Spring, 1998

ON the 10th March, the Museum saw the opening of its most recent special exhibition, ‘Lines of Faith’. The exhibition, which is concerned with Islamic scientific instruments and religious practice, is the first exhibition to be conceived, designed, and produced by the Museum’s M. Sc. students as part of their one-year graduate course. The Museum houses the largest collection of Islamic scientific instruments in the west, and one of the finest in the world. The aim of ‘Lines of Faith’ is to focus on these instruments by considering them in their religious context. The instruments are inscribed with many elaborate engravings, which show that they not only had scientific roles – they also played an integral part in the practice of religious observance.

Art and scientific knowledge were cultivated intensively in the Islamic world during the first six centuries after God’s revelations to Muhammad, especially in the 9th and 10th centuries A.D. During this period scholars in the Islamic world became substantially acquainted with the scientific understanding of older cultures, of which the Greek civilization was the most influential.

The new knowledge that they acquired was re-evaluated in Islamic religious society. In Islam, the study and practice of astronomy and astrology were of practical importance and significance for two reasons: the study of the cosmos could be seen as part of the revelation of the true meaning of the Qur’an and of God’s universe, and the daily and monthly movements of the sun and the moon were the primary means of regulating the rituals of religious life.

Religious life in Islam is primarily determined by the Qur’an and the Hadith – the account of words and actions attributed to Muhammad. For followers of Islam, the Qur’an is the Word of God revealed to Muhammad in ‘clear Arabic speech’ through the agency of the angel Jibril.

The revelations to Muhammad began in the year 610 A.D. and continued for the next twenty-three years. Unlike other religious texts, the Qur’an is not a narrative account of events that happened in the past, but is closer to rhythmic prose or an epic poem. The whole text contains 114 chapters, each called a sura, with a total of 6,236 verses.

The Qur’an not only provides ethical principles and attitudes, and fundamental values and norms; it also emphasizes the importance of reason and learning. Indeed, Islam makes the pursuit of knowledge an obligation of every Muslim.

The basic religious duties of Muslims are known as the five pillars of Islam: Shahada, or declaration – ‘There is no God but Allah and Muhammad is his Messenger’; Salat – a prayer to be performed five times a day, involving mental preparation, purification, certain movements of the body, and prayer in the direction of the Ka’ba, the holy shrine; Zakat – compulsory charity as a religious and social obligation; Sawm – fasting between dawn and sunset during the Holy Month of Ramadan; and finally Hajj – undertaking a pilgrimage at least once in a lifetime to the Sacred City of Mecca.

The Qur’an states that Muslims must pray in the direction of Mecca at certain times of the day, and fast during the Holy Month of Ramadan. These stipulations therefore have implications for direction finding, time-telling and calendar regulation, which often involve quite complex astronomical and mathematical problems. The desire to find solutions to these problems led to the production of scientific instruments with a clear religious function.

Central to Muslim life is to know the direction of the Ka’ba – the Holy Shrine in the city of Mecca. This sacred direction, the ‘qibla’, is faced during all ritual acts, such as prayer. The earliest qibla-indicator was the road taken by pilgrims to Mecca, but when the astronomical alignments of the Ka’ba were established, the qibla could be found by observation of the movement of certain stars, or the sun.

From the 8th century A.D., Muslim astronomers viewed the determination of the qibla as a problem of mathematical geography. The problem involved determining the geographical co-ordinates of given localities, and computing the direction of Mecca from these localities by methods of geometry or trigonometry. The need to determine the qibla formed the impetus of much of the work done by Muslim geographers.

The qibla of a given locality is a trigonometric function of the local latitude, the latitude of Mecca, and the longitudinal difference from Mecca. Its derivation was one of the most complicated problems of Islamic spherical astronomy, and its significance was heightened by its religious importance. One of the greatest achievements in determining the qibla was the work of Shams al-Din al-Khalili, who produced a method based on spherical trigonometry.

The development of these methods led to the creation of instruments such as the qibla-indicator, which codified complex astronomical information and mathematics. Using such instruments, with basic local geographical knowledge, a relatively uneducated person could accurately find the qibla for any location in the Islamic world.

In the Islamic world, the public call to prayer is given at five specific times a day from minarets or mosques by the “mu’adhdhin” or ‘muezzin’. Prayer times are determined by the position of the sun in the sky. The Muslim day begins with the sunset prayer, Salat al-Mahgrib, which is followed by the evening prayer, Salat al-‘Isha’, beginning at nightfall. Twilight regulates the third prayer of the day, Salat al-Fajr, which begins at daybreak. Salat al-Zuhr, the noon prayer, and Salat al-‘Asr, the afternoon prayer, are regulated by shadow-lengths. Zuhr is given shortly after the sun has passed its highest point, where shadow-length is at its shortest. ‘Asr is given when this length has doubled.

The traditional methods for identifying prayer times were based on folk astronomy, and often a simple gnomon or sundial was used by the muezzins during the day. A simple stick gnomon could be used, for example, to ascertain the time of ‘Asr, which varies both with location and with the time of year. Islamic scholars sought to combine the folk tradition with more precise knowledge of astronomy and mathematics, and therefore constructed instruments and tables for determining the times of prayer.

Although used by only a minority of Muslims, astrolabes and quadrants were made with lines for determining the times of prayer. A particularly fine example of an instrument in the Museum’s collection with these prayer lines engraved is a Moorish astrolabe-quadrant from 1219 A.H. or 1804 A.D. (The Islamic calendar is based on the lunar year of 354 days and is reckoned from the 16th July, 622 A.D., the date of the ‘Hijra’, or Muhammad’s flight from Mecca to Medina.)

The front of the instrument (illustrated on the left) is engraved as an astrolabe-quadrant of the type first invented by the Judaeo-Provençal mathematician and astronomer, Jacob b. Makhir ibn Tibbon, known by the latinized name as Prophatius Judaeus (c. 1236-1304 A.D.). An inscription on the instrument states that it was made to be used in the region around Miknas in Morocco, at a latitude of 43 degrees, and specifically for a mosque known as ‘al-Zaituna’.

Astrology and astronomy were closely linked in Islam, reflected by the fact that in Arabic one term encapsulates both meanings. The Qur’an suggests that there are signs in nature for man to read, and in the history of Islam the study of astronomy and astrology were at one time regarded as having a high spiritual purpose in the contemplation of the universe.

The main principles of Islamic astrology were inherited from the Babylonians and Greeks, and were made relevant to Muslim scholars because of the spiritual relationship, as interpreted from the Qur’an, between the celestial bodies and the heavens, and man and the earth.

The branches of astrology developed among Muslim scholars were judicial astrology, genethliac astrology and cosmological astrology. Judicial astrology was concerned with the prediction of future events or the future of institutions, and it was the practice most widely accepted within Islamic culture since it had political use and significance. Genethliac astrology concerned the horoscopes of individuals, while cosmological astrology dealt with the metaphysical relationship between heaven and earth.

Like its western counterpart, Islamic astrology has twelve signs of the zodiac, created by the division of the heavens into twelve houses of influence, each ruled by a constellation of stars. Each sign of the zodiac was thought to govern certain aspects of earthly life. These were not only the moods or humours of the soul and body of man, but also the seasons of the year, aspects of the weather and of agriculture.

The Hadith, however, mentions that only God knows the future, and implies that man should not attempt to predict it. Wrong predictions gave rise at times to the same conclusion. The observatory established in Istanbul in 1575 A.D., for example, was short lived. At the appearance of the famous comet of 1577 Taqi al-Din predicted that it was the harbinger of good times, and that the Sultan would win over the Persian army. The Sultan lost, a plague followed, and as a result the observatory was demolished three years later in 1580.

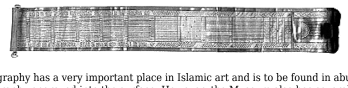
Over time astronomers within state observatories came to distance themselves from astrology due to its vulgar associations with fortune telling, although it retained its appeal among the population.

Islam obtained much of its astronomical knowledge from Greek antiquity, but original work was also undertaken. Cosmological theories were developed, mathematical models for planetary motion improved, and accurate observations taken. The modern use of Arabic terms such as zenith, azimuth and nadir, and star names such as Betelgeuse (‘yad al-jawza’ – hand of Orion) and Algol (ra’s al-ghul – the head of the ghoul) demonstrates the legacy of Muslim astronomy in the west.

Although instruments such as qibla-indicators are purely Islamic, other instruments were common to Islam and Christendom, such as the astrolabe. Islamic and European astrolabes can differ in many ways, even though they were used for similar purposes, and have a common origin. The Islamic need for finding prayer times, and determining the direction of Mecca, inevitably led to markings on instruments which are not found on western examples.

A typical characteristic of Islamic astrolabes, for example, is to find a circular table engraved on the inside of the mater, listing places with their corresponding latitude, longitude and the inhiraf, or direction to Mecca. Islamic instruments also tend to be of a highly decorative nature, in contrast to the European tendency for functionality, as a result of the duty of Muslim craftsmen to produce beautiful works, and thus to serve God.

There are many examples of fine craftsmanship among the Museum’s Islamic instruments. The astrolabe by Abd al-Karim al-Misri, illustrated on the right, is one such example: it is made of brass and is decorated on the face of the throne and limb with gold and silver Damascene work. The astrolabe was made for Abu-l-Fatih Musa ibn Abu-l-Bakr ibn Ayub, the nephew of Saladin and ruler of Mesopotamia from 1210 to 1230 A.D.



Calligraphy has a very important place in Islamic art and is to be found in abundance on Islamic instruments. The majority of surviving Islamic instruments are metal, and therefore have calligraphy engraved into the surface. However, the Museum also has several wooden instruments, such as the qibla-indicator illustrated opposite, on which the calligraphy is executed in paint and ink. The scroll illustrated above, which bears tables for determining prayer times, is an equally clear demonstration of the calligrapher’s skills, this time on parchment.

The Islamic association of instruments with religion was sometimes mirrored in European examples. Instruments such as sundials, although not used for any specific purpose associated with Christian worship, could be fashioned in the shape of crucifixes, or could be made to contain small compartments as reliquaries in which to place religious objects.

The precise regulation of religious observance is as essential to Muslims throughout the world today as it has been over the last 1,400 years. Such tasks as finding the qibla and determining prayer times are still a daily necessity. The use of brass astrolabes and other instruments has, however, been replaced, predictably enough, with more modern technologies. Computer programs can now be used to accomplish the task of determining the qibla and prayer times for any location on the planet. The Internet is also useful, as a convenient source for software packages and astronomical information of use for predicting the movement of the moon.

Surprisingly perhaps, hand-held instruments still have their place, and included in the exhibition is a battery-powered electronic qibla-indicator. The local geographical co-ordinates of the user are programmed into the instrument, which then provides the qibla direction, which can be put into practice with the aid of the compass included in the design. The device also calculates the five prayer times, and even incorporates an alarm to alert the user that the time for prayer is approaching.

While modern technology has provided Muslims with solutions to familiar questions, the global expansion of Islam has presented today’s worshippers with fresh difficulties. Since Islam follows the Lunar Calendar, the start of each month (of particular importance at Ramadan) is based on the first sighting of the lunar crescent – an event which occurs at different times around the world. Under Islamic law, this problem can be addressed in two ways. Either the sighting of a new crescent in any part of the world can be used as the basis for the start of the month worldwide, or different regions can declare different starts to the month, depending on local sightings. The latter option, known as the method of ‘different crescents’, has been assumed by Muslim groups in North America.

The inaugural student exhibition owes much to the help and advice of the Museum staff, as well as other authorities on Islam and its science. However, it has primarily been the work of the seven Museum M. Sc. students, whose efforts will act as a catalyst and model for others in the years to come.

A preliminary on-line version of ‘Lines of Faith’ is accessible via the ‘student space’ of the Museum’s website, and gallery talks by students are scheduled for Trinity term, details of which can be found in the calendar on the back page. The exhibition itself runs until the 27th June.

Class of ’98