of books on the geography of Africa, Asia, India, China and the Indies during the 8th through 15th centuries. These writings included the world's first geographical encyclopedias, almanacs and road maps. Ibn Battutah's 14th century masterpieces provide a detailed view of the geography of the ancient world. The Muslim geographers of the 10th through 15th centuries far exceeded the output by Europeans regarding the geography of these regions well into the 18th century. The Crusades led to the destruction of educational institutions, their scholars and books. They brought nothing substantive regarding geography to the Western world.

What is Taught: Robert Boyle, in the 17th century, originated the science of chemistry.

What Should be Taught: A variety of Muslim chemists, including ar-Razi, al-Jabr, al-Biruni and al-Kindi, performed scientific experiments in chemistry some 700 years prior to Boyle. Durant writes that the Muslims introduced the experimental method to this science. Humboldt regards the Muslims as the founders of chemistry.

What is Taught: Leonardo da Vinci (16th century) fathered the science of geology when he noted that fossils found on mountains indicated a watery origin of the earth.

What Should be Taught: Al-Biruni (11th century) made precisely this observation and added much to it, including a huge book on geology, hundreds of years before Da Vinci was born. Ibn Sina noted this as well . it is probable that Da Vinci first learned of this concept from Latin translations of Islamic books. He added nothing original to their findings.

What is Taught: The first mention of the geological formation of valleys was in 1756, when Nicolas Desmarest proposed that they were formed over a long periods of time by streams.

What Should be Taught: Ibn Sina and al-Biruni made precisely this discovery during the 11th century (see pages 102 and 103), fully 700 years prior to Desmarest.

What is Taught: Galileo (17th century) was the world's first great experimenter.

What Should be Taught: Al-Biruni (d. 1050) was the world's first great experimenter. He wrote over 200 books, many of which discuss his precise experiments. His literary output in the sciences amounts to some 13,000 pages, far exceeding that written by Galileo or, for that matter, Galileo and Newton combined.

What is Taught: The Italian Giovanni Morgagni is regarded as the father of pathology because he was the first to correctly describe the nature of disease.

What Should be Taught: Islam's surgeons were the first pathologists. They fully realized the nature of disease and described a variety of diseases to modern detail. Ibn Zuhr correctly described the nature of pleurisy, tuberculosis and pericarditis. Az-Zahrawi accurately documented the pathology of hydrocephalus (water on the brain) and other congenital diseases. Ibn al-Quff and Ibn an-Nafs gave perfect descriptions of the diseases of circulation. Other Muslim surgeons gave the first accurate descriptions of certain malignancies, including cancer of the stomach, bowel and esophagus. These surgeons were the originators of pathology, not Giovanni Morgagni.

What is Taught: Paul Ehrlich (19th century) is the originator of drug chemotherapy, that is the use of specific drugs to kill microbes.

What Should be Taught : Muslim physicians used a variety of specific substances to destroy microbes. They applied sulfur topically specifically to kill the scabies mite. Ar-Razi (10th century) used mercurial compounds as topical antiseptics.

What is Taught: Purified alcohol, made through distillation, was first produced by Arnau de Villanova, a Spanish alchemist, in 1300 A.D.

What Should be Taught: Numerous Muslim chemists produced medicinal-grade alcohol through distillation as early as the 10th century and manufactured on a large scale the first distillation devices for use in chemistry. They used alcohol as a solvent and antiseptic.

What is Taught: The first surgery performed under inhalation anesthesia was conducted by C.W. Long, an American, in 1845.

What Should be Taught: Six hundred years prior to Long, Islamic Spain's Az-Zahrawi and Ibn Zuhr, among other Muslim surgeons, performed hundreds of surgeries under inhalation anesthesia with the use of narcotic-soaked sponges which were placed over the face.

What is Taught: During the 16th century Paracelsus invented the use of opium extracts for anesthesia.

What Should be Taught: Muslim physicians introduced the anesthetic value of opium derivatives during the Middle Ages. Opium was originally used as an anesthetic agent by the Greeks. Paracelsus was a student of Ibn Sina's works from which it is almost assured that he derived this idea.

What is Taught: Modern anesthesia was invented in the 19th century by Humphrey Davy and Horace Wells.

What Should be Taught: Modern anesthesia was discovered, mastered and perfected by Muslim anesthetists 900 years before the advent of Davy and Wells. They utilized oral as well as inhalant anesthetics.

What is Taught: The concept of quarantine was first developed in 1403. In Venice, a law was passed preventing strangers from entering the city until a certain waiting period had passed. If, by then, no sign of illness could be found, they were allowed in.

What Should be Taught: The concept of quarantine was first introduced in the 7th century A.D. by the prophet Muhammad, who wisely warned against entering or leaving a region suffering from plague. As early as the 10th century, Muslim physicians innovated the use of isolation wards for individuals suffering with communicable diseases.

What is Taught: The scientific use of antiseptics in surgery was discovered by the British surgeon Joseph Lister in 1865.

What Should be Taught: As early as the 10th century, Muslim physicians and surgeons were applying purified alcohol to wounds as an antiseptic agent. Surgeons in Islamic Spain utilized special methods for maintaining antisepsis prior to and during surgery. They also originated specific protocols for maintaining hygiene during the post-operative period. Their success rate was so high that dignitaries throughout Europe came to Cordova, Spain, to be treated at what was comparably the "Mayo Clinic" of the Middle Ages.

What is Taught: In 1545, the scientific use of surgery was advanced by the French surgeon Ambroise Pare. Prior to him, surgeons attempted to stop bleeding through the gruesome procedure of searing the wound with boiling oil. Pare stopped the use of boiling oils and began ligating arteries. He is considered the "father of rational surgery." Pare was also one of the first Europeans to condemn such grotesque "surgical" procedures as trepanning.

What Should be Taught: Islamic Spain's illustrious surgeon, az-Zahrawi (d. 1013), began ligating arteries with fine sutures over 500 years prior to Pare. He perfected the use of Catgut, that is suture made from animal intestines. Additionally, he instituted the use of cotton plus wax to plug bleeding wounds. The full details of his works were made available to Europeans through Latin translations. Despite this, barbers and herdsmen continued to be the primary individuals practicing the "art" of surgery for nearly six centuries after az-Zahrawi's death. Pare himself was a barber, albeit more skilled and conscientious than the average ones. Included in az-Zahrawi's legacy are dozens of books. His most famous work is a 30 volume treatise on medicine and surgery. His books contain sections on preventive medicine, nutrition, cosmetics, drug therapy, surgical technique, anesthesia, pre and post-operative care as well as drawings of some 200 surgical devices, many of which he invented. The refined and scholarly az-Zahrawi must be regarded as the father and founder of rational surgery, not the uneducated Pare.

What is Taught: William Harvey, during the early 17th century, discovered that blood circulates. He was the first to correctly describe the function of the heart, arteries and veins. Rome's Galen had presented erroneous ideas regarding the circulatory system, and Harvey was the first to determine that blood is pumped throughout the body via the action of the heart and the venous valves. Therefore, he is regarded as the founder of human physiology.

What Should be Taught: In the 10th century, Islam's ar-Razi wrote an in-depth treatise on the venous system, accurately describing the function of the veins and their valves. Ibn an-Nafs and Ibn al-Quff (13th century) provided full documentation that the blood circulates and correctly described the physiology of the heart and the function of its valves 300 years before Harvey. William Harvey was a graduate of Italy's famous Padua University at a time when the majority of its curriculum was based upon Ibn Sina's and ar-Razi's textbooks.

What is Taught: The first pharmacopeia (book of medicines) was published by a German scholar in 1542. According to World Book Encyclopedia, the science of pharmacology was begun in the 1900's as an offshoot of chemistry due to the analysis of crude plant materials. Chemists, after isolating the active ingredients from plants, realized their medicinal value.

What Should be Taught: According to the eminent scholar of Arab history, Phillip Hitti, the Muslims, not the Greeks or Europeans, wrote the first "modern" pharmacopeia. The science of pharmacology was originated by Muslim physicians during the 9th century. They developed it into a highly refined and exact science. Muslim chemists, pharmacists and physicians produced thousands of drugs and/or crude herbal

extracts one thousand years prior to the supposed birth of pharmacology. During the 14th century Ibn Baytar wrote a monumental pharmacopeia listing some 1400 different drugs. Hundreds of other pharmacopeias were published during the Islamic Era. It is likely that the German work is an offshoot of that by Ibn Baytar, which was widely circulated in Europe.

What is Taught: The discovery of the scientific use of drugs in the treatment of specific diseases was made by Paracelsus, the Swiss-born physician, during the 16th century. He is also credited with being the first to use practical experience as a determining factor in the treatment of patients rather than relying exclusively on the works of the ancients.

What Should be Taught: Ar-Razi, Ibn Sina, al-Kindi, Ibn Rushd, az -Zahrawi, Ibn Zuhr, Ibn Baytar, Ibn al-Jazzar, Ibn Juljul, Ibn al-Quff, Ibn an-Nafs, al-Biruni, Ibn Sahl and hundreds of other Muslim physicians mastered the science of drug therapy for the treatment of specific symptoms and diseases. In fact, this concept was entirely their invention. The word "drug" is derived from Arabic. Their use of practical experience and careful observation was extensive. Muslim physicians were the first to criticize ancient medical theories and practices. Ar-Razi devoted an entire book as a critique of Galen's anatomy. The works of Paracelsus are insignificant compared to the vast volumes of medical writings and original findings accomplished by the medical giants of Islam.

What is Taught: The first sound approach to the treatment of disease was made by a German, Johann Weger, in the 1500's.

What Should be Taught: Harvard's George Sarton says that modern medicine is entirely an Islamic development and that Setting the Record Straight the Muslim physicians of the 9th through 12th centuries were precise, scientific, rational and sound in their approach. Johann Weger was among thousands of Europeans physicians during the 15th through 17th centuries who were taught the medicine of ar-Razi and Ibn Sina. He contributed nothing original.

What is Taught: Medical treatment for the insane was modernized by Philippe Pinel when in 1793 he operated France's first insane asylum .

What Should be Taught: As early as the 11th century, Islamic hospitals maintained special wards for the insane. They treated them kindly and presumed their disease was real at a time when the insane were routinely burned alive in Europe as witches and sorcerers. A curative approach was taken for mental illness and, for the first time in history, the mentally ill were treated with supportive care, drugs and psychotherapy. Every major Islamic city maintained an insane asylum where patients were treated at no charge. In fact, the Islamic system for the treatment of the insane excels in comparison to the current model, as it was more humane and was highly effective as well.

What is Taught: Kerosene was first produced by an Englishman, Abraham Gesner, in 1853. He distilled it from asphalt.

What Should be Taught: Muslim chemists produced kerosene as a distillate from petroleum products over 1,000 years prior to Gesner (see Encyclopaedia Britannica under the heading, Petroleum).

Muslim Scientific Inventions

The Muslim Scholar

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.

The Telescope

Abul Hasan is distinguished as the inventor of the Telescope, which he described to be a "Tube, to the extremities of which were attached diopters".

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.

The Watch

The first watch was made by Kutbi, a renowned watch-maker of his time. During the Abbasid reign the use of a watch became quite common and the famous Harun-ar-Rashid 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 (Bat) 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. "The Arabs were skilful in the construction of clepsydras and water clocks with automata," says a European writer.

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.

Gunpowder

Mir Fatehullah Khan is known to history as the inventor of 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.

"It has been acknowledged by Joseph Hell in his book, Arab Civilization that the distinction of inventing photography goes to Ibn al-Hashem, who is not only credited with its invention but also its development. Muhammad Musa, a great scholar of geography, has the unique distinction of being the inventor of an

instrument by which the earth could be measured. He also invented the "Astrolabe". These novel instruments invented by him have been preserved in the Museum of Madrid (Spain)."

Shipping instrument

A unique instrument was invented by Abu Solet Umayyah in 1134 A.D. through which a sunken ship would be raised - which greatly helped in the salvage expeditions of mediaeval times.

Manufacturing Soap, Paper and Cloth

The credit for manufacturing soap goes to Arab chemists, who introduced it to the world. 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.

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.

In the manufacture of cloth, Muslims particularly in Spain exhibited marvelous 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.

The Windmill

Al-Masudi who died in Cairo in 957 A.D. may be called the "Pliny of the Arabs" In his celebrated work The Meadows of Gold; he has described an earthquake, and the first windmill which was also invented by a Muslim.

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 belfry 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 synthesis.

Ptolemy (a 2nd Century Greek writer)'s 'Almagest' (the title as we know it today is actually Arabic) was translated, studied and criticized. 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 calanders.

Using longitude and latitude, calculating the circumference of the Earth within a few hundred miles, the Muslim geographers so 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.

Also compiled were almanacs - another Arabic term. Other terms from Arabic are zenith, nadir, Aledo, azimuth.

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, for example, wrote a mathematical treatise on shadows that helped calibrate sundials accurately.

Astrolabe

The Astrolabe is perhaps the most famous of 'Islamic inventions'. Primitive astrolabes were developed by the Greeks, but the refinements made by the Muslim Mathematicians, and craftsmen made them more accurate and versatile. When the device entered Europe through Spain and Italy, it was the latest in high technology. In the storyteller of 'The Canterbury Tales', Geoffrey Chaucer, wrote instructions on its use. The well-known romance of Heloise and Abelard resulted in a son they named - Astrolabe! their instruments used by Muslim astronomers and navigators were

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. 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, Al-Khawarizmi, invented the subject of algebra (al-Jabr), which was further developed by others, most notably Umar Khayyam. 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. Additionally, they invented the symbol to express an unknown quantity, i.e. variables like x.

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.

Medical Sciences

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

Al-Razi, known in the West as Rhazes, the famous physician and scientist, (d. 932), was the inventor of "Seton" in Surgery and the author of 'Al-Judari wal Hasbak', an authentic book dealing with measles and small pox.

Seen as one of the greatest physicians in the world in the Middle Ages, Razi stressed empirical observation and clinical medicine and was unrivalled as a diagnostician. He also wrote a treatise on hygiene in hospitals.

Kahaf Abul-Qasim Al-Sahabi was a very famous surgeon in the eleventh century, known in Europe for his work, 'Kitab al-Tasrif' (Concessio).

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. Alhazen was the world's greatest authority on "optics".

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.

Glass Ibn Firnas is credited with making glass from stones. He had constructed his home as a sort of planetarium where one could see stars, clouds and even lightning. Attempts at flight

According to Hitti, "Ibn Firnas was the first man in Arab history to make a scientific attempt at flight. His flying equipment consisted of a suit of feathers with wings, which, we are told carried him a long distance, in the air. When he alighted, however, he hurt himself because his suit was not provided with a tail.