

ALĠĀFIQĪ

AN ANDALUSIAN OCULIST (12th Century)

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ABSTRACT:

This study of Alġāfiqī, an Andalusian Oculist, consists of three parts. Firstly, the character and his environment: historical and geographical background of Alġāfiqī. Secondly, the work: the content of “Almuršid fī Alkuḥl” (The Guide to Oculistic Practice); and thirdly, the extrinsic muscles of the eyeball: a comparative study of Alġāfiqī’s text and those of other authors in the period between 10th and 12th century AD.

Keywords: Ophthalmology. History. Andalusian ophthalmology. Alġāfiqī. 12th century.

THE CHARACTER AND HIS ENVIRONMENT

The term Algāfiqī is a demonym; an adjective which, as all adjectives, refers to a noun, even when the noun is omitted. In this case, Algāfiqī refers to the native geographic location of our character: Gāfiq, a city in the south of Aláandalus, located north of Cordoba (1A).

A demonym is usually placed following the name and is intended to distinguish a person from others who might have either identical or very similar names. This becomes even more relevant when a person's name is simplified and shortened to one or two ancestors, even though quoting four ancestors is most appropriate culturally (2).

Demonyms may also denote tribal or family affiliation. Indeed, Ġāfiq is also a clan of the ʿAkk tribe, originally from the southwest of the Arabian Peninsula (3,4), which today corresponds to Yemen's territory (Figure 1) (5). Adjectives added at the end of a name may also refer to a trade; e.g., Alkahhāl, which translates to oculist.

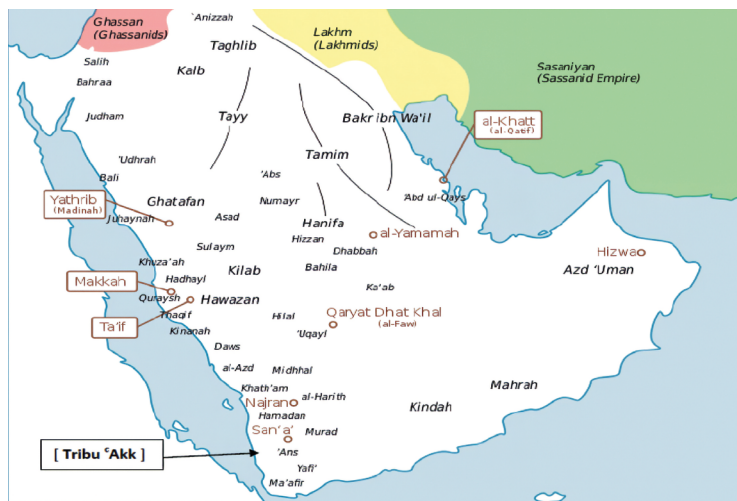


Figure 1: Arabian Peninsula, 7th century. Location of tribes.
^cAkk tribe (5).

The demonym Alġāfiqī was common in Aláandalus. Indeed, 28 out of the 1,651 juriconsults and traditional scholars' have the demonym Alġāfiqī in their name according to the book "History of the Wise of Aláandalus" by the Andalusian historian, biographer and jurist Ibn Alfarādī (Cordoba, 962-1013; 51 years-old) (6). Out of these 28 authors, 17 lived in Cordoba (7).

Below are three outstanding characters who carried the demonym Alġāfiqī.

Alġāfiqī, governor

°Abd Alrahmān Alġāfiqī (Yemen, ġ?-Poitiers, France, 732)

He was known as °Abd Alrahmān ibn °Abd Allāh □ Alġāfiqī Al°akkī; and both himself and his demonym belong to the Yemeni tribe °Akk-Ġāfiq (8). As an active member of the military expeditions of his tribe, he headed from the Arabian Peninsula to Egypt, Tunisia, followed by Morocco and later Aláandalus. He held the position as the sixth and also the fourteenth governor of Aláandalus, acting as governor in 721 for a short period of time, and later again between 730 and 732 (9). His journey from Yemen to the Iberian Peninsula was the same followed by other clans and tribes.

Alġāfiqī, botanic

'Aḥmad Alġāfiqī (Ġāfiq, Córdoba, ġ?-ġ?-1165)



Figure 2: Aḥmad Alġāfiqī "Al'adwiyah Almufrah." Alphabetical order. (11).

His full name is 'Aḥmad ibn Muḥammad ibn 'Aḥmad ibn Alsayyid Alġāfiqī and was known as 'Abū Ġāfar. An exemplary, virtuous, and wise Andalusian scholar, this individual authored the "Al'adwiyah Almufrah", which translates to "The Simple Drugs" (Figure 2) (10).

This incomparable book is an encyclopedic reference treatise arranged alphabetically, with meticulous descriptions and clarifications as well as references to the regions where both simple known remedies and new drugs could be found (11).

The book, with 1,772 names of simple medicines, contains 1,153 lexicons from 11 languages (12). 'Aḥmad Alġāfiqī is considered the greatest botanist of Aláandalus according to Meyerhof, who co-published the abbreviated version of the book "Al'adwiyah Almufrah" in English with Šubḥī (13). Aḥmad Alġāfiqī has also been credited for au-

thoring the "Book of Fevers and Tumors" and the "Book of Rejection of All Damages Affecting the Body." The manuscripts of these two books are today in the Bodleian Library in Oxford University (14) and none of them appear to have been edited or translated.

Alġāfiqī, oculist

Muḥammad Alġāfiqī (Ġāfiq, Córdoba, ¿?–Córdoba, s. XII).

His full name was Muḥammad ibn Qassūm ibn 'Aslum Alġāfiqī. The correct transliteration would be 'Aslum, not 'Aslam, as Ibn Ḥazm (15) clarifies in his description of the Ġāfiq's clan genealogy, which belongs to the 'Akk clan. Indeed, when Ibn Ḥazm explains that this clan lives in Aláandalus, in a town that carries the clan's name – Ġāfiq – located in a valley north of Cordoba, he writes “amongst them: *Banū 'Aslum (vocalizing the letter L with the grapheme u)*” (16). The same clarification in brackets appear in Lévi-Provençal's edition (17). According to the genealogic data available through Ibn Ḥazm, the ancestor 'Aslum seems to have a greater degree of kinship with the Ġāfiq clan.

Muḥammad Alġāfiqī worked as a doctor, with special dedication to the art of the oculistic practice, both in Cordoba and Malaga. The date of his birth and death remains unknown. However, a date present in his work helps providing more clarity regarding the time period he lived in. On El Escorial Manuscript n.835 “Almuršid fī Alkuḥl” (The Guide to Oculistic Practice), reverse folio 50, Alġāfiqī mentions a date when he witnessed a case of intoxication by venomous mushrooms: “*I witnessed in Ṣāliḥa, nearby Malaga, people who had prepared and eaten a mushroom-based soup. All died and were buried on two consecutive days. This happened on the year 595*” (18A) of the Hijri calendar. This date would correspond to the end of the year 1198 AD.

A degree of uncertainty exists in the literature of medical biography about these last two characters, mostly due to the lack of references to the life of Alġāfiqī the oculist and Alġāfiqī the botanist. Indeed, some consider Alġāfiqī the oculist to be the father of Alġāfiqī the botanist (19,20), while other authors confuse Alġāfiqī the oculist with Alġāfiqī the botanist. Separately, it is also surprising that Ibn 'Abi 'Uṣaybi'ah (Damascus, 1203-Salkhad, southern Syria, 1270; 67 years), a historian and medical biographer who was himself a physician with special dedication to the Oculistic practice, only commented on and quoted Alġāfiqī the botanic (11), but not Alġāfiqī the oculist, even though both Alġāfiqī's were contemporaries. There is indeed very little biographical data available on both individuals. It is known that both lived in the 12th century, and both were originally from the Andalusian city of Ġāfiq.

The city of Ġāfiq is today known as Belalcázar (21), located 104 km north of Cordoba (Figure 3). Ġāfiq was the capital of the “Faḥaṣ Alballūṭ” region (Llano de las Bellotas in Spanish) during the Andalusian period. Nowadays, this plain corresponds to the “Valle de Los Pedroches”, known as “Silense” during the Roman period (1B). This valley was, and remains, a large, wealthy county in a strategic location at the center of the southern third of the Iberian Peninsula. Thanks to its location, it became a communication hub between the center and the south of the peninsula through the roads connecting Toledo and Cordoba, Sevilla and the south and southwest of Aláandalus.

Ġāfiq was one of the most prosperous cities of Aláandalus, due to its geographical location, as mentioned above. Indeed, the city was the natural entry from the north to the “Llano de las Bellotas” and also benefited from its location on the axis of important communication routes between the 9th and 12th century. The city's location also meant it played a significant role in the defense of the Cordovan capital itself.

Al'isṭahrī, a geographer from the mid-10th century, in his work “Masālik Almamālik” (Paths of the Kingdoms), describes Ġāfiq as a capital city of “Faḥaṣ Alballūṭ” (22). In-



Figure 3: Valle de los Pedroches (Llano de las Bellotas). Belalcázar (Ġāfiq).

deed, Al'isṭahṛī lists 16 cities as amongst the “most famous cities of Aláandalus” [...](23), with Ġāfiq in the 11th position. For the very same reason, the city of Ġāfiq is captured on the maps of Al'isṭahṛī which are schematic and of geometric layout (Figure 4-left (24), 4-right (25)).

Al'idrīsī (Ceuta, 1100 – Sicily?, 1166; 66 years-old), a renowned geographer who sought to achieve a more faithful representation of reality (26), resorted to sectional maps that can be collated together (27). In them, he locates Ġāfiq in a valley formed between two mountain ranges (Figura 5) (28). In his work, “Nuzhat...”, Al'idrīsī describes Ġāfiq using the following words “*In the Region de las Bellotas there are many castles, with Pe-*

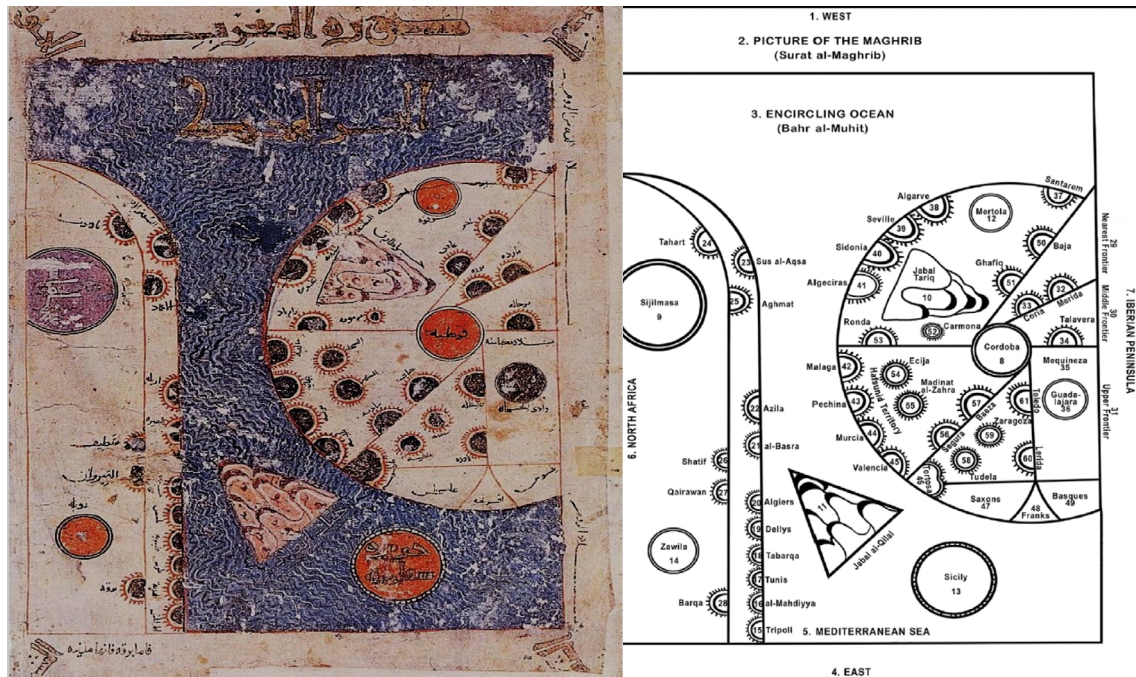


Figure 4: Left. Al'isṭahṛī. Iberian Peninsula and North Africa. 10th century. Aláandalus. Ġāfiq (27). Right. Ġāfiq (no. 51). Translation of the place names on the map by Al'isṭahṛī (28)

droche and Ġāfiq being the biggest amongst them”(29A). “The castle of Ġāfiq is strong and impregnable, a prominent fortress. Its people are brave, vigorous, hardened, daring and determined” (29B). It is known that the people of Ġāfiq were feared and avoided by their adversaries. Unsurprisingly, one of the meanings of the word Ġāfiq relates to being energetic, impetuous and passionate.



Figure 5: Al’idrisī. Iberian Peninsula, 12th century; Alándalus, Ġāfiq (30).

THE WORK

The manuscript “*Almuršid fī Alkuḥl*” (*The Guide of Oculistic Practice*) became known late, in the 19th century. It is probably due to this reason that we do not find the Latin equivalent of the name Alġāfiqī the Oculist.

Only two copies of the original manuscript “*Almuršid fī Alkuḥl*” are known to have survived. One copy is in El Escorial Library in Spain (Ms. 835) and an exact copy of it can be found in Cairo’s Dār Alkutub. In the first page of the manuscript copy from El Escorial, notes have been added. One note in Spanish, states that the copy was written in Malaga on the 791 of the Hijri periods [1389 AD]. Directly after that note there is another note, in Arabic, with a similar content though the date varies—written with letters as follows: 991 [H=1582 A.D]. The calligraphy of this note is different from the calligraphy of the manuscript (18B).

Lucien Leclerc (1816-1893) found the manuscript in El Escorial and made it known through a brief description.

Julius Hirschberg (1843-1925) noted that the manuscript bears the number 835 and he had the beginning and end of the manuscript translated with the help of his Orientalist

collaborators Julius Lippert (1866-1911) and Eugen Mittwoch (1876-1942). The effort and research work of these three authors, over five years, culminated in the publication, in 1905, of a reference text on the ophthalmology of the Muslim world.

Max Meyerhof (1874-1945) produced a French version of Treatise VI: Diseases of the Eye and its Treatment of “*Almuršid fī Alkuḥl*”. *Le Guide D’oculistique* was published by the Laboratory of Northern Spain (Cusí) on the occasion of the XIV International Congress of Ophthalmology. Madrid, 1933.

Hasan cAlī Hasan (1945-) undertook a study and a translation, into Spanish, of the totality of Ms. 835 “*Almuršid fī Alkuḥl*” for his PhD (1977).

The Guide of Oculistic Practice is not only a historical document, it is also a real and objective testament of the state of ophthalmological knowledge, between the end of the 12th century and the beginning of the 13th century. Evidence of the importance of Alġāfiqī’s work to have a more accurate understanding of the state of ophthalmological knowledge is that Ibn Zuhr, *Avenzoar* (Seville, 1091-1161), the Andalusian clinician par excellence, in his work *Altaysīr* (“*Theizir*”), book I, Treatise 8^o, describes 31 eye diseases; while Alġāfiqī describes 76 diseases in his “*Almuršid fī Alkuḥl*”.

“*Almuršid fī Alkuḥl*” is effectively a monographic text on the eye and the eye diseases in the adult human body. Moreover, it contains several specific chapters for the pediatric age; an early reference for future texts on pediatric ophthalmology. It is paramount to bear in mind that at that particular historical period almost all the texts tended to be encyclopedic rather than monographic and with little dedication to childhood eye diseases.

“*Almuršid fī Alkuḥl*” is a work enriched from Alġāfiqī’s personal experience. The author himself acknowledges at the beginning of the book (18C) the access he had enjoyed to the texts from Ḥunayn (810-874); Alzahrāwī (936 -1013); Ibn Sīnā (981-1037); ‘Ammār Alkawṣilī (s. X) and ‘Alī ibn ‘Īsa (s. XI).

Alġāfiqī seeks to offer a text that gathers all the necessary knowledge needed to practice as an oculist, from theoretical and practical perspectives, medical and surgical. To fulfill this goal Alġāfiqī includes in his book other fields of medical, therapeutic and surgical knowledge and wisdom – in addition to the ophthalmological knowledge itself – that can be related to the eye, as in Alġāfiqī’s view, these are also necessary for the oculist. Indeed, in his book he states “*so you know, son, that in the Art of Medicine, and I mean Oculistic practice, I have not found a book that gathers everything that is required to understand and practice the art of the oculist [...]. As for my book, it gathers everything necessary*” (18C). These words crystalize and clarify the goal of this book.

Alġāfiqī makes a sharp and critical appraisal of previous works for the oculistic practice such as the works of Ḥunayn, Ibn Sīnā, ‘Ammār Alkawṣilī and ‘Alī ibn ‘Īsa, which he considers insufficient to adequately practice as an oculist, though he acknowledges overlap with Alzahrāwī (18C) in some instances. Bearing in mind Al’idrīsī’s definition of the people of Ġāfiq, amongst whom our author lived and grew up, it may be that the enthusiasm ġāfiqī inhabitants demonstrated in defending their territory paralleled the enthusiasm shown by Alġāfiqī in defending his ideas.

Alġāfiqī shares personal observations and commentary as well, for example:

Alġāfiqī’s solution to close nonpurulent skin wounds is to bring the lips of the incision or the wound together. He recommends the suture needles to be of medium thickness,



neither fine nor thick, with a triangular needle tip, because triangular needle tips are conducive for the scarring process. Whereas for purulent wounds, Alġāfiqī lets them heal by second intention.

Alġāfiqī also advises to insert the tip of the needle at a distance of the lip of the wound that is equivalent to the width of the little finger, to avoid tearing the suture.

With regards to cautery, Alġāfiqī says *“My son, know that cauterization with iron has a limited effect, while the effect of cauterization with caustic remedies can go beyond the intended limits and affect other parts of the organ”*.

Alġāfiqī affirms cauterization can be performed at any time of the year, following the criteria of 'Abū Alqāsim Alzahrāwī. Indeed, Alġāfiqī does not share the view of others who think that spring is the best time to cauterize. In Alġāfiqī's opinion, delaying an indicated cauterization can lead to damage that could have been avoided. Alġāfiqī recognizes that it may be necessary to resort to cauterizing again if the disease recurs over time.

Alġāfiqī recommends cauterizing with caution and restraint, identifying and marking the nearby blood vessels with paint to avoid injuring them; he also recommends avoiding excessive cauterizations. Alġāfiqī relates to an occasion where he had warned a doctor not to cauterize anymore because he had already cauterized enough but the doctor continued to cauterize and caused irreparable damage to the patient (18D).

Alġāfiqī also recommends caution and restraint for surgeries. When talking about the removal of a fatty cyst from the eyelid, he warns: *Try, if possible, to position the cyst in the area of the greatest angle; avoid piercing the eyelid; proceed gently and with good manners and use the scissors to rid the cyst of its adhesions*. Alġāfiqī says he saw the removal of a fatty cyst by some who acted roughly and caused a distended eyelid that required another surgery to repair the damage (18E). Alġāfiqī warns that hypertrophic scarring can produce eyelid retraction or distention (18F).

Treatise I

Precepts of Hippocrates. The excellence of the profession. The Elements of Nature. The natural temperament of the eye.

Treatise II

Overview of the components of the eye. The nerves of the eye. Non-pulsatile vessels. The pulsating vessels. The muscles of the eye. The eye, structure and function. The sense of vision. The pneumas; The psychic cerebral pneuma. Natural powers and states of the eye.

Treatise III

The air and the weather. Activity and immobility. Food and beverages (Cereals. Legumes. Vegetables. Plant roots and tubers. Fruits of plants, shrubs and trees. Cattle meat, its distal parts and viscera. Poultry meat. Cooking meat. Fish. Eggs and Dairy products. Honey and Sugar. Water. Spirits drinks). Sleep and wakefulness. Excretions, retention and congestion (sweating and bathing, intercourse, defecation, menstruation and panting when walking). Mood states.

Treatise IV

Sum of the disease, the cause and the symptom. Classes of diseases of the eye. Diseases of the parts of similar components. Structural and shape diseases. Diseases of dis-

unity and disruption. Sum of the causes of diseases. Causes of the diseases of the parts of similar components. Causes of morphological diseases. Causes of disunity and disruption diseases. Sum of the symptoms. Classes of symptoms. Symptoms due to alteration of the sense of vision. The pleasure of feeling healthy and the ailment of illness. Symptoms due to alteration of voluntary motility. About spasm and trembling. Symptoms of natural processes and their alteration. Symptoms and causes of the first digestion: formation of chyme in the stomach. The four powers required for digestion. Second digestion: formation of blood in the liver. Third digestion: be part of the organs. Indicators and signs of health and disease in the eye.

Treatise V

Classes of medicaments. Preparation, indications of medications and how to apply them on the eye. Simple medications described in alphabetical order. Purging, purifying medications and rules for their correct use. Degrees of tolerance to medicines and foods. Compound medications. Preserving the health of the eye; remedies. Colors beneficial for the vision. Colors harmful to vision.

Treatise VI

Headaches, causes and treatments. The migraine and its treatments. About bandages (Bandages for headaches, migraines, eye pain and cranial contusion. Bandages for diseases of the eye. Bandages for dark circles under the eye). Ointments to prevent the growth of plucked eyelashes. About tumefaction (Phlegmatic swelling. Furuncle, furunculosis or anthrax. Erysipelas, erythema. Pustule and eczema. Necrosis and gangrene. Post-phlebotomy hematoma. Malignant ulcers. Cold edema. Emphysema. Hard excrescences. Cancer. Bubo. Antrum, cavern of drained bubo. Fistula. Cyst and Wart). Sum about the wounds (Head wounds as a prototype. Phlebotomy. Bandages. Sutures. Needles: shape, size and mode of use. Cicatrization). About cauterization (cauterization of headache; non-chronic migraine; chronic migraine; chronic lacrimation; incipient cataract; post arterial section at the temple).

Eye diseases in children: Emphysema and Edema. Papillae, giant papillae. Ankyloblepharon. Strabismus and uneven eyes with different levels. Trachoma. Ulcerative blepharitis. Leucoma.

Eye diseases and its treatment:

- Diseases of the eyelid (32): Trachoma. Chalazion. Lithiasis. Ankyloblepharon and Symblepharon. Lagophthalmos and Ectropion. Sty. Supernumerary eyelashes and Distichiasis. Trichiasis. Ciliary madarosis. Eyelashes poliosis. Eyebrow madarosis. Lice, crabs-Louse and Larvae. Papillae, giant papillae. Ulcerative blepharitis. Pruritus. Tumefaction. Induration. Thickening and Tylosis. Erysipelas and erythema. Furuncle. Xanthoma. Papilloma. Emphysema. Rash and hives. Eczematous blepharitis. Ringworm and excoriation. Warts. Edema. Pustules. Erosions and ulcers. Cysts. Ptosis. Ecchymosis. Tremor, tics and spasm. Immobility.
- Diseases of the internal angle: Lacrimal abscess [Dacryocystitis]. Lacrimal tumefaction (Excessive enlargement of the caruncle). Epiphora (Corrosion and reduction of the caruncle with insufficient tear drainage).



- Diseases of the conjunctiva (33); Conjunctivitis and Ophthalmia. Hematoma of the caruncle and Hyposphagma (subconjunctival hemorrhage). Strange bodies. Pterygium. Edema. Induration. Pruritus. Pannus. Follicles. Lacrimation and wet eye. Putrid ulcer. Papilloma. Granuloma. Tearing up.
- Corneal diseases: Ulcers. Pustules. Scar or cloud and Leucoma. Staining scars and bluish or grayish spots on the eye. Erosion. Putrid ulcer. Cancer. Fossulas. Color change. Imbibition. Desiccation. Hypopyon. Prolapse and how to distinguish it from the pustule (Perforation).
- Iris diseases: Dilated pupil. Narrow pupil. Prolapse (Perforation). Differences between the prolapse of the iris and the corneal pustule.
- Cataract (Location and definition. Cause. Signs and symptoms. Types. Indications for medical and surgical treatment. Medical treatment. Surgery. Postoperative recommendations. Reoperate. Cataract capsule. Instruments. Differences between cataract shadows or floaters, and floaters due to stomach pain, headache and those of albuminoid humor).
- Albuminoid humor diseases: Color change. Total desiccation. Partial desiccation. Decrease. Increase. Diluted. Thick.
- Diseases of the glacial humor (crystalline lens): Deviation to the right, left, up and down. Color change: blackish, whitish, reddish, yellowish. Elevation. Protrusion. Decrease. Increase. Desiccation. Softening. Condensation. Break.
- Arachnoid diseases: Tearing up. Disunity from hot corrupted temperament.
- Visual pneuma diseases: Hyperopia. Myopia. Hemeralopia. Nyctalopia.
- Vitreous humor diseases: Color change: reddish, yellowish, blackish, whitish. Softening. Desiccation. Increase. Decrease. Dense. Thick. Corrosion and loss of consistency.
- Retinal diseases: Simple. Composite. Loss of continuity with dispersion of the luminous pneuma and blindness.
- Optic nerve diseases (34); Widening. Narrowing. Obstruction. Compression. Tumefaction. Section. Tearing up. Fissure. Burn. Dispersion of the luminous pneuma and Amaurosis. Alteration of cerebral ventricles.
- Diseases of the three muscles assigned to tense the base of the optic nerve: Spasm. Relaxation with widening of the optic nerve and exophthalmos.
- Exophthalmos. Enophthalmos (Causes and medical treatment).
- Choroidal diseases: Induration. Softening. Thickening, Plethora. Tumefaction. Compression. Repercussion on the glacial humor (crystalline lens) and the optic nerve [Retina].
- Diseases of the oculomotor muscles: Vertical strabismus. Horizontal strabismus. Eye pain. [Non-surgical] treatment of strabismus.
- Weak vision: Obstruction of the optic nerve. Narrow pupil, dilated pupil. Wrinkled cornea. Brain involvement. Persistent crying. Convalescence.
- Reminder about eye indications and preparation of eye drops, powders, pomades, creams, vapors, electuaries, tablets, gargles, suppositories, jams, theriaca, ointments, sternutatories. Powders to stop bleeding and repair the wound. Cicatrizing liniments and solvents from remains in poor condition. Phlebotomy, scarification and suction cups.

THE EXTRINSIC MUSCLES OF THE EYE BALL: A COMPARATIVE STUDY

This section presents the writings on the extrinsic muscles of the eyeball in “Altaṣrīf...” by Alzahrāwī; “The Canon” of Ibn Sīnā, and “Almuršid...” of Alġāfiqī are presented in chronological order. It is followed by a comparative analysis.

As a way of **introduction**, it is note-worthy the different approaches of the three authors to the anatomy of the eyeball. Indeed, Alzahrāwī (Medina Azahara, 936–Cordoba, 1013; 77 years-old) dedicates independent chapters to study the optic nerve with the rest of cranial nerves (35A). He dedicates another chapter to the body’s motor muscles, where he encompasses both the eyeball and the eyelid muscles in a single paragraph (35B). Alzahrāwī’s explanation begins with a reference to the lens (glacial humor), as an essential element for vision, and then provides details about all the components of the eyeball in the following order: sclera, choroid, retina, vitreous humor, glacial humor, arachnoid, albuminoid humor, uvea-iris, cornea and “conjunctiva”. In that sense, he describes them in a back-to-front order.

He alludes as well to the controversy over the number of ocular layers. He says that for some there are 7, 5, 4, 3 and even 2, but concludes that these differences are rather on the form than the content (35C).

Meanwhile, when Ibn Sīnā (Afshona, Uzbekistan 980- Hamadan, Iran 1037; 57 years-old) explains the anatomy of the eye, he describes the common elements, such as nerves and muscles, in different sections; and in separate sections describes the components of the eyeball (36). Accordingly, the study of the optic nerve is found in the framework of the cranial nerves (37A) while the study of the ocular muscles is in the part dedicated to studying the muscle mass of the body. Ibn Sīnā dedicates a chapter to studying the muscles of the eyeball and another to the muscles of the eyelid (37B).

When he begins to describe the layers and the humors of the eyeball, Ibn Sīnā takes the lens (glacial humor) as the reference point. This is consistent with his philosophical thinking and underlines its influence on his medical writing. The lens is indeed the key element in the sense of vision for Ibn Sīnā. After describing the lens, he moves on to detailing the other components of the eyeball in the following (centrifugal) order: vitreous humor, albuminoid humor, retina and arachnoid, choroid and uvea-iris, sclera and cornea and “conjunctiva” (37C).

Ibn Rušd (Cordoba, 1126–Marrakech, 1198; 72 years-old) also studies the optic nerve in a separate chapter together with the rest of the cranial nerves in his book “Alkullīyyāt...” [Generalities...]. He follows the same exact approach and steps as Alzahrāwī with regards to the ocular anatomy, highlighting the functions performed by the various ocular components (38).

It is worth bearing in mind that neither Greek authors nor these authors distinguish between anatomy and physiology, and as such, the morphological descriptions are simultaneously an analysis of the physiology and the mission performed by the different parts of each organ.

Alġāfiqī, similar to the aforementioned authors, also studies the optic nerve (18G) and the eye’s musculature (18H) in two independent chapters. Alġāfiqī describes the components of the eyeball in the following order: glacial humor, vitreous humor, albuminoid humor, retina, choroid, sclera, cornea, uvea-iris, “conjunctiva” and arachnoid. This author clarifies the reasons for the different understandings of the number of ocular layers, up to 11 for some, and he concludes that the wise have agreed on 7 layers and 3 humors (18I).

This shows that the above-mentioned authors coincide, in one way or another, on both the number of layers and humors of the eyeball, as well as their location within it.

On the **extrinsic muscles** of the eye, Alzahrāwī (35B) argues that there are 24 muscles in both eyes, 12 muscles per eye. The muscles of the eyeball are located as follows: 3 muscles at the base of the nerve where the visual pneuma runs. One muscle in the minor canthus, another in the major canthus. One muscle at the top and one at the bottom. 2 muscles that are positioned obliquely and move the eye in a circle. The upper eyelid has 3 muscles. [.....]

In Ibn Sīnā's opinion there are 6 muscles that move the eyeball. 4 muscles are located in the 4 cardinal points of the eyeball: one muscle above and one below, and one muscle in the nasal canthus and another in the temporal canthus. The purpose of these muscles is to move the eye to the same side where the muscle is located. In addition, there are 2 other muscles that move the eye in an oblique direction and jointly move it in a circle.

Ibn Sīnā then describes another muscle at the back of the eyeball. He says "*behind the globe there is a muscle that is intimately adhered to the hollowed nerve and gives it greater anchorage and firmness when fixing the gaze and prevents its protrusion. The insertion tendons of this muscle are various and branched, which produced confusion among some anatomists who considered it either as a single muscle, two, or even as three muscles; be it as it may, this muscle has only one prominence*" (37D) (muscle belly).

Alġāfiqī begins and ends his chapter on the muscles of the eye by enumerating the elements that make up the muscle (18H), following Galen's approach: red muscle, ligament, nerve and an enveloping layer. There are 24 muscles in both eyes. There are 6 muscles at the root of the 2 nerves where the visual pneuma runs. The utility of these 6 muscles is to tighten the root of each of the nerves, preventing their dilation and thus the dispersion of the visual pneuma too.

The remaining muscles are distributed equally between both eyes, 9 muscles per eye: "*one muscle in the greater canthus above and another below. Another muscle in the minor canthus above and another below. 3 muscles spread across the upper eyelid and 2 oblique muscles that turn the eye to the right and left, up and down*" (18J).

That said, when Alġāfiqī describes the two diseases of the muscles that move the eye, distention and spasm, he speaks in singular and says "*the muscle above*", "*the muscle below*" "*the muscle in the greater canthus*" "*the muscle in the external angle*" (18K).

The synchrony in the movement of the two eyes, according to Alġāfiqī, is due to the good interweaving of the nerves within the muscles (18J). As for the ligaments, they are responsible for maintaining the natural position of the eye in its place despite the movements it performs (18L).

Comparative analysis

Alzahrāwī, in a paragraph, addresses briefly all the musculature of the eye, both the eyeball and the eyelid. Ibn Sīnā's systematization is manifested by dedicating, for greater clarity, two independent chapters, one for the eyeball muscles and another for the palpebral muscles. Alġāfiqī dedicates a chapter to the study of all the muscles of both eyes. Ibn Sīnā enumerates the elements forming the muscle, when he mentions the muscle mass of the body, while Alġāfiqī enumerates them at the beginning of a chapter on the muscles of the eye.

All of them believe there to be six oculomotor muscles: 4 straight and 2 obliques. Ibn Sīnā adds that when a rectus muscle contracts, the eye is directed towards the side of the contracted muscle. The authors do not differ in terms of the anatomical location of the 4 rectus muscles, although Alġāfiqī presents a different distribution for the rectus muscles.

Thus, Alzahrāwī and Ibn Sīnā place a single rectus muscle in each of the four cardinal points of the eyeball. On the other hand, it seems that Alġāfiqī considers that there are 2 rectus muscles in the area of the greater canthus, one above and one below the cardinal point, in addition to 2 other muscles in the external angle located in the same manner. Nevertheless, when Alġāfiqī refers to the spasm and distention of the muscles that move the eyeball, he speaks in the singular, mentioning “*the muscle above*”, “*the muscle below*”, “*the muscle in the greater canthus*”, “*the muscle in the external angle*”, offering a rectus muscle distribution in accordance with the distribution provided by the other authors, and different from the one described in the chapter on the eye muscles.

Alġāfiqī considers that the spasm of the upper muscle or the distention of the muscle below deflects the eyeball upwards and vice versa. The muscle spasm in the greater canthus or the muscle distention in the lateral angle deviates the eye towards the greater canthus and vice-versa.

The authors maintain a degree of consensus regarding the oblique muscles, since they all consider 2 to be the number of muscles, and that they are placed obliquely. The action of the oblique muscles is to move the eye circularly and into oblique positions, as it is clearly seen in Alzahrāwī and Ibn Sīnā’s texts. For Alġāfiqī, the function of the obliques is to turn the eye towards the four cardinal points.

The muscles or the muscle surrounding the root of the cupped nerve (optic nerve) are/ is described by all the authors. Yet only Ibn Sīnā and Alġāfiqī provide a justification for its existence, although they disagree on its function. Ibn Sīnā adduces the following reasons: firstly, the maintenance of the natural position of the eye since this muscle supports the eyeball and prevents its protrusion outwards. In addition, it provides firmness to the eyeball to fix the gaze and increases the stability of the nerve. Meanwhile, Alġāfiqī deems that the usefulness of these muscles consists in preventing the distention of the optic nerve cavity, since the distention of this nerve leads to the dispersion of the visual pneuma, which results in the weakening of vision and even its loss. According to Alġāfiqī, the ligaments that fix the eye are responsible for maintaining the natural position of the eye, preventing it from leaving its position when performing its movements. When Alġāfiqī speaks of exophthalmos, he attributes one of its causes to the relaxation of the 3 muscles that are located at the root of the optic nerve (18M).

Was it a single muscle or were there several? This question was a dilemma among anatomists, only addressed by Ibn Sīnā when he cites their theories: the unitary, the dualist, and the tertiary. Ibn Sīnā shows a rather undogmatic attitude by not adopting any of these theories, despite claiming that this muscle mass has only one “*prominence*” (muscle belly). Perhaps for this reason he does not specify a total sum of the eye muscles. Meanwhile, both Alzahrāwī and Alġāfiqī position themselves strongly in favor of the tertiary theory. For these two authors there are 3 muscles that surround the root of the optic nerve. Accordingly, they come to a total of: 6 muscles for the globe, 3 for the nerve and another 3 for the upper eyelid, that is, 12 muscles for each eye. This is why Alzahrāwī states in his chapter on the number of eye muscles that they are 24. Alġāfiqī shares a similar opinion, and he used a language closer to the expressions used by both Alzahrāwī and Ibn Ruṣd.

Palpebral motility is an exclusive mission of the upper eyelid, and for this reason, it is endowed with 3 muscles, as expressed by all these authors. Ibn Sīnā explains so in detail and justifies it in the chapter dedicated to the eyelid muscles. Movement is not necessary for the lower eyelid. That is the reason it lacks muscles, according to Ibn Sīnā, and as Alġāfiqī states.

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NOTES

The transliteration used in this article is based on the ISO 233/1961 standard (1984 Revision), which preserves the original Arabic spelling of a name or word as faithfully as possible; the main characteristic of transliteration, for being literal, is its reversibility, meaning that the original word can be reconstructed in the Arabic alphabet from the transliterated word. This is the advantage over transcription, as it is phonetic, where there is merely an approximation. In quotations and bibliographical references, the spelling used in the edition is retained.

BIBLIOGRAPHY

1. Fernández González R. El Castillo de Belalcázar. Boletín de la Real Academia de Córdoba de Ciencias, Bellas Letras y Nobles Artes; 1969; 89: 17 (PDF 19/279) https://storage.e.jimdo.com/file/b41c40f1-7a6a-414f-b07a-7096d5bb59f5/BRAC_n89_1969-cita.pdf
2. Wüstenfeld F. Register zu den genealogischen Tabellen der Arabischen Stämme und Familien. Mit historischen und geographischen Bemerkungen. Göttingen: Dieterichschen Buchhandlung; 1853; p. X. Toronto: University of Toronto (PDF 18/504). <https://archive.org/details/genealogischenta00w-suoft/page/n17/mode/1up>
3. Alḥaġrī M. Mġmūc Buldān Alyaman wa Qabā'ilihā. [*Sum of Yemen's territories and its tribes*]. 2^a ed. Ṣancā', Yemen: Dār Alḥikmah Alyamāniyyah; 1996; Vol. II, 3: 608 (PDF 611/812) y 621 (PDF 624/812). <https://archive.org/details/boldanalymn>
4. Athamina K. Some Administrative, Military and Socio-Political Aspect of early Muslim Egypt. In: War and Society in the Eastern Mediterranean: 7th–15th Centuries. Edited by Yaacov Lēv. (The Medieval Mediterranean. vol.9). Leiden: Brill; 1997; p.108. https://books.google.es/books?id=6boJul-GkWBgC&pg=PA101&redir_esc=y%23v=onepage&q&f=false#v=onepage&q&f=false
5. https://en.wikipedia.org/wiki/Banu_%27Akk https://upload.wikimedia.org/wikipedia/commons/thumb/3/30/Map_of_Arabia_600_AD.svg/1255px-Map_of_Arabia_600_AD.svg.png
6. García Novo M. Ibn al-Farādī. Real Academia de la Historia 2018. <http://dbe.rah.es/biografias/4791/ibn-al-faradi>
7. Ibn Alfarādī. Tārīḥ 'Ulamā' Al'andalus [History of the Wise of Aláandalus]. 1^a ed. Beirut: Dar al-Kotob al-Ilmiyah; 1997; p.458- 494. <https://www.aljam3.com/47917/83874/494>
8. Hijjawi Qaddumi, G. Book of Gifts and Rarities. Cambridge: Center for Middle Eastern Studies. Harvard University Press; 1996; p.350. <https://shorturl.at/cgagK>
9. https://books.google.es/books?hl=es&id=sm1YjEPj_LoC&q=cAkk-%C4%A0%C4%81fiq#v=onepage&q=Abd%20Al%20ra%E1%B8%A5m%C4%81n%20&f=false
10. Lévi-Provençal, E. “‘Abd al-Raḥmān b. ‘Abd Allāh al-Ġhāfiqī”, in: Encyclopaedia of Islam, Second Edition, Edited by: P. Bearman, Th. Bianquis, C.E. Bosworth, E. van Donzel, W.P. Heinrichs. First published online: 2012. First printed edition: 1960-2007 http://dx.doi.org/10.1163/1573-3912_islam_SIM_0120
11. Dār Alkutub [Biblioteca Nacional y Archivos de Egipto]. Medicina, Taymūr, 389. <https://www.sciencesarabexpo.org/catalogue/soigner/saidala2.html>
12. Ibn 'Abī 'Uṣaybi'ah. 'Uyūn Al'anbā' fī Ṭabaqāt Al'aṭibbā' “*Top stories on categories of doctors*”. 1^a ed. Beirut: Dar Alkotob Alilmiyah; 1998; 459-460. <https://scholarlyeditions.brill.com/reader/urn:cts:a->



- 89 —

29. Valencia Rodríguez R. La cartografía y Andalucía en la Edad Media. En: Olmedo Granados F. et al. (coord.). *Andalucía. La imagen cartográfica hasta fines de siglo XIX*. Sevilla: Instituto Cartográfico de Andalucía; 2010: 100 (PDF10/15). <https://grupo.us.es/ixbilia/media/R-Valencia-2010-Cartografia-medieval-Andalucia.pdf>. <https://shorter.me/ofvye>
30. Piqueras J. Fansa G. La Península Ibérica en el gran Atlas de al-Idrisi. Segon Congrés Català de Geografia. 29 – 31 de maig de 2008. p.476 (PDF12/13) <https://publicacions.iec.cat/repository/pdf/00000070/00000087.pdf>
31. Al'idrīsī M. Nuzhat Almuštāq fī Iẖtirāq Al'āfāq. [Excursión para los apasionados por cruzar horizontes] Biblioteca Nacional de Francia. Ms. árabe 2221; ed. 1250-1325: 189r,202r (PDF 385,411/722). <https://gallica.bnf.fr/ark:/12148/btv1b52000446t/f385.item>
32. There is only one exact manuscript copy of Ms. 835 from El Escorial, held at Dār Alkutub in Cairo. These two manuscripts are copies of an original that has not been found. On the first page of the manuscript copy from El Escorial there are added notes, one in Spanish stating that it was written in Málaga and bearing a date written in numerals: 791 of the Hegira [1389 AD]; and immediately below this note there is another note, in Arabic, with similar content, in which only the date differs, being written in letters: 991H. [1582 AD]. Perhaps the discrepancy between the dates may be due to an error. *Cfr.* Hasan. *Almuršid...*, pp. 33-34 and 40
33. Hasan. *Almuršid...* óp. cit., p.45-46.
34. *idem.*
35. Meyerhof M. *Le Guide D'oculistique*. Barcelona: Masnou; 1933.
36. Esteban de Antonio M. *Historia de la oculística con especial dedicación a la estrabología*. Madrid: Mac Line; 2011; I: 333-340, 1071; II: 1121.
37. Alġāfiqī distinguishes between different eyelid diseases: A. Those of the eyelid: Trachoma. Chalazion. Lithiasis. Anquiloblepharon and Simblepharon, Lagophthalmus and Ectropion. Styte. Supernumerary eyelashes and Distichiasis. Trichiasis. Papillae, giant papillae. Ulcerative blepharitis. Xanthoma. B. Those common to the eyelid, scalp and eyebrows: ciliary madarosis. Canities eyelashes and Madarosis of eyebrows. Lice, Crabs-Louse and Larve. C. Those affecting the eyelid and conjunctiva: Itching. Induration. Thickening. Emphysema. Edema. Flaccidity. Ecchymosis. D. Those appearing on the eyelid and the rest of the body: Furuncle. Papilloma. Rash and hives. Ringworm, and others.... *Cfr.*ref. 30. Meyerhof. *Le Guide...* p.23; 19. Hasan. *Almuršid...* p.334.
38. It is worth bearing in mind that the conjunctiva, even later than in the medieval period, was identified with the white part of the eye, which corresponds to the visible part of the sclera. And the sclera was considered as the back end of the eyeball, not visible. As a result, there is no description of the appearance of the sclera or its diseases, because it was not accessible to eye inspection.
39. The optic nerve was conceived as a conduit that circulated inside the “luminous or visual pneuma” originating in the brain. This concept belongs to the Humoral Doctrine, present between the 3rd century BC until 17th AD.
40. Alzahrāwī. *Altaṣrīf...* Ms. 5007. Biblioteca Nacional. Madrid. fol.7v.
41. *idem.* fol.6r.
42. *idem.* fol.9v.
43. Diab Haggi F. *La oftalmología de Avicena y su influencia en la medicina de Alándalus*. Salamanca: Universidad de Salamanca.1986. Tesis doctoral. II:315-318, 374-377.
44. Ibn Sīnā. *Alqānūn...* [El Cánón...] Cairo: Edición Būlāq;1877; p. 54. Edición reputada como la mejor existente en lengua original.
45. *idem.*p.40-41.
46. *idem.* p.108-110.
47. Cruz Hernández M. Ibn Rušd (Averroes). Vida, obra, pensamiento, influencia. Córdoba;1986; p. 333-340.
48. Hasan. *Almuršid...* op. cit. p.76-77; 79-80
49. *Idem.* p. 81-87.
50. *Idem.* p.73.
51. *Idem.* p. 454.