

Compiling *al-Qānūn fī l-Ṭıbb*, Book II: Ibn Sīnā's Descriptions of Simple Drugs

El-Kānūn fī'l-Ṭıbb'ın Derlenmesi, Kitap II: İbn Sīnā'nın Basit İlaçlar Açıklamaları

Raphaela VEIT* 

ABSTRACT

Ibn Sīnā's *Kitāb al-Qānūn fī l-ṭıbb* (*Canon of Medicine*) is unanimously regarded as the most important work in the medical curriculum for centuries, both in East and West. The *Qānūn* is famous for the integration and development of Ancient Greek thinking in the Islamicate world as well as for the pedagogical presentation of its content. In addition to the works of Ancient Greek doctors, Ibn Sīnā also used the writings of his predecessors in the Islamicate area. This so far hardly studied aspect is particularly noteworthy in the second book of the *Qānūn* which deals with the description of about eight hundred simple drugs, mainly plants and minerals.

This article will offer some insights into the source material used by Ibn Sīnā when he compiled the second book of his *Qānūn* 'On simple drugs'. It will also refer to the question of how the author structured this mass of information and how hereby his originality can be shown.

Keywords: Ibn Sīnā, al-Qānūn fī l-ṭıbb, simple drugs, Dioscorides, Galen

Öz

İbn-i Sina'nın el-Kanun fī't-Ṭıbb'ının hem Doğu'da hem de Batı'da tıp müfredatında yüzyıllardır en önemli çalışma olarak kullanıldığı ittifakla kabul edilmektedir. Kanun, içeriğinin pedagojik sunumu için olduğu kadar eski Yunan düşüncesinin İslam dünyasına entegrasyonu ve gelişimi açısından da ünlüdür. Eski Yunan doktorlarının çalışmalarına ek olarak İbn-i Sina, seleflerinin İslami alandaki yazılarını da kullanmıştır. Özellikle Kanun'un ikinci kitabında şimdiye kadar çok çalışılmamış olan bitkiler ve mineraller olmak üzere yaklaşık sekiz yüz basit ilacın açıklanmasıyla ilgili olan husus dikkat çekicidir.

Bu çalışmada İbn-i Sina'nın Kanun'unun ikinci kitabını derlerken 'Basit İlaçlar' üzerine kullandığı kaynak materyal hakkında bazı bilgiler sunacaktır. Ayrıca, müellifin bu bilgi birikimini nasıl yapılandırdığı ve metnin özgünlüğünün nasıl gösterilebileceği sorusuna da değinecektir.

Anahtar Kelimeler: İbn-i Sina, El-Kanun fī't-Ṭıb, basit ilaçlar, Dioscorides, Galen

Submitted/Başvuru: 01.05.2019 Accepted/Kabul: 14.05.2019

* **Corresponding author/Sorumlu yazar:** Raphaela Veit (Dr.), Thomas-Institut, University of Cologne, Germany,
E-mail: raphaela.veit@uni-koeln.de, ORCID: 0000-0003-2601-960X

Citation/Atıf: Veit, R. (2020). Compiling *al-Qānūn fī l-ṭıbb*, Book II: Ibn Sīnā's descriptions of simple drugs. In M. Kaçar, C. Kaya, A. Z. Furat (Eds.), *The 1st International Prof. Dr. Fuat Sezgin Symposium on History of Science in Islam Proceedings Book* (pp. 351-357).

<https://doi.org/10.26650/PB/AA08.2020.001.025>

1. Ibn Sīnā and Medicine

With his *Kitāb al-Qānūn fī l-ṭibb* (*Canon of Medicine*) Ibn Sīnā, or Latinised Avicenna, produced a medical encyclopaedia which has been unanimously regarded as the most important work in the medical curriculum for centuries, both in East and West. We know from Ibn Sīnā's autobiography, that he earned his living as a physician for decades at the courts of various Persian rulers,¹ although he had a rather low opinion of medicine as a science in general, even describing it as a simple science, which he had already mastered at the age of only sixteen. Given the immense amount of work behind the compilation of the *Qānūn*, this low opinion is somewhat surprising. Thus, to get a better understanding of Ibn Sīnā's approach to medicine, it would be worth looking into his medical education and training as he described it himself in his autobiography (Gutas, 2014, pp. 10–11; 1988 (1st ed.), pp. 22–23; Lüling, 1977, pp. 496–513; see also Pormann, 2013, pp. 92–93). About his childhood years, Ibn Sīnā wrote *I was provided with a teacher of the Qur'ān and a teacher of literature, and when I reached the age of ten I had mastered the Qur'ān and a great deal of literature to such an extent that I evoked great amazement* (Gutas, 2014, p. 11; 1988 (1st ed.), p. 23). [...] *Next I desired [to learn] medicine and I read the books that had been written on this subject. Medicine is not one of the difficult sciences, and therefore I excelled in it in a very short time, to the point that distinguished physicians began to read medicine with me. I cared for the sick and there opened to me indescribable possibilities of therapy which can only be acquired through experience. [...] being now sixteen years of age* (Gutas, 2014, p. 16; 1988 (1st ed.), p. 27).

A closer analysis of these passages reveals three points; first, Ibn Sīnā's description of himself as self-taught in the field of medicine, despite our knowledge of his medical teachers,² second, a certain lack of respect for medicine as a science, and third, Ibn Sīnā's explicit reference to visiting the sick and his practically tested methods of healing. The first two points could be analysed through the philosophical structure of the previous text in his autobiography in which Ibn Sīnā portrays himself as proof of his own epistemological theory, according to which specific individuals with powerful souls are able to acquire intelligible knowledge without the help of a teacher. In addition, although he learned medicine as a practical science following the Greek-Aristotelian tradition, he did this not only for the sake of medicine, but also for the philosophical sciences in the context of which he places medicine. As a non-theoretical science, which could only be tolerated in a philosophical context, medicine had to be portrayed as *not one of the difficult sciences* (on this discussion see Gutas, 1987 (update 2011), p. 68 and Pormann, 2013, pp. 92–97). The third point reflects the actual medical practice of Ibn Sīnā, an aspect which is highly relevant also in the context of simple drugs.

Regarding the production of *al-Qānūn fī l-ṭibb*, Ibn Sīnā's student al-Juzjānī informs us that his master wrote the first part of the *Qānūn* in the house of a learned man, where he was taking refuge after his escape from Bukhara to Gorgan: *He had already written the first book of the Qānūn, and every night pupils would gather at his house, while by turns I [al-Juzjānī] would read from the Shifā' (the Book of Healing) and someone else would read from the Qānūn. When we were finished, different kinds of singers appeared, a drinking party was prepared with its utensils, and we partook of it. The instruction took place at night, because of the lack of free time during the day on account of his service to the Amīr* (Gohlman, 1974, pp. 54–57). With regard to the remarks above on the different appreciation of medicine and philosophy, it is interesting to note that according to al-Juzjānī, Ibn Sīnā organized nocturnal symposiums in which the medical (*al-Qānūn*) and the philosophical (*al-Shifā'*) work of Ibn Sīnā received the same attention.

1 Gutas (1987 / update 2011), p. 68 refers explicitly to Ibn Sīnā's successful medical practice, evaluating it as a condition for his later political influence in mainly Buyid contexts: *From Jorjān Avicenna moved to Ray, where he joined the service of the Buyid Majd al-dawla Rostam and his mother Sayyeda, the power behind the throne. Although he had with him letters of recommendation for his new employers, it appears that he gained access to the political elite of the Jebāl again through his skill as a physician. He treated Majd al-dawla who was suffering from a black bile disease. [...] and finally [he] arrived in Hamadān where he was summoned to treat Šams al-dawla. ...*

2 Apparently Ibn Sīnā's teachers in medicine were Abū Manšūr al-Ḥasan ibn Nuḥ al-Qumrī (d. after 380 H. / 990 CE) as well as the Christian doctor Abū Sahl 'Īsā ibn Yahyā al-Masīhī (d. ca. 400-401 H. / 1009-1010 CE), see Ullmann, 1970, pp. 147, 151.

2. The Structure and Contents of *al-Qānūn fī l-ṭibb* and its Impact to the Latin World

Ibn Sīnā's writings are renowned for the integration and development of Ancient Greek thinking in the Islamicate world. His *Canon of Medicine* contains all of the various medical knowledge of his time; it is particularly famous for the pedagogical presentation of its content. The *Qānūn* is divided into five books. The first book deals with the general principles of theoretical and practical medicine such as the composition of the body, anatomy, the causes and symptoms of illnesses and their prevention. The second book presents simple, that means non-combined, remedies and describes about eight hundred drugs. The third book discusses illnesses in the head-to-toe order which is already known since Antiquity. The fourth book is dedicated to general pathology such as symptoms, diagnosis and prognosis, tumours, ulcers, fractures and different kinds of fever; in addition, there is also a treatise on personal hygiene. In the fifth and last book of the *Qānūn*, the composition and administration of composed medicines is discussed through the presentation of about 650 recipes.

In the Latin world, from the High Middle Ages onwards, medical teaching was based on the treatises of Ancient-Greek-Arabic origin, among which Ibn Sīnā's *Canon medicinae* played the largest role. Only with the development of modern science from the beginning of the seventeenth century onwards, did it begin to lose its significance in Europe (Chandelier, 2017; Jacquart & Micheau, 1990, pp. 87–153; Siraisi, 1987; Meyerhof, 1931, p. 353). It is interesting, regarding Ibn Sīnā's writings on simple drugs in the second book of the *Qānūn*, that some extracts from it were published in Breslau in 1609 CE or 1610 CE, in the form of a Latin-Arabic synopsis - not in a medical context but as philological examples, as a supplement to an Arabic grammar.³ With that in mind, Ibn Sīnā's *Canon of Medicine* can be considered an interface between cultures, and as such, it is of exceptional relevance, not only for the history of science, but also for today's perception of Antiquity and the history of the Greek-Arabic scientific medical tradition in Europe.

3. About the Sources of the Second Book of *al-Qānūn fī l-ṭibb* - Example: Simples Starting with the Letter *alif*

As already mentioned, the second book of Ibn Sīnā's *Qānūn* is dedicated to the presentation of simple drugs. Ibn Sīnā's text consists of two main parts: The first one deals with fundamental questions on the substances' temperament, their properties and their correct storage - in these texts Ibn Sīnā largely refers to the Ancient medical tradition but his argument is more detailed and further developed than that found in the Galenic corpus.⁴

The second part is devoted to the simple drugs themselves, listing the descriptions of about eight hundred substances. Most of them refer to plants but also minerals, yet Ibn Sīnā additionally discusses substances and excrements of aquatic and terrestrial animals, including man.⁵

While examining the sources of these texts in the second book of the *Qānūn*, one can see that in many descriptions of substances Ibn Sīnā refers to other authors and their works. Most of these are attributed to Ancient Greek treatises, thus, the texts of Ancient antiquity clearly form the main foundation of Ibn Sīnā's presentation of simple remedies. But there

3 The editor of this Arabic grammar was Peter Kirsten (1575-1640 CE), rector of the University of Breslau, who eventually became the personal physician of Queen Christine of Sweden in 1636 CE and taught as a professor at Uppsala; for more details, see Bobzin, 1995, p. 401; Siraisi, 1987, p. 154; Fück, 1955, pp. 57–59.

4 First Discourse:

Section I: Temperaments of simple drugs

Section II: Determination of temperaments of simple drugs through experiment

Section III: Determination of temperaments of simple drugs through analogy

Section IV: Effects of potencies of simple drugs

Section V: Rules applying to extrinsic properties of drugs

Section VI: The collection and storage of drugs

5 The composition of the *İbni Sina Botanik Bahçe*, which forms part of the Istanbul Museum of the History of Science, was inspired by the second book of Ibn Sīnā's *Qānūn*. It gives an impression of the abundance of plants which are described in this *Qānūn* part.

are also some references to texts of the Islamicate area and to the context of the so-called Gondēshāpūr School, as well as one mentioning of the famous ayurveda physician Caraka.

A closer look at these findings, based on the seventy-three descriptions of drugs starting with the letter *alif* (Ibn Sīnā, 1987, pp. 30–67), will show a more precise picture.

References to Dioscorides' (d. c. 90 CE) famous work *On medical material* are given in the context of fourteen drugs in the *alif* chapter (Ibn Sīnā, 1987, *alif* 1-3, *alif* 16, *alif* 18, *alif* 24, *alif* 40, *alif* 45, *alif* 50-51, *alif* 55-56, *alif* 58, *alif* 73). This treatise comprises over a thousand substances, which Dioscorides divided into five books. In the Arabic tradition, these five volumes are (incorrectly) supplemented with two further books. The significance that this work enjoyed in the Islamicate cultural area is borne out of, not only the numerous Arabic translations that were made of the text, but also the subsequent corrections of these translations and the lavishly decorated manuscripts with intricate illustrations of the individual plants that can be found today in any exhibition of Islamic book art. Only a few copies of the Syrian translation made by Ḥunain ibn Ishāq (on Ḥunain ibn Ishāq, see Pormann & Savage-Smith, 2007, pp. 25–27; Sezgin, 1970, pp. 247–256; Ullmann, 1970, pp. 115–119) remain today. The definitive edition for the Islamic realm was the Arabic translation produced in the mid-ninth century CE in Baghdad by Iṣṭafān ibn Bāsīl, working together with Ḥunain ibn Ishāq. In the tenth century CE, this translation was separately edited in Spain and in Iran. Another anonymous translation also appears to have existed. This was important for the history of Islamicate pharmacy because some of its passages are quoted by al-Rāzī in his *Kitāb al-Ḥāwī* (on al-Rāzī and his work, see Sezgin, 1970, pp. 274–281; Ullmann, 1970, pp. 128–136). After Ibn Sīnā, further editing was undertaken, as well as partial re-translations of the text itself.⁶

Eleven mentions in the *alif* part of Ibn Sīnā's work come from Galen's (c. 129 - c. 216⁷ CE in Rome) treatise *On simple drugs* (Ibn Sīnā, 1987, *alif* 2, *alif* 6, *alif* 8, *alif* 11, *alif* 16, *alif* 26, *alif* 28, *alif* 47, *alif* 67-69). The influence of Galen in the development of the science of medicine both in the East and the West cannot be emphasised enough. As early as Ḥunain ibn Ishāq numerous Arabic translations of Galen's texts were being undertaken. Because some of the original Greek texts have since then been lost or destroyed, in some cases, it is only the Arabic translations that survive today (Chipman, 2019, pp. 310–311; Sezgin, 1970, pp. 66-77, 109–110; Ullmann, 1970, pp. 35, 47–48).

Other authors and sources are only occasionally cited in Ibn Sīnā's *alif* descriptions. One reference is to Paul of Aegina (Ibn Sīnā, 1987, *alif* 68); little is known of his life, other than that he worked as a doctor in Alexandria around the time of the Arabic conquest of the city in 642 CE. Only fragments of the Arabic version of his "memory text" (*Kunnāsh al-thuraiyā*) have survived, some of these in the works of al-Rāzī (Sezgin, 1970, pp. 168–170; Ullmann, 1970, pp. 86–87; for more details on this author see Pormann, 2004).

Another mention belongs to a certain Badighūras (Ibn Sīnā, 1987, *alif* 55) to whom the standard Arabic medical work on the subject of "substitute medicine" was assigned. The name Badighūras may well be derived from the Greek name Badighoras, but this remains a hypothesis and a concrete identification of the author is yet to be established (Sezgin, 1970, pp. 20–22; Ullmann, 1970, pp. 292–293).

Finally, three citations are made to a person named Ibn Juraij (Ibn Sīnā, 1987, *alif* 18, *alif* 20, *alif* 65), speculated to be the monk Abū Juraij al-Rāhib, who is considered a physician of the Alexandrian period (on Abū Juraij, see Sezgin, 1970, pp. 208–209; Ullmann, 1970, pp. 91–92). Quotations from his work appear frequently in the works of al-Rāzī and Ibn al-Baiṭār (on Ibn al-Baiṭār and his work, see Ullmann, 1970, pp. 280-283).

All in all, in the second book of Ibn Sīnā's *Qānūn*, thirty descriptions of drugs starting with the letter *alif* can be linked to sources of Ancient-Greek medicine, twenty-five of which refer to Dioscorides or Galen.

6 On these questions and the different editions, see Ullmann, 1970, pp. 257-263 and especially 2009; Pormann & Savage-Smith, 2007, pp. 51–54; Sadek, 1983; Sezgin, 1970, pp. 58–60.

7 According to Ullmann (1970, p. 35) Galen died around the year 199 CE.

Further on, in the *alif* chapter, there are two references to the medical textbook *Kunnāsh al-Khūz* (Ibn Sīnā, 1987, *alif* 1, *alif* 70) which is located in the context of the so-called Gondēshāpūr School, the medical centre of the Sassanids in southwest Iran, near Susa, in the Khuzestan Province. This work is often quoted by authors such as al-Rāzī (Kahl, 2015, pp. 36–38; Sezgin, 1970, pp. 184–185; Ullmann, 1970, p. 101; on the so-called Gondēshāpūr School, see Pormann & Savage-Smith, 2007, pp. 20–21).

But, in this part on drugs starting with *alif*, authors from the Islamicate area are also mentioned. One such reference belongs to Māsarjawaih (Ibn Sīnā, 1987, *alif* 71), a physician of apparently Jewish-Persian descent who appears to have lived in Baṣra in the eighth / ninth century CE, being regarded as one of the first to have undertaken translations from Syriac into Arabic. His Arabic texts on medical remedies have only survived as quotations in the works of later authors such as al-Rāzī and Ibn al-Baiṭār (Sezgin, 1970, pp. 206–207; Ullmann, 1970, pp. 23–24). There might be a connection between Māsarjawaih's work and that of a certain writer called al-Yahūdī (“the Jew”) who is quoted occasionally by al-Rāzī and Ibn al-Baiṭār (Sezgin, 1970, pp. 206–207; Ullmann, 1970, p. 24). Ibn Sīnā alludes to al-Yahūdī once in his *alif* descriptions on simple drugs (Ibn Sīnā, 1987, *alif* 7).

Another representative of early Arabic medicine, Masīḥ al-Dimashqī, is also referred to once by Ibn Sīnā in the *alif* part (Ibn Sīnā, 1987, *alif* 2). This physician lived at the time of the Caliph Hārūn al-Rashīd (r. 170-193 H. / 786-809 CE). Al-Rāzī makes frequent use of his textbook (*Kunnāsh*) (Sezgin, 1970, pp. 227–228; Ullmann, 1970, p. 112).

Last but not least, Ibn Sīnā mentions once the physician Caraka (Ibn Sīnā, 1987, *alif* 7) a famous author of the field of ayurvedic medicine, who appears to have lived in a time span from about 100 BCE to about 200 CE (Kahl, 2015, pp. 18–20; Pormann & Savage-Smith, 2007, pp. 22, 36; Sezgin, 1970, p. 198; Ullmann, 1970, p. 122). This reference belongs to the so-called *Caraka's Compendium*, which, together with Suśruta's *Compendium* and Vāgbhata's treatise *Heart of Medicine*, had been translated from Sanskrit via Farsi into Arabic, and thus, became available in the Islamicate world at around 800 CE (Kahl, 2015, p. 19; Shankardass, 2002, pp. 290–291). All three works represent a basic text on ayurvedic medicine which - like the humoral pathology of the Greeks - is also based on the theory of humors in the body.⁸ However, rather than the four humors blood, phlegm, yellow and black bile, the ayurvedic system is constructed around the three components of wind, gall and phlegm. As in the Ancient-Greek system, the idea of a healthy body is based on the view of a balance between the humors; lack of balance causes illness. All three ayurvedic works are mentioned by al-Rāzī and also by 'Alī ibn Rabbān al-Ṭabarī (fl. 850 CE), in the context of his description of the Indian medical system in his *Paradise of Wisdom* (Pormann & Savage-Smith, 2007, p. 36). At this point, also the decisive influence that Ibn Sīnā's *Qānūn* had on ayurvedic medicine should be stressed.⁹

To sum up so far: Among the seventy-three descriptions of simples starting with the letter *alif*, thirty-eight of them include references to other works and authors: thirty belong to the Ancient-Greek predecessors of Ibn Sīnā, two are situated in the context of the so-called Gondēshāpūr School, five arise from the Islamicate area and one from ayurvedic medicine.

In addition to the sources referred to by name, Ibn Sīnā also points to unspecified individuals or groups of people or, very often, he just formulates something in an impersonal way (*some say, it is said, ...*). A reference to Christians can be found twice, one of them in the connection with pork meat (Ibn Sīnā, 1987, *lām* 8) and the other when Ibn Sīnā describes the use of a decoction of garlic with olive oil in the case of dropsy (Ibn Sīnā, 1987, *thā'* 5). - In the description of truffle in the context of the eyes, Ibn Sīnā names the prophet Muḥammad but also the prestigious doctor al-Masīḥ al-Dimashqī (Ibn Sīnā, 1987, *kāf* 30): *Its [the truffle's] water, as the Prophet, may peace be upon him is reported to have said, strengthens the eyesight. The physician al-Masīḥ and others have also confirmed this fact.*

8 Rahman, 1999, p. 24: *The question of the interaction of Sanskrit scholars and literature with Arabic and Persian scholars and literature requires examination. [...] In the field of medicine there was close interaction between Ayurveda and Unani systems, perhaps because both systems were based on similar principles.*

9 Shankardass, 2002, p. 291: *In fact, Ibn Sīnā's books, especially al-Qānūn have been most popular among Indian physicians. As a matter of fact, all the centres of Unani medicine in India and its practitioners, are followers of his system even today [...].* See also Veit, 2011, pp. 354, 363–364.

Besides listing many details regarding drugs in his Persian homeland (Pormann, 2011, p. 514; Veit, 2011, p. 362), Ibn Sīnā also enriched his second book of the *Qānūn* with information taken from Indian and Chinese contexts (Veit, 2011, pp. 360–361). We should be aware, however, of the merger of knowledge that had taken place relative to Indian medications even before Ibn Sīnā's arrival to the scene. Long before the compilation of the *Qānūn* took place, we find Dioscorides or Galen mentioning a large number of plants that actually originated from India. Occasionally, there are references to China, too. A certain number of descriptions also point to the Central Asian area; in this context, we find information about plants of the Himalayas and Tibet, but also the city of Bukhāra, which constituted a pivotal place in Ibn Sīnā's childhood (Gutas, 1987 (update 2011), p. 68; Veit [forthcoming]). In view of the fact that a decisive part of the spice trade was conducted over the Silk Road, it is a little bit surprising that these references are quite limited.

4. Ibn Sīnā's Approach to the Use of his Sources

A comparison of Ibn Sīnā's texts with the relevant earlier compilations shows that he took a different approach to the arrangement of his material than that used by his predecessors. In his work *On medical material*, Dioscorides starts his descriptions of simples with a general summary of each drug, their background and their characteristics. This is followed by a detailed description of the individual parts of each item and its specific medical uses. Galen, in his treatise *On simple drugs*, decided to highlight each substance's properties instead of providing a detailed description of their appearance. Al-Rāzī, in the *Kitāb al-Ḥāwī*, tended to list different medical opinions on specific plants or mineral substances sequentially, with each set of teachings being preceded by the name of the author, whom the passage was taken from.

Ibn Sīnā, in his presentation of simples, also followed the theoretical structure of the four humors paradigm as it was developed in Greek Antiquity, but instead of giving a running text, he developed a thematic order which is identical, though often incomplete, for every substance. This structuring comprises essence, nature, characteristics, choice, temperament, actions and properties, cosmetic uses, effect on ulcers, pustules and swellings, joints, the head area, ocular organs, respiratory and chest area, alimentary organs, excretory organs, fever, poisons and substitutes. Besides mentioning only the qualities hot, cold, moist or dry of each substance, Ibn Sīnā also provides information of a quality's intensity by subdividing it into different degrees. In doing so, Ibn Sīnā did not just follow Galen, but he also completed the Galenic system by replenishing degrees of primary qualities to his description of various substances which were not yet included in the Greek sources (Pormann, 2011, pp. 503–506).

Conclusion

The analysis of the sources used by Ibn Sīnā for his compilation *On simple drugs* in the second book of the *Qānūn* revealed an extraordinary influence from works of Ancient Greek authors. This text is marked by its Ancient Greek framework, both in relation to the theoretical groundwork and with respect to concrete content. This coincides with other studies on pharmacology in the Islamicate world. Within this framework, however, significant developments took place. By no way can Ibn Sīnā's text be reduced to just a repetition of the works of the Ancient Greek authors (see also Chipman, 2019; Pormann, 2011). He not only consulted further treatises written between the epoch of Galen and his time, he also enriched his material by adding information observed from his surroundings. Thus, many details on the use and availability of substances in the Persian area of his time came to us. Furthermore, the importance of the clear reorganisation of his presentation and the newly added degrees of qualities, which were lacking before, cannot be stressed enough. This could be regarded as a further systematic development and an improvement of Islamicate pharmacology as a science.

References

- Bobzin, H. (1995). *Der Koran im Zeitalter der Reformation. Studien zur Frühgeschichte der Arabistik und Islamkunde in Europa (Beiruter Texte und Studien 42)*. Stuttgart: Steiner.
- Chandelier, J. (2017). *Avicenne et la médecine en Italie. Le Canon dans les universités (1200-1350)*. Paris: Honoré Champion.
- Chipman, L. (2019). The Reception of Galenic Pharmacology in the Arabic Tradition. In P. Bouras-Vallianatos and B. Zipser (Eds.), *Brill's Companion to the Reception of Galen* (pp. 304–316). Leiden: Brill.
- Fück, J. (1955). *Die arabischen Studien in Europa bis in den Anfang des 20. Jahrhunderts*. Leipzig: Harrassowitz.
- Gohlman, W. E. (1974). *The Life of Ibn Sina*. Albany: State University of New York Press.
- Gutas, D. (1987) (update 2011). Avicenna ii. Biography. *Encyclopaedia Iranica III/1*. London: Routledge & Paul, pp. 67–70, available online at <http://www.iranicaonline.org/articles/avicenna-ii> (accessed on 2nd April, 2020)
- Gutas, D. (2014) (Second, Revised and Enlarged Edition). *Avicenna and the Aristotelian Tradition: Introduction to Reading Avicenna's Philosophical Works*. Leiden: Brill. (1st edition: 1988)
- Ibn Sīnā (1982-96). *Kitāb al-Qānīn fī l-ṭibb*, 5 vols. New Delhi: Jamia Hamdard. (Book II: 1987)
- Jacquart, D. and Micheau, F. (1990). *La médecine arabe et l'occident médiéval*. Paris: Maisonneuve et Larose.
- Kahl, O. (2015). *The Sanskrit, Syriac and Persian sources in the "Comprehensive book" of Rhazes*. Leiden: Brill.
- Lüling, G. (1977). Ein anderer Avicenna. Kritik seiner Autobiographie und ihrer bisherigen Behandlung. *ZDMG Suppl.* 3(1), 496–513.
- Meyerhof, M. (1931). Science and medicine. In T. Arnold and A. Guillaume (Eds.), *The Legacy of Islam* (pp. 311–355). Oxford: Clarendon Press.
- Pormann, P. E. (2004). *The Oriental Tradition of Paul of Aegina's Pragmateia*. Leiden: Brill.
- Pormann, P. E. and Savage-Smith, E. (2007). *Medieval Islamic Medicine*. Edinburgh: Edinburgh University Press.
- Pormann, P. E. (2011). The Formation of the Arabic pharmacology between tradition and innovation. *Annals of Science* 68(4), 493–515.
- Pormann, P. E. (2013). Avicenna on medical practice, epistemology, and the physiology of the inner senses. In P. Adamson (Ed.), *Interpreting Avicenna* (pp. 91–108). Cambridge: University Press.
- Rahman, A. (1999). A Perspective of Indian Science. In A. Rahman (Ed.), *History of Indian Science, Technology and Culture AD 1000-1800* (pp. 7–31), III. Oxford: University Press.
- Sadek, M.M. (1983). *The Arabic Materia Medica of Dioscorides*. Québec: Les Éditions du Sphinx.
- Sezgin, F. (1970). *Geschichte des arabischen Schrifttums* vol. III: *Medizin-Pharmazie, Zoologie - Tierheilkunde bis ca. 430 H.*. Leiden: Brill.
- Shankardass, M.K. (2002). India's Interactions in Medical Knowledge and Practice. In A. Rahman (Ed.), *History of Science, Philosophy and Culture in Indian Civilization*, III, 2: *India's Interaction with China, Central and West Asia* (pp. 275–296). Oxford: University Press.
- Siraisi, N.G. (1987). *Avicenna in Renaissance Italy. The Canon and medical teaching in Italian universities after 1500*. Princeton: Princeton University Press.
- Ullmann, M. (1970). *Die Medizin im Islam* (Handbuch der Orientalistik: Abt. 1, Der Nahe und der Mittlere Osten: Ergänzungsband 6, Abschn. 1). Leiden: Brill.
- Ullmann, M. (2009). *Untersuchungen zur arabischen Überlieferung der Materia medica des Dioskurides* (mit Beiträgen von R. Degen). Wiesbaden: Harrassowitz.
- Veit, R. 2011. Greek Roots, Arab Authoring, Latin Overlay: Reflections on the Sources for Avicenna's *Canon*. In C. Fraenkel, J. C. Fumo, F. Wallis, and R. Wisnovsky (Eds.), *Vehicles of Transmission, Translation, and Transformation in Medieval Textual Culture* (pp. 353–369). Turnhout: Brepols.
- Veit, R. [forthcoming]. *Materia medica* in a multilingual context: Avicenna's *Canon of Medicine* and its Latin translation of Book II. In E. Anheim, N. Berend, and S. Piron (Eds.), *Proceedings of the conference Circulations of texts and people in the Middle Ages* (Cambridge: June 2018 / Paris: January 2019).

