Chapter 7

Medicine
We do not seem to possess the prerequisites to draw definite conclusions about many problems. Even so, it is important to state our views on these matters in accordance with our abilities. For, it is not ruled out that discoveries may be made later, through which certainty can be achieved in many matters which we cannot solve today.

Ibn Rušd (Averroes, d. 595/1198)
1. Medical Instruments

As in the fields of mathematics, astronomy, physics, chemistry, zoology, botany and geography, Arabic literature provides us in the field of medicine also with examples which show that the people in the Arabic-Islamic cultural area were well acquainted as early as the 3rd/9th century with the method of depicting human figures to illustrate medical matters. It is beyond doubt that in this process the Arabic-Islamic scholars and illustrators were following the tradition of their Greek predecessors. The only illustrations known to me in the field of medicine dating from the 3rd/9th century are to be found in the Cairo manuscript of the well-known «Ten Treatises on the Eyes» by Hunain b. Ishāq (d. 260/873): «Five illustrations of the eye, three of them identical, adorn the manuscript; these are painted in black and red water colours; the vitreous body of the eye was painted in some other colour which apparently attacked the heavy paper, because it disintegrated in all illustrations exactly where it corresponds to the vitreous body.»

Published in 1910 by M. Meyerhof and C. Prüfer, the illustrations were made known to a wider public in the edition of the entire book published by Meyerhof in 1928.

From the point of view of the development of the history of medicine it is highly significant that towards the end of the 4th/10th century the Andalusian physician Abu l-Qāsim Ḥalaf b. 'Abbās az-Zahrāwī already describes and illustrates more than 200 instruments in the 30th treatise of his book on surgery which encompasses the entire art of healing. When he laments the neglect of surgery in his country and age, stating that from the books of his predecessors just a few illustrations were known, we should understand this lament in a limited sense and see it rather in relation to a narrow geographical area. At any rate az-Zahrāwī does not neglect to often mention the provenance and the inventor of an instrument which he describes. He also stresses that, even though there are innumerable medical instruments, a capable surgeon ought to be in a position at any time to develop new instruments if need be.

Whatever may have been the motivation for the author of the K. at-Taṣrīf and from whatever sources and circles the material covered may originate, az-Zahrāwī is, according to our knowledge, the first and perhaps even the only surgeon in the history of medicine before modern times, to describe more than 200 instruments (which, according to his own account, he did not invent) and to provide these descriptions with illustrations. The importance of his achievement is even enhanced by numerous illustrations of scenes of treatment where the use of the instruments is depicted.

1 Dār al-Kutub al-Qaumiya, ms. Taimūr, tibb 100.
2 Tarkīb al-'ā'in wa-‘ilālahā wa-‘ilāgūhā ‘alā ra'y Ibuqrāt wa-Gālinūs wa-hiya ‘aṣr maqālār, pp. 314-318 of the manuscript.
5 The Book of the Ten Treatises on the Eye ascribed to Hunain ibn Ishāq (809-877 A.D.)... edited ... by Max Meyerhof, Cairo 1928 (repr. Frankfurt 1996 as Islamic Medicine, vol. 22).
Az-Zahrāwī and his book on surgery enjoyed and continue to enjoy in the Occident a much greater fame than in the Islamic world. The text was translated by Gerard of Cremona into Latin barely 200 years after it was written. It was also translated into Hebrew and into Provençal. Soon thereafter the first important work on surgery, the *Cyrrurgia* by Guglielmo da Saliceto⁹ (ca. 1275), appeared in the Occident. This was followed in the next century by the much more voluminous work by Guido de Cauliacio¹⁰ (Guy de Chauliac, d. ca. 1368). Of course, the books by Ab’ Bakr ar-Razzī (d. 996) and Ab’ b. al-‘Abbās al-Ma™s¬ (last quarter of the 4th/10th cent.) and Abū ‘Ali Ibn Sinā (d. 987/925) had a greater influence on the two western works than az-Zahrāwī’s book. The importance of the 30th treatise of his book for the development of the new surgery in Europe, which began in the 13th century, seems to have lain more in the varied descriptions and illustrations of the medical instruments and scenes of medical treatment. It is highly astonishing to see how widely the manuscripts of the translation of az-Zahrāwī’s surgery are disseminated in European libraries. To these should be added the incunabula, the first of which appeared in 1497. Since the Basel edition of 1541, az-Zahrāwī’s treatise has also circulated under the title *Methodus medendi certa, clara et brevis*.

The study of az-Zahrāwī’s surgical treatise from the point of view of Arabic studies and history of medicine began with the *Albucasis de Chirurgia* by Johannes Channing (Oxford 1778), in which he translated the text into Latin on the basis of the two Oxford manuscripts, Huntington 156 and Marsh 54, together with their illustrations. Later, in 1861, Lucien Leclerc¹¹ published a successful French translation with plates containing his copies of the illustrations of 172 instruments. He relied primarily on a Parisian manuscript which he described as «le manuscript d’Aboucasis de la bibliothèque de la rue Richelieu»; besides Channing’s work and the Latin manuscripts, he consulted one more Arabic manuscript which he had «discovered» in Algeria. In 1898, in the first volume of his *Geschichte der Chirurgie und ihrer Ausübung*, E. Gurtl¹² included a summary of the French translation by Leclerc together with 102 of Leclerc’s illustrations of instruments.

In 1918, in the second part of his *Beiträge zur Geschichte der Chirurgie im Mittelalter*, Karl Sudhoff¹³, compiled «the illustrations of instruments of the Latin Abulqâsim-manuscripts of the Middle Ages». There he reproduced more than 200 illustrations. It is also of interest for the history of medicine that at least two manuscripts of the Latin translation contain coloured illustrations of scenes of medical treatment, namely the manuscript in the Austrian National Library, Vienna, with the shelf mark S.N. 2641 and the Cod. 15 of the University Library in Budapest, and also, the Turkish version prepared in 1465 by Şerefeddin Şabuncuoglu for the Ottoman ruler Mehmed Fâtih. Both the Vienna codex¹⁴ with 68 illustrations and the Paris codex (MS suppl. turc 693) of the Turkish version¹⁵ with 140 illustrations have been made accessible in facsimile editions in recent years.

Eva Irblich, who edited the Latin facsimiles, deals in her informative introduction with the provenance of the miniatures by comparing the pictures of the Latin translation and of the Ottoman version: «The ‘naïve’ Turkish miniatures of surgery of Charaf ed-Din in MS suppl. turc 693 in the Bibliothèque nationale at Paris demonstrate the simplicity of the pictorial representation of the medical text where the figure of the physi-

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¹² Berlin 1898 (repr. Hildesheim 1964), pp. 620-648 with plates IV and V.
¹⁵ Şerefeddin Sabuncuoglu, *Cerrahiyet-i 1-Hâniyye* ed. İber Uzel, 2 vols. (transcription of the text and facsimile), Ankara 1992. The illustrations of the manuscript were published, some in colour but most of them in black and white, with French explanations by P. Huard and M. D. Grmek, *Le premier manuscrit chirurgical turc rédigé par Charaf ed-Din (1465) et illustré de 140 miniatures*, Paris 1960.
cian and that of the patient are drawn mainly from the front next to each other and not as interacting with one another. Here the differences between an Oriental miniature drawn in two dimensions in a decorative and flat style and an Occidental painting delineated with plasticity, depicting a scene with a three-dimensional or decorative background stand out most clearly.»

«The dark skin colour of the figures, certain architectural elements such as the tent, the coffered wall or the round cupolas and the figure of the physician with a turban lead to the conclusion that the miniatures could go back to Arabic models. However, other elements such as the curtains, the flat cupolas, sculptures on pillars as bearers of cupolas or of curtains recall in their pictorial idiom components of the paintings of antiquity. Other pictorial elements, such as those of the human figures, the gothic architecture, the beginnings of landscape painting or of the two-dimensional decorative background of the pictures, reflect the southern European style of painting, which, despite its individuality, could be seen as part of the south Italian style of painting.»

However, «the area of origin of the Latin version of the text in the school of translators of Toledo is more closely related, and it is also possible that the painting of the manuscript was influenced by antiquating and orientalizing stylistic elements of Moorish Spain.»

Concerning Eva Irblich’s informative analysis, I wish to clarify the following. In contrast to the Latin translation with its 68 illustrations, the Turkish version of 870/1465 offers roughly 140 miniatures of medical scenes. Moreover, the Latin version does not contain any illustrations of medical instruments. Leaving this aside, there is nevertheless so much agreement in both versions, not only in the depiction of the medical scenes, but also in the text that a common origin can be assumed. We can be sure of the fact that a copy commissioned by the author was provided with qualitatively good or at least adequate illustrations of instruments and medical scenes. Usually such tasks were executed by professional painters who belonged generally to the minority groups. It is, no doubt, possible that the illustrations deviated from the original in the course of time through repeated copying before, during and after the translation. I am inclined to think that the miniatures of the original were of a tolerably good quality. Among the models of ophthalmological instruments in our collection, there are several that were not produced according to the illustrations of the Taṣrīf by az-Zahrāwī, but after the drawings from the Kitāb al-Kāfī fi l-kuhāl by Ḥalīfa b. Abī l-Mahāsīn al-Ḥalābī (written before 674/1275). This book, of which two manuscripts are extant, was studied and translated into German by Julius Hirschberg.0 In his descriptions of the instruments, Ḥalīfa included two plates of illustrations which are reproduced below from the Istanbul manuscript of the Yeni Cami collection. Moreover, in Ḥalīfa’s book there is also an illustration of the optic nerve crossing which could originally go back to ‘Ammār b. ‘Ali al-Mausili’s (4th/10th cent.) ophthalmological work (see below, p. 27).

16 Abu’l Qāsim Halāf ibn ‘Abbās al-Zahrāūi, Chirurgia, op. cit., commentary p. 31a.
17 ibid, pp. 31b-32a.
18 ibid, p. 32a.
Ophthalmological instruments from the *Kitāb al-Kāfī fī l-khul* by Ḥalīfa b. Abī l-Maḥāsin al-Ḫalabī (written before 674/1275), from the Istanbul manuscript of the Süleymaniye Kütüphanesi, Yeni Cami 924.
2. Series of Anatomical Pictures

There are extant several series of five or six pictures each from Islamic medicine which attracted scholarly interest in the first decade of the 20th century. I have in mind particularly the illustrations of the book Tāsārīḥ-i Mansūrī by the Persian physician Mansūr b. Muḥammad b. Ahmad b. Yūsūf from the late 8th/14th century. The illustrations in the book, which had been published several times in India since 1848, were studied by K. Sudhoff in connection with his investigations into the anatomical illustrations. The pictures show diagrams of the bone system, the nerve system, the muscles, veins and arteries in the human body and the artery system of a pregnant woman. Sudhoff came to know of other pictorial representations, certainly older, of the bone system, the system of veins, muscles and arteries from the Oxford manuscript1 of the Daḥīrā-i Ḥwārezmšāhī by Ismā‘īl b. Ḥasan b. Ahmad al-Ḡurgānī (d. 531/1137 or 535/1141). While comparing the pictures and the texts of the Persian manuscripts with the corresponding material in Occidental books, Sudhoff comes to the conclusion that the series of anatomical diagrams and their texts must have reached the Occident outside Spain at two different periods of time and perhaps through two different channels. He sees an important point for differentiation in the fact that the 13th century manuscript from Provence, now preserved in Basel, is the only manuscript to contain a diagram of a skeleton, a diagram of the female genital organs (without a drawing of the embryo) and a legend which is added to the skeleton. Moreover, he discovers that both the diagram of the skeleton with the legend and the drawing of the female genitalia (here with a sketch of the embryo) appear in the Persian book of anatomy. He states that the group of those Latin manuscripts which are different from the Basel family of manuscripts had their precursors in a codex of 1154 in the cloister at Prüfening (near Regensburg) and another one in the cloister at Scheyern (ca. 1250). He is of the view that they show «such a clearly discernible agreement that a rather close connection between the two must be assumed.» But, he asserts, it is impossible that the Prüfening codex could have served as a model for the younger codex. From this he concludes that the text from Provence, preserved in Basel, «has been combined from two distinct compilations of the 11th and 12th century which originated in Salerno», and comes to the following conclusion: «There is a close connection between the pictures from Prüfening, Scheyern and Oxford. I assume that they date from Antiquity and came down to us via Byzantium. The pictures from Provence preserved in Basel also originated in Antiquity, but perhaps their path of transmission was quite different.»

Towards the end of the study Sudhoff expresses his views on the origin of the Persian illustrations: «It seems to me that, also through Arab medicine, the Persian manuscripts at London and Oxford point to a path of transmission of technical diagrams of anatomy which perhaps goes back to those very same diagrams from Alexandria, of which we have already received distorted tidings in Occidental written records – perhaps! However, we do not yet have the faintest idea of how many

3 MS Fraser 201, Bodl. 1576, v. Cat. of Pers., Turkish, Hindūstānī … Mss., ed. Hermann Ethé, vol. 1, Oxford 1889, columns 951-952; v. K. Sudhoff, Ein Beitrag, op. cit., p. 52: «The six anatomical diagrams are to be found … on the flyleaves at the end of the second volume.»

4 Ein Beitrag zur Geschichte der Anatomie im Mittelalter, op. cit., p. 29.
5 Drei weitere anatomische Fünfbilderserien, op. cit., p. 187 (repr., op. cit., p. 121).
6 Ein Beitrag zur Geschichte der Anatomie im Mittelalter, op. cit., p. 3.
7 ibid, p. 3.
8 ibid, p. 23.
9 ibid, p. 28.
groups of anatomical illustrations may have been made in Antiquity and how many may have been handed further down ...»

In a study dealing with the same subject, which was published two years later and mentions E. Seidel as a co-author, Sudhoff concludes: «But today it can already be said with the utmost probability, it can almost be asserted with historical evidence, that these illustrations together with the text must be based on a short illustrated anatomical textbook in Greek, which was written in Alexandria and was provided with schematic drawings, probably after available models. The transmitted Latin text is completely free from Arabic influence, therefore it originates directly in the Occidental tradition from Antiquity. This text together with its illustrations was, of course, also known to the Arabs, but since the anatomical drawings could not be handed down for religious considerations, the text also is difficult to locate. But probably that will happen some day.»

Sudhoff explains his notion of an ancient illustrated text on anatomy that reached the Occident directly and without any intervention by the Arabic-Islamic culture area in the following manner: «The strict school of thought of Islam to which all our Arabic authors on medicine belong, namely that of the Sunnis, made it impossible to preserve and hand down to us through further copying the Alexandrian anatomical drawings which, undoubtedly, must have been known to these authors as well ...»

«The more liberal school of thought of the Persian Shiites, for whom the drawing of a human figure and thus anatomical drawings were not completely prohibited, intervenes in the transmission quite successfully, with its own contribution. Because, however much these illustrations (e.g. in the drawing of the liver) deviate from the other paths of tradition, they also point to Alexandria, even though perhaps to a different author or to another period of Alexandrian medicine. Nothing definite can be said about this at this point. Did Manṣūr ibn Muhammad ibn Aḥmad change much in the drawings that were available to him or that he used? I believe he changed hardly anything, but through how many competent and through how many more incompetent hands had these illustrations passed, since the time they were first drawn on sheets of papyrus in Alexandria!»

I wish to say a few words on Sudhoff’s explanations or hypotheses and offer my own explanation. There is no doubt that the Arab physicians adopted the science of medicine primarily from the Greeks. They make no secret of it and in their books mention their sources with a precision unknown in other culture areas. It has not yet been clearly established how widely spread anatomical illustrations were among the Greeks. If such illustrations reached the physicians of the Arabic-Islamic world, we must assume that, like the development of medical knowledge as a whole, they too did not remain in the same state as they had been received. A full investigation of this still awaits to be done. At the moment we know of only the three illustrations of the anatomy of the eye which Hunain b. Ishāq passed on to us on the basis of Galen’s work. But if we then encounter some anatomical sketches of the human body in Latin and also Persian manuscripts, and if both have obviously some connection with each other, then we are not justified in regarding them as unrelated loans from Greek sources. If one of those Latin manuscripts dates from 1154 and is preserved in a south Frankish cloister, then the present level of knowledge of the history of development of medicine allows us to connect the content of that manuscript [9] with those activities that began in Salerno in the first half of the 11th century through the person of the converted Arab Constantinus Africanus [14 (ca. 1015-1087) and through the Arabic books which he brought with him, translated and circulated, some of them under a different name. The many books that Constantinus Africanus brought with him included the voluminous textbook of medicine by ‘Ali b. al-‘Abbās al-Maḡūsī (4th/10th cent.), in which as many as 110 chapters are devoted to anatomy and

10 K. Sudhoff, Ein Beitrag, op. cit., p. 72.
11 Drei weitere anatomische Fünfbilderserien, op. cit., p. 185 (repr., op. cit., p. 119).
12 ibid, p. 186 (repr., p. 120).
13 ibid, pp. 186-187 (repr., pp. 120-121).
14 A large part of the studies on Constantinus Africanus and on the medicine at Salerno was reprinted in: Islamic Medicine, vol. 43, Frankfurt 1996, v. also Heinrich Schipperges, Die Assimilation der arabischen Medizin durch das lateinische Mittelalter, Wiesbaden 1964, pp. 17-54.
surgery.\textsuperscript{15} It is highly probable that a copy of this work with anatomical drawings reached Salerno. Incidentally, it may be mentioned that the book circulated in Latin translation in Europe for about 200 years as the work of Constantinus Africanus until it was translated once more into Latin and thus the true author became known. In any case, the book by `Ali b. al-`Abbās was the only one with anatomical and surgical chapters to reach Salerno through Constantinus Africanus. That the origin of the well-known «Salernitanian Anatomy» was directly dependent on this book was already mentioned by Robert von Töply,\textsuperscript{16} a contemporary of Sudhoff. It is revealing that more advanced illustrations with more precise descriptions are to be found in the Persian anatomy book and that here the number of figures increased from four to six. Of course, we do not wish to interpret this fact as the achievement of this particular author in whose book we encounter them, but rather as one of the many fruits brought forth by medicine in the Arabic-Islamic culture area to the end of the 8th/14th century. We only need to recall the significant progress in the knowledge of the anatomy of the eye that occurred between Hūnain b. Ishāq and Ibn al-Haitham, or Kamāladdin al-Fārisi, as the case may be. To conclude, we may say a few words on Sudhoff. It was directly revealed in the research\textsuperscript{17} on the history of Arabic medicine: indeed, it ought to have occurred to Sudhoff that not an insignificant development took place between the extant anatomical drawings of the \textit{Daḥīra-i Ḥwārāmshāḥi} (ca. 505/1110) and those of the \textit{Ṭašrīḥ-i Mānsūrī} (ca. 800/1400).

\textsuperscript{15} For a systematic overview of Arabic surgery one must primarily consider anatomy, especially because it had been regarded since Antiquity as a propaedeutic to surgical procedure.


\textsuperscript{17} Incidentally, it may be mentioned that the book circulated in Latin translation in Europe for about 200 years as the work of Constantinus Africanus until it was translated once more into Latin and thus the true author became known. In any case, the book by `Ali b. al-`Abbās was the only one with anatomical and surgical chapters to reach Salerno through Constantinus Africanus. That the origin of the well-known «Salernitanian Anatomy» was directly dependent on this book was already mentioned by Robert von Töply,\textsuperscript{16} a contemporary of Sudhoff. It is revealing that more advanced illustrations with more precise descriptions are to be found in the Persian anatomy book and that here the number of figures increased from four to six. Of course, we do not wish to interpret this fact as the achievement of this particular author in whose book we encounter them, but rather as one of the many fruits brought forth by medicine in the Arabic-Islamic culture area to the end of the 8th/14th century. We only need to recall the significant progress in the knowledge of the anatomy of the eye that occurred between Hūnain b. Ishāq and Ibn al-Haitham, or Kamāladdin al-Fārisi, as the case may be. To conclude, we may say a few words on Sudhoff. It was directly revealed in the research\textsuperscript{17} on the history of Arabic medicine: indeed, it ought to have occurred to Sudhoff that not an insignificant development took place between the extant anatomical drawings of the \textit{Daḥīra-i Ḥwārāmshāḥi} (ca. 505/1110) and those of the \textit{Ṭašrīḥ-i Mānsūrī} (ca. 800/1400).
Fig. 1: System of the Bones.
Fig. 2: System of the Nerves.
Fig. 3: System of the Muscles (without label).
Fig. 4: System of the Veins.
Fig. 5: System of the Arteries.

Figs. 1–5: Anatomical illustrations from *Dahira-i Hwārazmšāhī* (ca. 505/1110), MS Oxford 1567, after Sudhoff.
Fig. 6: System of the Bones.

Fig. 7: System of the Muscles.

Figs. 6–11: Anatomical Illustrations from Ta'rih-i Manşūrī (ca. 800/1400), MS Ayasofya (İstanbul) 3598.
Fig. 8: System of the Nerves.

Fig. 9: System of the Veins

Fig. 10: System of the Arteries

Fig. 11: System of the Arteries of a pregnant woman with embryo.
Fig. 12: System of the Bones, from Ta‘īriḥ-i Manṣūrī.

Fig. 13: System of the Muscles, from Ta‘īriḥ-i Manṣūrī.

Figs. 12–17: From Ta‘īriḥ-i Manṣūrī (ca. 800/1400), MS India Office (Londres) 2296.
Fig. 14: System of the Nerves, from Taṣrīḥ-i Mānṣūrī.

Fig. 15: System of the Veins, from Taṣrīḥ-i Mānṣūrī.

Fig. 16: System of the Arteries, from Taṣrīḥ-i Mānṣūrī.

Fig. 17: System of the Arteries of a pregnant woman with embryo, from Taṣrīḥ-i Mānṣūrī.
3. Anatomical Illustrations of the Organ of Vision

One weak point of Arabic literature is that textual descriptions are not illustrated, as is desirable, with figures and sketches, with the exception of the fields of mathematics and astronomy. But even in these fields it happens not infrequently that the spaces for figures are left empty by the copyists, probably in anticipation that a specialist would be entrusted with this work. Those who are familiar with Arabic manuscripts are aware of the fact that in many cases autographs, if they are extant, contain illustrations whereas these are missing in the copies. During my studies of the history of Arab sciences and the question of their reception in the Occident, I gained the impression that many Arabic manuscripts with illustrations had the good fortune, as it were, to reach the Occident at an early stage so that their illustrations are preserved in the Latin translations. I am thinking here of the fine scenes of surgical treatment by Abu l-Qasim az-Zahrawi (see above, p. 5), which are missing in the Arabic manuscripts and which appear only in the Turkish version in an inferior quality.

In 1908 J. Hirschberg lamented the state of manuscripts circulating without the illustrations of the originals: «The Arabs began … at an early date to embellish their textbooks of ophthalmology with anatomical illustrations of the organ of vision. Thus, according to the express mention of Halifa, the (for us lost) book ‘of information about the diseases of the eye’ by Ḫubaiš, the son of Ḫunain’s sister, from Baghdad (from the 9th century of our era) was provided with an illustration of the eye.

The textbook of ophthalmology by ‘Ali b. ʿĪsā from Baghdad from the beginning of the 11th century, which was a classic for the Arabs, did not contain any figures except a diagrammatic representation of the adherence of the retina to the vitreous body. Unfortunately, this diagram is missing in all the five manuscripts which we could use. We make the same lament about the work by ʿAmmār of Mosul, which dates from about the same time: the text, although only in the Hebrew translation, speaks of figures, but shows only the empty spaces where those were meant to be entered.»

Julius Hirschberg, the great savant of Arabic-Islamic ophthalmology, did not yet know the three anatomical illustrations of the eye by Ḫunain b. Ishāq (d. 260/873, see below, Figs. 1-3) which are preserved in the Cairo manuscript. Their discovery two years later was left to his younger colleague, Max Meyerhof. Hirschberg also did not yet know the Arabic original of the pictorial representation of the eye by Ibn al-Haitham whose Occidental successors can be traced up to the end of the 16th century. About the oldest Arabic drawing of the eye known to him, he says: «Fortunately we have this illustration of the optic nerve crossing together with that of the eye and the brain in a later Arabic text on ophthalmology, that by Halifa from Syria, from about 1266 our era, but only in the Jeni [Cami] manuscript of this work, not in the manuscript from Paris.»

«First of all one must appreciate that the Arab ophthalmologists since Ḫunain had made real efforts to exploit the anatomy, the physiology and the pathology of the brain for their patients. Therefore we do not wish to criticize them for having dragged the optic nerve crossing unnaturally to the front in this imaginary stylized representation of the brain in order to be able to illustrate it at all; we also do that in our diagrams.»

In connection with the anatomy of the eye and its nomenclature, Hirschberg says: «Not really from the Greeks, but rather from the Arabs, [17] i.e. from the medieval Latin translations of the same do we have the names for the membranes and the moistures of the eye which are in use today.»

About the anatomy of the eye Hirschberg goes on to say: «Among the most important things which ar-Rāzi’s [d. 313/925] Kitāb al-Manṣūrī period hands down to us is the contraction of the pupil upon the incidence of light. The fact that the pupil of the healthy human eye contracts when there is brightness and dilates in darkness,—a fact which the first thinking human being ought to have noticed at each dusk in the eyes of his companion,—is, strangely enough, not to be found in the extant

1 Geschichte der Augenheilkunde, 2nd and 3rd volumes: Geschichte der Augenheilkunde im Mittelalter und in der Neuzeit, Leipzig 1908, p. 150.
2 ibid, p. 150.
3 ibid, p. 152.
4 J. Hirschberg, Geschichte der Augenheilkunde, op. cit., p. 154.
writings of any of the Greek authors, neither of the philosophers, nor of the physicians.»^6

«Moreover, this is not just a casual remark by Rāzi, but the articulation of a fact that he recognized as important: he even wrote a special treatise on it under the title: ‘Why pupils contract in light and dilate in darkness’.»^7 Here we may also mention the unusual chapter of a book on ophthalmology about «the differences of the eyes of animals compared to human eyes and the special characteristics of the latter». It is the sixth chapter of the Kitāb al-‘Umda by Ṣādaqa b. ʿIbrāhīm aṣ-Ṣādli from the second half of the 8th/14th century:^8 «This is rather a peculiar chapter, to a certain extent the seed of a compara-
tive anatomy and physiology of the organ of vision: let us recall that even the detailed and classical
textbooks of ophthalmology of the first two thirds of the 19th century, by J. Beer, Mackenzie, Artl, did
not tackle this unwieldy topic; that only in our time
did the most voluminous handbooks of ophthalm-
ology, such as that by Graefe-SAemisch in the first
edition II, 2, 1876, and our second edition which is
not yet complete, after that also the Encyclopédie
francaise d’ophtalmologie which is appearing just
now, undertake to deal with this topic meticulously
and scientifically. Thus we will not demand too
much from our Ṣādli.»^9

Julius Hirschberg wrote his general history of
ophthalmology at a time when Arabic studies and research into the history of the Arabic-Islamic natural
sciences were still at a rather primitive level.

Nevertheless, what Hirschberg brought out and published from Arabic-Persian literature on the subject
of the anatomy of the eye retains its path-breaking
significance for the subject even now. But if the
modern historian of medicine misses an adequate
impact of the insights gained by Hirschberg about
Arabic medicine in general and the anatomy of the
eye, in particular, in the subsequent historiography
of the subject, the main reason probably lies in the
fact that from the beginning a renowned and most
prolific colleague like Karl Sudhoff continuously
entertained a negative view towards the results
presented by Hirschberg. It was not so much a
well-founded scepticism towards the results arrived
at by Hirschberg that motivated Sudhoff, but rather
his fundamentally Eurocentric attitude towards
the status of the Arabic-Islamic culture area in the
history of science. According to his view, which
is expressed again and again in his works, he not
only denies any creative role in the history of sci-
ence by the Arabic-Islamic culture area, but even
denies it the role of a mediator between the Greeks
and the Occident in the Middle Ages. He is of the
opinion that the Occident got to know the works of
the Greeks without the mediation of the Arabs and
translated them directly into Latin, even if they had
been translated into Arabic [18] and even if these
translations might have reached the Occident.

The first scholar who opposed this attitude was,
as far as I know, S. L. Polyak. In 1941 he wrote^10:
«The knowledge of the structure of the eye and of
its function, possessed by western Europe during
the Late Middle Ages, including the pictorial rep-
resentation, manifestly was transplanted from the
Near East, from the so-called ‘Arabs’, mostly by
way of Spain, together with many other intellectual
and practical pursuits, such as philosophy, medi-
cine, alchemy, etc. It could not have been an indig-
enuous product. This, if one realizes how completely
annihilated was the Greek thought in the territories
of the Christianized Teutonic barbarians and the de-
graded Latins of the West, is what could be expect-
ed. The belief that there was a tradition regarding
the structure of the eye preserved in western Europe
from classical Greek times, or possibly taken over
directly from the cultural sphere of Alexandria, and
even more so the claim that the early eye diagrams
were a product of indigenous European efforts and
thus independent from the Arabic Civilization and
indirectly from the Greek Civilization (Sudhoff
1907, 1915; Bednarski 1935) seem, therefore, not
to be well founded.»

In the ninth chapter of his book on Arab diagrams
of the eye and their influence in Europe upon the
anatomy and physiology of the visual organs,^11
Polyak offers the best discussion of the subject by
a non-Arabist that we know of, aside from Hirsch-

^6 J. Hirschberg, Geschichte der Augenheilkunde, op. cit., p. 155.
^7 ibid, p. 156.
^8 ibid, pp. 84-85; C. Brockelmann, Geschichte der arabischen

^10 The Retina. The anatomy and the histology of the retina in
man, ape, and monkey, including the consideration of visual
functions, the history of physiological optics, and the histologi-
cal laboratory technique, Chicago 1941, p. 128.
^11 ibid, p. 114 ff.
berg. He considers Ibn al-Haitham and his commentator Kamāladdin al-Fārisī (ca. 700/1300) as important representatives of physiological optics and connects the well-known works on optics written in Europe in the 13th century with the works of Ibn al-Haitham and Ibn Sinā which had been available for more than a century in Latin translations. Witelo’s *Perspectiva*, fundamentally an analytical commentary on the work of Ibn al-Haitham and the first product of European endeavors in the field of optics, strangely coincides with the commentary written in Persia by Kamāladdin al-Fārisī, as far as the time and contents are concerned. The translation of Ibn al-Haitham’s book and the appearance of Witelo’s work mark, according to Polyak, the beginning of a long sequence of more or less important treatises on optics, among them the first and most popular works being those by Roger Bacon (ca. 1219-ca. 1292) and John Pecham (Peckham), the archbishop of Canterbury (ca. 1235-1292). Polyak considers all the European diagrams of the eye that were drawn for European works until the end of the 16th century, including those by Leonardo da Vinci, to be dependent on Arabic models. Polyak, who was not an Arabist, was the first to publish and realize the importance of the Arabic diagrams of the eye by Ibn al-Haitham and Kamāladdin al-Fārisī which are preserved in libraries in Istanbul. In the 1940s, following in the footsteps of the famous Eilhard Wiedemann, the Egyptian scholar Muṣṭafā Naẓīf presented—to use the words of Matthias Schramm—the optical achievements of Ibn al-Haitham in an exemplary fashion and extensively. Twenty years later one more exemplary work on Ibn al-Haitham appeared. It is entitled *Ibn al-Haithams Weg zur Physik*. The scientist who enriched the scholarship on the history of Arabic-Islamic sciences with this book was Matthias Schramm himself. Here, I will not venture the difficult task of evaluating it in an adequate manner. However, it is not in this work, but in another, likewise excellent study that supplements this work, that Schramm pointed out a perspective which is completely novel for our topic. In this article, entitled *Zur Entwicklung der physiologischen Optik in

der arabischen Literatur*, he informs [19] us about Ibn al-Haitham’s endeavors «to combine anatomical and optical reflections with one another». From the point of view of physiological optics, the spherical form of the cornea was «no more a mere fact noticed by doctors of anatomy, but becomes a necessity: it alone guarantees the unbroken penetration of the rays which advance from all sides to the centre of the eye and to the centre of vision.» Thus Ibn al-Haitham gains «as a result of his physical contemplations ... the first hypothesis of the construction of the eye, clearly defined by means of geometry». Of great significance is also the fact that Schramm, by way of further developing physics and physiological optics as presented by Ibn al-Haitham, finds a work of high standard in the commentary by Kamāladdin al-Fārisī, who was active three hundred years later. Of Schramm’s statements, the one that refers to Kamāladdin’s theory on the image of the pupil may be cited here because of its connection to our particular topic. Kamāladdin states that the idea of Galen and his followers is untenable and that, through dissection of the eye of a slaughtered wether, he comes to the conclusion that during the formation of the image in the pupil the reflection takes place on the upper surface of the lens. Kamāladdin’s achievement is appreciated by Schramm in the following words: «Through his deliberations and experiments Kamāl al-Dīn has been led to a result which was achieved afresh only in 1823 by Johannes Evangelista Purkynje. Kamāl al-Dīn was the first to detect definite proof for the reflection on the upper surface of the lens and gave reasons for it in the context of his theory in an excellent manner.»

12 ibid, p. 126.
13 ibid, p. 128.
15 Published in Wiesbaden, 1963.
18 ibid, p. 296.
19 Kamāladdin explains Galen’s theory on the image of the pupil as follows: «Galen and those who follow him maintained: It is this (that is to say the layer which is like a spider’s web) in which we see our image (ṣārū) if we look into the eye of somebody who is near us in the same way as we see in a mirror (mirʿat)» (*Tanqūl al-Manāzir*, ed. Hyderabad 1347-48/1928-29, vol. 1, p. 65, translated by Schramm, *Zur Entwicklung der physiologischen Optik*, op. cit., p.308.)
20 ibid, pp. 315-316.
The oldest preserved anatomical illustration of the eye is by Hunain b. Ishāq (d. 259/873)\textsuperscript{21}
\[20\] On the importance of this diagram of the eye, S. L. Polyak\textsuperscript{22} wrote the following in 1941: "In his Book of the Ten Treatises on the Eye (Kitāb al-‘ashr makālāt fi al-‘ain) he gives a good description of the parts composing the eye, of the optic nerve and its connection with the brain, and also of the physiology of the visual system, besides the pathology and the treatment of eye diseases. In an Arabic manuscript of this book discovered by Meyerhof (1911), especially noteworthy are the diagrams of the eye. The best of these [v. ci-dessus, fig. 3] shows the inner structures of the eyeball in an imaginary horizontal cross-section inclosed in a frame representing the two lids as seen in a living person.

Of the several circular layers, or coats, the most outward is the conjunctiva, to which the oculomotor nerve is attached on each side; the next is the sclera, together with the cornea; then the chorioid membrane, with the uvea (iris); and finally the retina, the innermost. This latter membrane, according to the text, is made up of two components—a hollow nerve, which apparently is the retina proper, and the blood vessels. The inner space of the eye is divided by a cross-partition into an anterior compartment, filled with the aqueous humor, and a posterior compartment, the vitreous. The crystalline lens is represented in the very center of the eyeball as a circular sphere, whereas in the text it is correctly described as flat. A thick semicircular line in front of the lens and continuous with the cross-partition represents the arachnoid membrane—in modern terminology the ‘anterior capsule’ of the lens—together with the ciliary zonule and perhaps also the ciliary body. The most anterior portion of the outward tunic, facing upward and correctly showing the cornea with a smaller radius of curvature, is left unlabeled in the figure. The pupillary opening is represented by a small circle behind the cornea, inclosed in a cres-


\textsuperscript{22} The Retina, op. cit., pp. 106-107.
cent-shaped structure which represents the uvea, or the iris. The optic nerve is hollow. The two sheaths enveloping the nerve, the dura and the pia, continue directly into the scleral and the chorioid tunic, respectively, while the optic nerve itself spreads out into the retina.»

«The obvious mistakes in this Arab diagram, which, like the text, is in all probability a copy or an adaptation from the Greek original of Galen’s *On the Utility of the Parts of the Human Body* or from a similar treatise now lost, are at once apparent. First, the eyeball is too small in comparison with the palpebral fissure. Its walls are disproportionately thick, the anterior chamber too spacious, the posterior absent, and the vitreal cavity far too small. The two chief errors of the Greek anatomy — the location of the lens in the center of the eyeball and the channeling in the center of the optic nerve — have been faithfully copied by the Arabs. Yet, in spite of this, the figure gives a fair idea of the disposition of the minute structures of the eye and is unquestionably more correct than the confused geometrical diagrams which decorated numerous Latin manuscripts in Europe from the thirteenth to the fifteenth century and even later. Thus, for instance, the arrangement or sequence of the tunics of the eyeball and of the optic nerve is correct. Even the positions of the lens, with its suspension in the araneal tunic, and of the zonular ligament are nearer actuality than those represented in the above-mentioned geometrical schemes of the early European writers. Altogether, this venerable Arab diagram is more natural than the later, highly schematized, artificial Western figures. In one respect, viz., the curvature of the cornea, it is even more correct than the diagram of Vesalius, whose copy was published in Alhazen’s and Vitello’s joint edition (A.D. 1572).»
Some more, historically very important figurative representations of the anatomy of the eye follow, which are, moreover, suitable for depicting the paths of reception:

**Fig. 4:** Illustration of the human organ of vision in the *Kitāb al-Manāẓir* by al-Hasan Ibn al-Hätim (ca. 432/1041), MS Istanbul, Süleymaniye Kütüphanesi, collection Fatih 3212, fol. 81b.²³

**Fig. 5:** Longitudinal section of the human eye according to Ibn al-Hätim in the Latin translation of his optics, MS Edinburgh, Crawford Library of the Royal Observatory.²⁴

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Fig. 6: Longitudinal section of the human eye according to Kamâladdîn al-Fârisî (ca. 700/1300), *Tâqîh al-Manâzîr*, MS Istanbul, Topkapâ Sarâyî, Ahmet III, 3340, fol. 24b.²⁵

Fig. 7: One more sketch of the human organ of vision according to Kamâladdîn al-Fârisî (ca. 700/1300), from his book *al-Bâşîr fi 'îlm al-manâzîr*, MS Istanbul, Süleymaniye Kütüphanesi, collection Ayasofya 2451, fol. 42b.²⁶

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The illustration became well known because it was included in the edition of the Latin translation of Ibn Sinā’s Qānūn of 1479. K. Sudhoff published the same diagram in 1907 after the Leipzig Codex 118 (folio 217) to provide proof «that even independently of the Arab tradition a longitudinal section through the eye must have been part of the inheritance throughout the Occidental Middle Ages.»

To this J. Hirschberg replied in a letter to Sudhoff: «It is true, the great textbooks of ophthalmology by Halifa and Salah ad-Din from Syria, which were provided with illustrations of the eye, were totally ignored by the Latin world of the European Middle Ages; but the latter got to know, among others, ‘The Treatise on the Eye’ of the Christian from Toledo, ‘Salomo filius de Arit, Alcoati’, from 1159; I was the first to show that it was written originally in the Arabic language and that it was derived entirely from Arabic sources. This work contained, in the first book, a figure of the eye of which the author is quite proud … The illustration in your manuscript is probably from this manuscript. Unfortunately, the figure was omitted in the only complete manuscript of Alcoati (No. 270 of the Ampron. Library at Erfurt), which was first published by our friend Pagel and which Pansier printed once again.» Sudhoff took note of this statement by Hirschberg, at first, with some discomfiture but, after another eight years, dismissed it: «I do not quite believe that this picture originated from Alcoati as Hirschberg assumed at that time (Archiv für Geschichte der Medizin, I, p. 316), particularly not after the Occident taught us several other graphic representations of the construction of the eye, and also because Alcoati positively detests transferring the cornea outside the conjunctiva. Alcoati had nothing of his own in his ophthalmology, least of all [24]

Fig. 8: Latin rendering of an Arabic diagram which shows a longitudinal section through the eyeball.

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27 Robert Tüply, Anatomia Ricardi Anglici (c.a. 1242-1252), Vienna 1902, p. 39 (Additamenta), fig. 3.

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30 in: Archiv für Geschichte der Medizin 1/1907/316.
in anatomy. This has its origins entirely among the Greeks and came from them to the Arabs and into the Occident and to Salerno and other schools of physicians through all sorts of channels, and finally once more on the path of the Latin translations from the Arabic.»

Then Sudhoff reproduces the illustration of the longitudinal section of the eye from the Leipzig manuscript 1183, fol. 217:

In 1941 S. L. Polyak expressed his view on the two diagrams of the Leipzig Codex (15th cent.) and the incunabulum of the Liber Canonis by Ibn Sinā (1479) and stated that they were either rough copies of the drawing by Kamāladdīn al-Fārisī or, more likely, of that drawings’ common source in the book of optics by Ibn al-Haṭṭām. In my view, we should rather suppose that both the diagrams (of Avicenna and of the Leipzig Codex) as well as the illustrations by «Alcoati» are connected to a stage of development that took place in the Arabic-Islamic culture area after Ibn al-Haṭṭām but before 1159, a development which obviously also influenced Kamāladdīn al-Fārisī. It may also be pointed out that the 5th book of the Arabic original of «Salomo filius de Arit Alcoati» (written in 1159), has come to light, the author of which could perhaps have been called Sulaimān b. Ḥāriṭ al-Qūṭī.

32 The Retina, op. cit., p. 128.
33 Escorial 894 (44a-76a), v. J. Hirschberg, Geschichte der Augenheilkunde, Leipzig 1908, pp. 70-71. Editions, studies and translations of the book were published in Islamic Medicine vol. 56, Frankfurt 1996.
**Fig. 10:** Diagram of the membranes of the skull and the brain and of the eyeball with its membranes from a print of the *Liber Canonis* by Avicenna (Ibn Sinâ) from the year 1544 (fol. 416). It is still an open question as to whether the diagram is really by Ibn Sinâ or not.

**Fig. 11:** Longitudinal section of the human eye after Roger Bacon (ca. 1219-ca. 1292), from the *Perspectiua Rogerii Bacconis*, Frankfurt 1614, p. 27.

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Fig. 12: Longitudinal section of the human eye after John Pecham (Peckham, or similar other forms), the archbishop of Canterbury (ca. 1235-1292), in the manuscript F. IV. 30 (fol. 128b) of the Basel university library.6


Fig. 13: Illustration of the human organ of vision after that in Witelo’s (ca. 1230-ca. 1279) *Perspectiva*, Oxford, Bodleian Library, MS Ashmole 424.7

Fig. 14: Illustration of human vision after Leonardo da Vinci (1452-1519), from *Codice Atlantico*, vol. 3, fol. 628.

Fig. 15: Crossing of the optic nerves from the book on ophthalmology by Ḥalīfa.\(^9\)

Julius Hirschberg, who copied and published this illustration\(^{10}\) (see above, p. ) after pointing out its deficiencies and merits,\(^{11}\) evaluates it in the following manner: «In any case we see in this venerable picture, which probably goes back to models at least from the time around 1000 A.D., a cautious attempt to represent what D. W. Soemmerring\(^{12}\) insightfully arranged in his classic illustration in 1827.»

\(^{9}\) MS Istanbul, Süleymaniye Kütüphanesi, collection Yeni Cami No. 924, fol. 12a.

\(^{10}\) ‘Ammār b. ‘Aţī ..., op. cit., p. 34.

\(^{11}\) ibid., p. 164.

4. 
Portraits of Famous Physicians

1. Dioscorides (2nd half of the 1st cent. B.C.), in a posture of teaching, from the Arabic translation of his Materia Medica, MS Istanbul, Topkapi Sarayi, collection Ahmet III, 2127 of 626/1229 (fol. 1b).  

2. Dioscorides and a pupil, from the Arabic translation of his Materia Medica, MS Istanbul, Topkapi Sarayi, collection Ahmet III, 2127 of 626/1229 (fol. 2b).


3. Ishāq b. ‘Imrān, a physician from Baghdad, who died before 296/907 in Qairawān. In Schedel’s World Chronicle\(^1\) of 1493 he is portrayed as «the very famous physician Isaac benimiram» who, quite accurately, had «written of many things in medicine». His book on melancholy was plagiarized by Constantinus Africanus (see below).

4. An occidental portrait of Abū Bakr ar-Rāzī, Latinized Rhazes (physician, chemist and philosopher, d. 313/925), from the translation of his medical encyclopedia *al-Ḥawī* (Liber Continens), printed frequently since 1486.\(^4\)

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It is remarkable that, on the one hand, this physician who is not well known in the West is at least mentioned by Schedel—who is otherwise not exactly receptive towards Islamic culture—, on the other hand, the same woodcut said to be his likeness, a few pages later is supposed to represent «Avicenna, a physician, the most famous of all doctors of medicine.» All the same, a detailed passage with praise for the latter is included there (folio 202).

5. Abū Bakr at-Rāzī (Rhazes), after the portrayal in the Latin translation of his Hawī in a manuscript of 1506.

6. An occidental picture, dating probably from the 15th century, of Abu l-Qāsim az-Zahrāwī, Latinized Albucasis (4th/10th cent.). The chapter on surgery, which will be cited often below, of his Kitāb at-Taṣrīf had a deep influence on occidental medicine. The original of the picture is in the Biblioteca Apostolica Vaticana, MS Chigi F. VII. 158 (fol. 49a).


7. One more occidental picture of Abu l-Qāsim az-Zahrāwī (on the left in the picture). It is on the title page of Liber Theoricae nec non Practicae, the Latin translation of the first and second chapter of his at-Tasrif, in the edition by Sigismund Grimm, Augsburg 1519.7

8. An occidental portrait of Abū ʿAli Ibn Sinā (d. 428/1037), known in the Latin West as Avicenna. The portrait adorns the initial letter of the introduction to the Latin translation of his al-Qānûn fi t-tibb (Canon Medicinae), Venice 1483.8

9. Ibn Sinā (Avicenna), together with Hippocrates (d. 377 B.C.), Galen (2nd cent. A.D.) and Aetius (6th cent. A.D.), on the title page of the Latin translation of his Qānūn in the edition Venice 1608.9

7 v. S. Hamarneh, G. Sonnedecker, op. cit., ill. after p. 28.
8 v. Europa und der Orient 800−1900, op. cit., p. 131.
9 v. H. Schipperges, Arabische Medizin im lateinischen Mittelalter, op. cit., p. 35.
10. Ibn Sinā at the bed of a lovesick nephew of Qābūs b. Wuṣmīr, a ruler from the Ziyāride dynasty in northern Persia, at whose court Ibn Sinā spent some time. The illustration is to be found in the Čahār maqāla by Nizāmi-i ‘Arūdi, in a manuscript dating from 835/1431 of the Museum for Turkish and Islamic Art in Istanbul.\(^{10}\)

I N T R O D U C T I O N


12. Reading the Latin translation of Ibn Sinā’s Qānūn, from an illuminated parchment manuscript of the Canon Medicinae from the 15th century12.

13. A scholar in Muslim dress, probably representing Ibn Sinā (Avicenna), shown in the middle, standing out, quite literally, among the «three philosophers» in the thus entitled painting by the Italian painter Giorgione (d. 1510). The original of the picture hangs in the Kunsthistorisches Museum Vienna13.


11 v. A. Terzioğlu, Yeni araştırmalar 1515’inda…, p. 84.
12 v. Europa und der Orient 800–1900, p. 103.
13 v. A. Terzioğlu, Yeni araştırmalar 1515’inda…, p. 85.
15. «Auenzoar a physician», illustration and reference in Schedel’s World Chronicle (1493). The reference is to ‘Abdalmalik Ibn Zuhr (d. 557/1162), who came to be known in the Occident as Avenzoar. Schedel also mentions his «Book of Medicine Theysir» that is *at-Taisir fi l-mudawat wa-t-tadbir*, which was translated into Latin.

16. «Auerrois a physician and lover of wisdom», illustration and reference from Schedel’s World Chronicle (1493). It is the versatile philosopher Muḥammad b. Ahmad b. Muḥammad Ibn Ruṣd (d. 595/1198), Averroes of the Latins. Schedel has some historical and geographical knowledge about his life and achievements.

16 Ibid., fol. 202a.