

A Foundation of Western Ophthalmology in Medieval Islamic Medicine

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The conquests of Muhammad starting in the 7th century led to the spread of Islam and the teachings of the Qur'an, a theology believing that genuine health and happiness is the natural state of existence. While medieval Europe rejected the medical knowledge of the pagan Greeks, the early Islamic world was eager to assimilate and expand the Hellenistic medical teachings, emerging as the collector and preserver of Western medicine. For ophthalmology, an especially extensive literature developed. The prevalence of eye diseases in the Islamic lands resulted in particular interest in their skilful diagnosis and treatment. Using principles of clinical observation, many ocular diseases were described or classified for the first time. Intricate surgical excision with an array of minute instruments was used in the treatment of several external diseases of the eye such as pannus and pterygium. Suction removal of cataracts using a hollow needle was also described. Their advances in the knowledge of optics, anatomy, and physiology of the eye became major contributions to modern ophthalmology. Latin translations of the extensive Arabic literature on ophthalmology influenced late medieval Europe, and many of these contributions of early Islamic empire remain today. Medieval Islam made these advancements because it eagerly encouraged knowledge and physician thinkers from all cultures.

A Medium for Medieval Medicine

Three civilizations emerged from the fall of Rome in 476: the Byzantine Empire, the Early Medieval West, and Islam. The Islamic empire emerged as the sole preserver of the classical knowledge of ophthalmology and added contributions that are still significant today. The Islamic empire was able to achieve its great contribution to ophthalmology because of unique cultural conditions within its borders during its establishment and its golden age.

When Arabia was split into many different tribes in 622, Muhammad founded his ideal community in Medina, where religion and state became one.¹ Muhammad gave specific instructions on various aspects of health, treating people himself, stressing that genuine health is the natural state of existence.² With the prevalence of disease, medicine became a central part of medieval Islamic culture.³

With Muhammad's death in 632, Arabia was at peace for the first time¹, united under a new and resourceful religion, which espoused sound health amongst its followers. Inclusion of other societies within its growing borders allowed the young Islamic world to flourish, absorbing the culture and scientific knowledge of other civilizations.

While conversion to Islam outside Arabic lands was gradual, linguistic conversion

proceeded more rapidly. After only a century, Arabic was the official and working language, often completely replacing older languages within the empire. Islam not only inherited the earlier scientific and medical traditions, but also received contributions from its non-Arab, non-Muslim peoples who adopted Arabic as a common language of scholarship⁴, facilitating unprecedented scientific and medical exchange and enabling significant expansion of past knowledge.

Because copying the Qur'an was an act of piety, Islamic culture also had an engrossing tradition of book-making, including calligraphy, illustration, paper-making, and binding. Illustration practices were adopted from the Byzantine and Persian cultures, while Chinese paper making was improved upon.³ Islamic medical knowledge was recorded in textbooks and transmitted across its lands and to future generations.

The Royal Library of Baghdad

The knowledge of the earlier Greek medical teachings came to Islam through Nestorian Christians, driven out of Byzantine and settling in Persia.⁶ Their translations and teachings were valued by an emerging Islamic empire which needed to find ways of dealing with common medical problems: disease, pain, injuries, and

successful child-bearing.⁷ Upheavals in the first millennium of Christianity caused the loss of many Greek medical works which are now only known from Arabic translations.⁵

This heritage of medical theory and practice was assimilated and elaborated by an international community of scholars of many different cultures and languages including Arabic, Persian, Syriac, Hebrew, and Turkish.^{1,7} During the Abbasid Dynasty (750-1258), Islam's Golden Age, translation of Greek, Hindu, Syriac, and Persian texts accelerated. Caliphs of this age promoted knowledge and curiosity⁴ and the Royal Library in Baghdad became a centre where countless precious manuscripts from all corners of the empire were collected for translation.⁵

Hunayn ibn Ishaq, a Syriac-speaking Christian working in Baghdad at this time, made Arabic translations of nearly all known Greek medical books. He also wrote several medical and ophthalmologic treatises that later circulated in Latin in Europe. His treatises were fundamental in establishing the basic conceptual framework of medicine in renaissance Europe. These translations maintained a continuity of ideas between Roman, Islamic and late Medieval European practices.⁷

Islamic physicians like Hunayn produced a vast medical literature of their own, combining Greek doctrines and their own observations.⁵ By the end of the ninth century, Arabic medicine had fully integrated the Galenic humoral system, and further developed the Galenic tendency to systematize by writing medical treatises that organized the vast body of medical knowledge into one comprehensive and logical structure. Hunayn's original work, Ten Treatises on the Eye, is an example of this new organisation and an exhaustive work on the eye.⁴

As opposed to theoretical reflections on illness, a new trend developed that focused on expanding empirical knowledge and on practical procedures for treatment. Abu Bakr al-Razi or Rhazes, criticized the inherited medical knowledge for inferences that did not always correlate with clinical observations. He pioneered clinical medicine by conducting what

amounted to controlled experimentation. For instance, he used bloodletting in one group of patients while giving no treatment to another group.⁴ He also wrote case histories, 900 of which were included in his casebook, Kitab al-Tajarib. His casebook described 48 cases of eye conditions, often differing from his theoretical writings. A third of the ophthalmologic complaints in his casebook, with their complex mixture of symptoms, do not appear in his famous theoretical book, Kitab al-Mansuri. Furthermore, several treatments used in the casebook deviated from the theoretical work because of adjustments to the particular needs of the patient.⁸

Works of the late Islamic golden age reflect the mature development of all these trends as demonstrated by the Perfect Book on Ophthalmology written by Ibn an-Nafis (b. ca. 1210). The first part, on the theoretical principles, deals with anatomy, physiology, pathology, aetiology and symptomology. The second, on the clinical treatment and surgery, is systemically organized and provides an account of the improvements made based on clinical observation.⁹

Medieval Islam was responsible for translating and preserving many medical works into Arabic, allowing an international community of scholars to improve on inherited knowledge in two broad themes: the systematization of contemporary medical and ophthalmologic knowledge in manuals for easy transmission; and the development of clinical medicine through rigorous research and observation, challenging pre-existing theoretical frameworks. These frameworks allowed the Arabic advancement of classical ophthalmology.

A Specialty is Written

Blindness was a major cause of disability throughout the Islamic lands. As a result, Islamic physicians displayed particular concern and ability in the diagnosis and treatment of eye diseases³ and nearly every medical compendium had chapters on ophthalmology. Rhazes' work, Kitab al-Mansuri, included a large section on the specialty.¹⁰ It was one of the most widely read

medieval medical manuals in Europe and often reprinted with commentaries by prominent Renaissance physicians such as Vesalius.⁷

There were a large number of monographs devoted solely to ophthalmology.³ The early work of Hunayn's ninth-century manual, Ten Treatises on the Eye, and Ibn Nafis' thirteenth-century manual, Perfected Book on Ophthalmology, are two examples. Ali ibn Isa's tenth-century Memorandum Book for Oculists was the classical Arabic textbook of ophthalmology and became the standard treatise of the eye for several centuries in Islam and Christendom.¹¹ The text describes over a hundred different diseases of the eye organized by anatomical location and combined Greco-Roman knowledge with novel observations.¹²

The Greco-Roman attitude to ophthalmology was poor, with only five works on ophthalmology in the 800 years between Herophilus and Alexander, all of these lost and none by a specialist. Moreover, the writings of Galen referred to ophthalmologists in a derogatory manner. In contrast, during the 500 years of the Islamic golden age, thirty textbooks

on the eye were written, thirteen of them surviving and ten written by ophthalmologists. These doctors had thorough specialty training and were honoured by the public.¹³

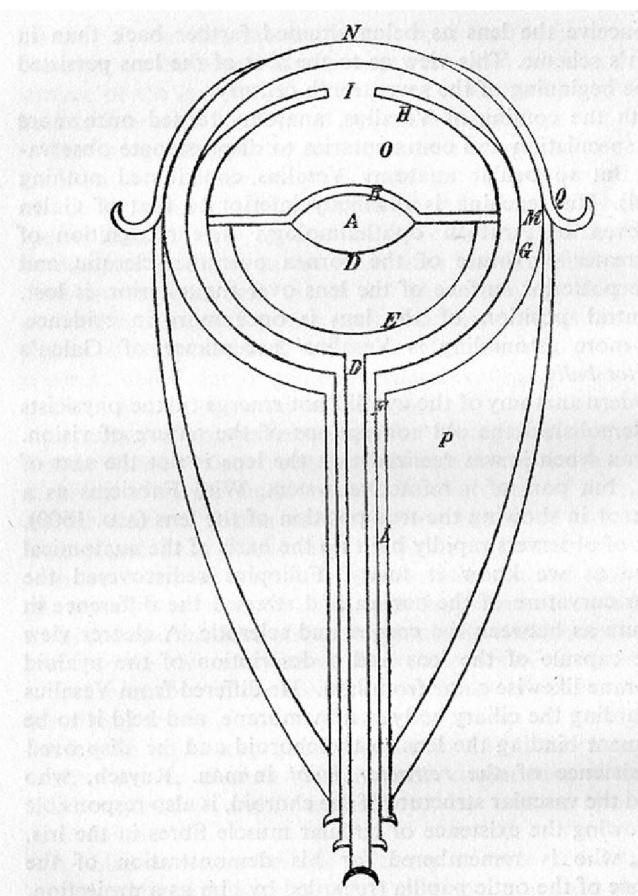
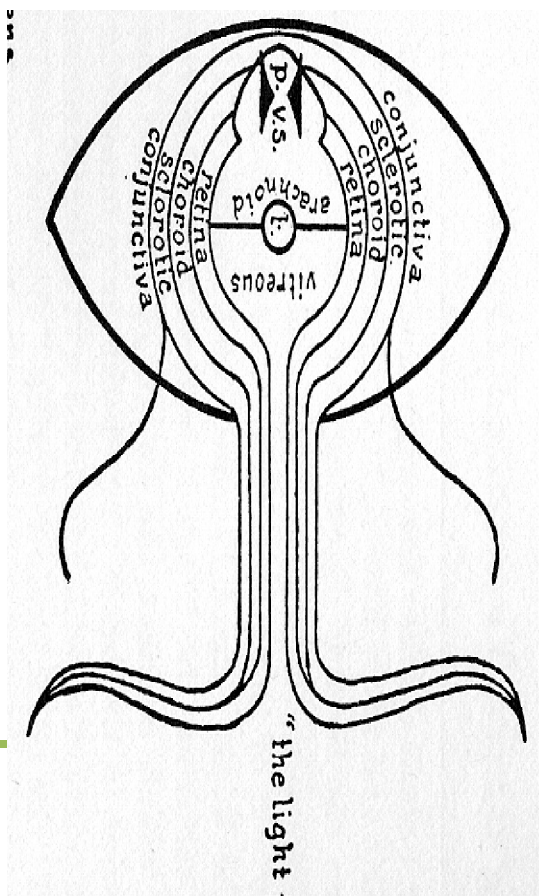
New Insights

Anatomy

The Islamic scholars based their anatomic knowledge upon Galen's works and as a result made similar errors: the posterior chamber was too deep, the optic nerve had a canal and there was an extra extrinsic muscle.¹³ Nonetheless, two important contributions to modern ophthalmology were made. First, Arabic medical literature contained the first illustrations of eye anatomy, with the earliest surviving drawing appearing in Hunayn's Ten Treatises on the Eye.¹⁴ The optic chiasm and brain were illustrated in Ali ibn Isa's Memorandum Book for Oculists.¹¹ This was passed on to the European Renaissance, including Vesalius, whose figures resemble the Arabic (Figure 1).¹⁴ Second, modern day terms for eye parts are derived from Arabic terms and not from Greek.

For instance, the medieval Latin translation of

Figure 1. Hunayn's figure of the eye, left, is the first known anatomical illustration, originally illustrated ca. 850 and shown here in translated form by Meyerhof (Wood, 1936). Vesalius (1514-1565) was greatly influenced by Arabic anatomy of the eye in his figure, right (Sorsby, 1933).



the Arabic word, *qarniyah*, became a part of the standard Leipzig anatomical nomenclature as *cornea*. In contrast, Galen used the Greek word, *kerotoeides*, which is not used today to describe the cornea.¹³

Optics

Ibn al-Haytham, known as Alhazen, rejected Hellenistic theories of vision postulating that vision resulted from rays emitted from the eye (Euclid), or transmission of a form from the object to the eye (Aristotle). Alhazen's remarkable insight was that an image of the object is formed due to the emission or reflection of light from the object to the eye.⁴ He worked out his theory sufficiently to create the foundation for use of lenses to correct vision. However, this possibility was recognized only after the transmission of his discovery to Europe, where two centuries later Roger Bacon suggests the use of lenses for vision correction.¹⁴

Cataract

The first authentic document on the treatment of cataracts was by the Roman, Celsus, who described entering a sharp needle into the eye to downwardly displace the lens from the pupil, breaking it up into many fragments if needed.¹⁴ This technique, known as couching, was commonly employed in the Arabic lands, with the major complications being infection and glaucoma. Although the success rate was only 4 in 10, it found wide acceptance because the alternative was blindness.³ Ammar, born in the late tenth century, invented the suction method for cataract extraction, by which a glass tube is introduced through a corneal incision for evacuation of the lens by suction (Figure 2).¹⁵ Unlike other contributions from the Arabic lands, the suction technique was only popular in the eastern part of the empire, and thus failed to reach Christian Europe, where couching continued until the technique was separately described by Daviel in 1748.¹⁴

External Diseases of the Eye

Chalazions were described as collections of a gross humor that gathers in the lid. If conservative topical treatments failed, it was incised with a round-headed lancet, scraped out

with the spoon at the end of the sound, closed with a suture, and irrigated.¹¹ Today's treatment is similarly incision and curettage.¹⁶ Styes were described as an abscess at the root of an eyelash. Treatment was rubbing with very hot bread.¹¹ Modern treatment is likewise hot compress.¹⁶ Original surgical techniques dealt with treating the sequelae of trachoma, a leading cause of blindness. Trichiasis was treated through extraction of the inverted hairs and cauterization of the roots using a needle that was heated red-hot. Trachomatous pannus was recognized as the superficial vascularization of the conjunctiva and treated surgically by raising the pannus with a number of very small hooks and excising the raised film with very thin scissors or cataract needle (Figure 3). Pterygium was described as the encroachment of the conjunctiva on the cornea and was removed using a similar technique as the removal of pannus.¹¹

The Reflected Light

The Renaissance in Europe was the result of the normal development of science coming from the Islamic Orient, passing through the multilingual communities of Southern Italy and Spain, and finally reaching Western and Central Europe.⁹ Constantinus Africanus, an Italian monk born in Carthage in 1018, translated numerous books into Latin. The translations into Latin occurred at the same time as the Crusades. The crusades both aggravated relations between Christendom and Islam and provided opportunities for Europeans to learn different Arabic technologies and practices.⁷

Systematic medical texts, such as Rhazes' Kitab al-Mansuri and Ali ibn Isa's Memorandum Book for Oculists, carried both classical and Arabic knowledge of ophthalmology and medicine to Christian Europe. Used by European physicians for centuries, these works had permanent influences on the formation of Western ophthalmologic theories, practices and terminology. Rhazes' writings were part of the curriculum in Western medical schools until the nineteenth century.¹ An analysis of *De Oculis*, a Latin textbook about eye diseases written by Peter Hispanus (Pope John XXI) in the thirteenth century, concluded that the text depended on

treatises from Hunayn, Rhazes, Galen and Plato alike.¹⁷

Although Arabic medicine and ophthalmology were founded on the work of other cultures, and although several of its brightest minds were not Muslim but Nestorian Christian, the golden age of Islam was responsible for numerous advances in ophthalmology that remain with us today. The common language of Arabic within Islamic lands allowed discussion of ideas and development of manuscripts by an international community of scholars. Medical knowledge was improved by the systemization of information and testing theory with clinical observation. Curiosity and knowledge, as well as acceptance of other cultures, allowed early Islam to rapidly develop scholarly knowledge in all fields, including ophthalmology.

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