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Treasures of the Aga Khan Museum

ARTS OF THE BOOK & CALLIGRAPHY

Treasures of the Aga Khan Museum ~
Arts of the Book & Calligraphy

Sabancı University Sakıp Sabancı Museum, Istanbul
November 5, 2010 — February 27, 2011

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Sabancı University
Sakıp Sabancı Museum, Istanbul
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Scientific Manuscripts of the Islamic World

In the world today there are several million Islamic manuscripts, not all of which have yet been analysed or made the subject of a bibliographic inventory. Among the available manuscripts, close to five percent of them are considered "scientific manuscripts", related to intellectual activities conducted in the domain of the rational sciences. One must consider the ensuing developments in terms of comparisons with the classical disciplines of the Greek tradition (mathematics, physics, philosophy). This is the case for mathematics, algebra, trigonometry, combinatorial analysis and the physical sciences, as it is for the life sciences of medicine and its different branches – anatomy, pharmacology – as well as botany, chemistry, alchemy and zoology. In this context Arabic, the sacred language of Islam, played an essential role as a tool and vehicle for what was not merely the transmission of Greek thought, for it included many innovations.

The foundation and expansion of the Islamic world from the seventh through the fifteenth centuries encompassed a geographical area ranging from India to Spain and including all of North Africa and Sicily. It is clear that from the middle of the eighth century all of the favourable conditions necessary for the development of scientific activity were coming together within this milieu. In particular, the privileged geographical position of the Islamic empire, enabling direct contact with the heirs of the ancient scientific traditions, was vital for the transmission of knowledge in which Islamic cultures played a decisive role. One thinks of course of the Greek, Persian, and Syriac scientific traditions but equally one should not forget Indian, Chinese and other traditions, which are also extremely significant.

Some Muslim cities emerged as true scientific centres. This was the case first in the caliphal capital of Damascus under the last Umayyads, and was especially true of Baghdad under the early ʻAbbasids. The "House of Wisdom" (*Bayt al-Hikma*) in Baghdad was one of the principal cultural and scientific centres of the ninth century. Although there is very little surviving textual evidence regarding this palace library, it has often been characterised as a type of academy or university in which various scholarly activities, including the translation of pre-

Islamic texts into Arabic, took place. The *Bayt al-Hikma* seems to have developed particularly under the ʻAbassid caliph al-Maʼmūn (r. 812–833). In this library many Greek, Persian and Indian works were collected, preserved and presumably translated. The high regard shown for these texts from various pre-Islamic traditions may have helped to create a culture that was integrated amongst the diverse populations under Arab rule, acting to legitimise the ʻAbbasid caliphate as the successor to the Sasanians. That hugely influential pre-Islamic Persian dynasty had famously built their own palace libraries known as *ganj* ("treasury"), a word equivalent to the Arabic *khizāna*, by which last term the *Bayt al-Hikma* was sometimes also known.

Important men of science and culture succeeded one another in the *Bayt al-Hikma*. Arguably one of the most exceptional, "the father of algebra", Al-Khwārazmī (c. 783–850), was a mathematician, geographer, astronomer and astrologer. From this scholar we have derived the modern English terms "algorithm" (the Latinization of his name being *algoritmi*) and "algebra" (from the title of one of his works, *Kitāb al-jabr wa-l-muqābala*). He is also credited with spreading so-called "Arabic" numerals (originally derived from Indian traditions) throughout Europe and the Middle East.

The Translations of *De Materia Medica* of Dioscorides

The development of scientific activities relied upon multiple translations. One of the oldest scientific manuscripts translated from Greek into Arabic was the treatise *De Materia Medica* (cat. nos 96 and 97) by the Greek physician Dioscorides. Born around 40 CE in Anazarbus in Cilicia (now in Turkey), Dioscorides died some fifty years later. His work exerted a great influence throughout the Middle Ages up to the sixteenth century. The book was first translated into Syriac and the earliest Arabic translation was made in the mid-ninth century in Baghdad, under the reign of the ʻAbbasid caliph al-Mutawakkil (r. 847–861), by Istafān Ibn Basīl and by Hunayn Ibn Ishāq (c. 809–873). The latter was a physician and Arab scientist, and a Nestorian Christian, known as the "master of translators", who was active in the *Bayt al-Hikma* in the mid-ninth century. In addition to his translations, he wrote several treatises on medicine and the diverse subjects that relate to it, such as the *Kitāb al-masāʼil fi'l-tibb* (Book of Questions on Medicine), an important reference book in the medical world of the Middle Ages.

In 948, the Byzantine Emperor Constantine VII offered as a gift a Greek copy of the text of Dioscorides to the Umayyad caliph of Cordoba, ʻAbd al-Rahmān III, leading to a revision of the text. A famous copy made in the first quarter of the thirteenth century was widely recopied and distributed and is now dispersed throughout many public and private collections. These pages illustrate one of the most frequent modes of transmission of medical knowledge in the Muslim world before the modern era. In the absence of teaching establishments, knowledge passed most often from master to disciple, supported by reading and interpretation of the works of the great authors.

The Diffusion of Scientific Knowledge

The testimony of the first Muslim historian of science, Sāid al-Andalusī (al-Tulaytulī), active in the eleventh century, demonstrates the importance of the Greek legacy:

> When the caliphate passed to al-Ma'mun, and when driven by his own genius, this prince wanted to learn philosophy, when the savants of his era became aware of the *Almagest* [a fundamental work of Ptolemy], when they understood the mechanism of the instruments of observation described in this book, al-Ma'mun was moved to assemble before him from all points of his empire, the remarkable men of his time.[1]

Very rapidly, this knowledge was disseminated throughout the Muslim world. Thus, it was at Qayrawan from the end of the eighth century that the beginning of scientific activities took place in the Maghrib. For a long time, Kairouan attracted to *Ifrīqiya* (modern Tunisia) a great number of scholars who brought with them the first copies of Euclid's *Elements*, the *Almagest* of Ptolemy and the first Muslim works of mathematics.

The earliest scientific works of the Islamic world containing original features emerged from the beginning of the ninth century, even before the end of the period of translation. These contributions were decisive in several domains, including mathematics, medicine, botany and pharmacology, and in particular astronomy.

Astronomy

Astronomy is without doubt the oldest of the sciences and also one of those which has most powerfully contributed to the evolution of human thought. Born from the needs of daily life (the measurement of time, agriculture, navigation, and so forth), and the fears of primitive man when confronted with the great natural phenomena, it remained closely associated with astrological superstitions until the beginning of modern times.

In the Muslim world, astronomy primarily served a religious function: to fix dates (for example the beginning of Ramadan, or the start of ʻĪd) by the visibility of the crescent moon; to determine times for prayer; to ascertain the direction of Mecca (and therefore the orientation of places of worship) regardless of the location; and similar needs. To this end, many portable observation instruments such as astrolabes and dials were fabricated, and treaties explaining how to use these were drafted.

The astrolabe consisted of a bronze disc that could be held from the thumb by means of a ring. This type of analogue calculator, already known in Greek antiquity, was perfected in the Islamic world. It permitted not only the determination of time, but also solved problems of spherical astronomy and geodesy (the science of the measurement and representation of the earth). The astrolabe represented the sky on a flat surface, with the points of the rete – the top disc of the astrolabe – indicating the position of the stars. But more than just an instrument of observation and calculation, it was also intended to as a tool for training future astronomers.

The penetration of the astrolabe into Europe followed the conquest of Spain by the Muslims around the year 711. As early as the tenth century al-Hākim II, Caliph of Cordoba, had established a school of astronomy that became an important centre for the fabrication of instruments (see the astrolabe in cat. no. 103). The production of astrolabes declined from the seventeenth century, but experienced a revival in the Persian world under the Safavid and then the Qajar dynasties; this reflects an revived interest in astrology and astronomical research (cat. no. 104).

It seems that the Muslim astronomical corpus is one of the best-preserved components of medieval scientific literature. Despite their bibliographical shortcomings, the texts studied to date provide a fascinating picture of this scientific activity.

In this way, the treatise *Suwar Kitāb al-Kawākib al-Thābita* (Description of the Fixed Stars) provides an example. The text was written by ʻAbd al-Rahmān ibn ʻUmar al-Sūfī (903–986), known in the West by the name of Azophus: this renowned astronomer officiated at the court of Isfahan under the Buyid Sultan ʻAdud al-Dawla. The latter commanded the treatise on fixed stars, which was a catalogue of one thousand and seventeen fixed stars mentioned by the famous Greek astronomer Ptolemy in his *Almagest* in the second century, the text of which al-Sūfī significantly improved. Al-Sūfī was the first to attempt to consolidate the traditional Arab and Greek names of the stars and constellations that did not overlap. For each star observed, he designed both the constellation as imagined from the exterior of the celestial globe, then the same view from the interior of the celestial globe, as it would be observed from the surface of the earth. In his book, al-Sūfī described forty-eight constellations according to both the Greek system and Arab tradition, specifying the exact coordinates of each star, their dimensions and their positions in their respective constellations. There exist numerous copies of this text dating from periods up to the eighteenth century (cat. no. 106). In addition, al-Sūfī found many innovative uses for the astrolabe.

Medicine and Anatomy

Baghdad in the ninth century attracted scholars from throughout the Muslim world, notably the famous al-Rāzī (c. 854–925; known in the West as Rhazes), regarded by chroniclers as “the Galen of the Muslims”. Versed in chemistry, philosophy and the medical sciences, his work was impressive: al-Bīrūnī in the eleventh century attributed 184 titles to him. An alchemist turned doctor, he vigorously defended the scientific approach in diagnosis and therapy, and greatly influenced the conception of hospital organization in connection with the training of future physicians. Nevertheless, the teaching of medicine in European universities relied more on the work of Ibn Sīnā, preferred without doubt for his theoretical character.

Written between 1012 and 1024, successively in Gurgān, Rayy and Hamadān, the *Qānūn fi'l-Tibb* (Canon of Medicine) was the most important medical work of Ibn Sīnā (known as Avicenna in the West; 980–1037). In his preface, he stated that he wanted to write a book that contained both general and specific rules of medical knowledge. Thus he wrote: “I say that medicine is a science that permits the knowledge of the states of the human body in relation to that which promotes health and that which drives its loss, with the purpose of preserving it in full and restoring it when it is lost”.[2]

The Canon contains five books, treating successively the generalities of medicine, simple medications, diseases affecting a specific part of the body, diseases affecting the entire body and surgery, and lastly compound medicines, i.e. drugs and pharmacology (cat. no. 94). Regarding anatomy and dissection, it has rarely been the subject of religious or legal condemnation in the Muslim world. Anatomical knowledge was inspired by the work of the famous Greek physician of the second century, Galen, translated into Arabic under the reign of the ʻAbbasid caliph al-

Ma'mūn (813–833) and his successors. Ibn Sīnā emphasized the importance of direct observation of human bodies because "it is necessary that they be approached through observation (*hiss*) and dissection (*tashrīh*), while those things that must be conjectured and demonstrated by reason are diseases and their particular causes and their symptoms and how disease can be abated and health maintained".[3]

His text became a great success, and ultimately eclipsed the earlier works of al-Rāzī, 'Alī ibn al-'Abbās al-Majūsī (known in the West as Haly-Abbas), and Abu al-Qāsim al-Zahrāwī (Latinized as Albucasis). Many times copied, commented on and translated, Ibn Sīnā's Canon was for centuries the most important medical textbook in both the East and the West. In time it was supplemented with certain works of al-Rāzī and later the *Kulliyāt,* which represented the medical art of Ibn Rushd (also known as Averroes; b. Cordoba, 1126 – d. Marrakesh, 1198), philosopher, theologian, jurist, mathematician and Muslim Andalusian physician of the twelfth century. Much of Ibn Rushd's medical writing remained largely unknown in his lifetime because his philosophical works were judged at one point to be heretical, but it was of considerable significance for the later development of medicine.

The *Tashrīh* (Anatomy) of Mansūr ibn Ilyās was the first text of the Muslim world that showed the anatomy of the entire human body (cat. no. 98). A physician and scholar of the late fourteenth century, Mansūr ibn Ilyās was a native of Shiraz and came from a family of scholars and physicians who practiced for several generations. His two principal works were an encyclopaedia of general medicine and a study of anatomy. Dedicated to the Timurid prince of Fars, Pīr Muhammad Bahādur Khān, his treatise on anatomy was one of the most widely disseminated medical volumes written in Persian. It was most famous for the six illustrations that appeared in the manuscripts. Five chapters – each illustrated by an anatomical chart – respectively addressed the bones, nerves, veins, arteries and muscles. The last chapter (*khātima*) was devoted to the complex organs like the heart and the brain, and to the development of the foetus, usually illustrated by a diagram of a pregnant woman.

Cosmology and Zoology

The *'Ajā'ib al-makhlūqāt wa gharā'ib al-maujūdāt* (Wonders of Creation and Oddities of Existence) was the first systematic presentation of cosmography in Islamic literature. For its composition, al-Qazwīnī largely relied upon the work of his predecessors. The polymath Zakariyā' ibn Muhammad ibn Mahmud al-Qazwīnī (1203–1283) was born in Iran and worked in several cities, particularly Damascus. He was Qadi in Iraq at the time of the capture of Baghdad by the Mongols in 1258.

His cosmography is a type of encyclopaedia divided into two parts dedicated respectively to the superterrestrial world – celestial phenomena, the inhabitants of the heavens, chronology and so forth – and the terrestrial world: the four elements, meteors, winds, the seven climates, the known rivers and seas, the mineral and plant kingdoms, and living creatures from man to the animals, passing by the jinn. The popularity of the cosmography genre is evidenced by the large number of copies of the *Wonders of Creation* that survive in Arabic and in the Persian and Turkish translations. These are usually illustrated (cat. nos 99 and 105).

In the same literary genre one finds the treatise *Manāfi' al-hayawān* (cat. no. 95) composed by the doctor Abū Sa'īd 'Ubayd Allāh Ibn Bakhtīshū'. He lived in Mayyāfāriqīn (currently Silvan in Turkey) and died in 1058. A Persian translation was created in 1295/1300 by 'Abd al-Hādī of Maragha, following a commission from the Ilkhanid ruler Mahmūd Ghāzān (r. 1295–1304). The work, usually widely illustrated, successively examines men, domestic animals, wild animals, birds and fish, ending with insects. Along with physical and behavioural descriptions the text describes the medicinal properties of the organs and secretions of the animals in question.

Botany, Pharmacology and Alchemy

In medieval times, botany was closely bound to medicine and generally limited to a practical role within the creation of medicines. If the "recipes" from the medieval epoch were essentially borrowed from Greek works, or inherited from Indian medicine, they were enriched by the oral traditions of many populations of the Islamic world and by the experiences of Arabic-speaking doctors or pharmacists. The *Khawāss al-Ashjār* (cat. nos 96 and 97), as we have already mentioned above, is a translation of the *De Materia Medica* of Dioscorides. It is a treatise on the fabrication of medicines from some five hundred plants that serve as the basis for pharmacology in Islamic countries.

Alchemy was also an important scientific discipline in the Muslim world. This science was linked to both the physical domain of matter and to the spiritual world as well. Indeed, there existed a physical chemistry of scientists or practitioners concerned with the properties of substances (including metals and their transmutation) and from another side, a spiritual alchemy that examined the transformation of the soul (cat. no. 107). From the early centuries of Islamic civilization, alchemy had its supporters and its detractors. However, it had the merit of leading to the discovery of new chemicals through multiple experimental investigations in the "laboratories" of the alchemists.

1 Sāid al-Tulaytulī, *Tabaqāt al-umam*, French trans. R. Blachère: *Catégories des nations* (Paris 1935); English trans. from French by Shannon de Viviés.

2 Ibn Sīnā, *Qānūn fi'l-Tibb*, cited in D. Jacquart and F. Micheau, *A l'ombre d'Avicenne: Le médecine au temps des califes* (Paris, 1996); English trans. from French by Shannon de Viviés.

3 Ibn Sīnā, *Qānūn fi'l-Tibb*, cited in Emilie Savage-Smith, 'Attitudes Toward Dissection in Medieval Islam', *Journal of the History of Medicine and Allied Sciences* 50/1 (1995), 67–110, this quote pp. 92–93.