



Article

Research Foci in the History of Science in Past Islamicate Societies

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Abstract: In recent years, numerous changes have emerged in the History of Science of what has traditionally been called the Islamic world. By now, it has become usual to speak of the Islamicate world, albeit more so in Islamic Studies and related historical disciplines. The notion Islamicate wishes to express that the societies ruled by Muslim dynasties were multi-cultural, multi-ethnic, multi-confessional and plurilingual. Different Muslim denominations could form majority but also minority groups. The processes of change in the study of the sciences in those societies can be summarized as efforts to pluralize research approaches and to historicize objects, themes, people, institutions and practices. The pluralization of approaches includes the multiplication of (1) modern disciplinary homes for studies of scientific topics dealt with in Islamicate societies, (2) the languages acknowledged as languages of scientific texts such as New Persian, Ottoman Turkish or Urdu worthwhile to analyze, (3) the number of historical disciplines accepted under the umbrella of history of science, (4) the centuries or periods as well as the regions that have been incorporated into the investigation of past scientific knowledge and (5) the recognition that more than a single history can and should be told about the sciences in past Islamicate societies. The process of historicization means, first and foremost, to turn away from macro-units of research (Islam, medieval or Arabic science) to medium- or micro-level units. Historicization indicates, secondly, the turn toward contextualization beyond the analysis of individual texts or instruments. And thirdly, it signifies the integration of features or aspects of scholarly practices that are not limited to the content of a discipline or a text but include layouts, the organization of text production, types of visualizations of knowledge or rhetorical strategies and paratextual elements. My paper reports on trends that I consider relevant for understanding how the field changed over the last decades and how it ticks today. But it does not try to be comprehensive.

Keywords: Islamicate societies; methodological pluralism; historicization; regionalization; microhistory; contextualization; historiographical changes and conflicts



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1. Introduction

In this paper, I survey major research trends in a subfield of History of Science as they emerged during the last two to three decades. This subfield is called History of Science in Islamicate Societies. Its practitioners study texts, instruments, institutions, people and their various practices from two main perspectives: content and context. Both perspectives are to be pursued if one wishes to understand the “Lebenswelten” (life spaces) of any past scientific community and its achievements and shortcomings. Such an understanding of the interdependence of content and context was not always accepted in History of Science at large nor in its subfield, about which I write. While content analysis was the main goal of research in this subfield in the 20th century and remains the main goal of many researchers today, context has emerged as a strong trend in the 21st century among a smaller group of scholars. As in other disciplines of the Humanities, the pull toward context has brought with it a trend toward downgrading the analysis of philological and technical content, in particular among younger scholars. Scholars of older generations are often summarily dismissed as positivists, without sufficiently engaging with their insights

and their own academic, political and cultural contexts. Conflict, exclusion and closure are the main effects of putting content and context research in opposition. In my paper, I first provide in Section 2 a general survey of the main research trends since the late 20th century, linking them repeatedly to their beginnings and changes in the previous period after WWII. In the Section 3, I discuss major developments in the cluster of research dedicated to contextualizing the sciences in past Islamicate societies. Section 4 deals with a shift in historical perspective, the turn away from a belief in a universal history of science valid for all Islamicate societies for many centuries toward the idea of regional specialization and differentiation valid only for some societies in some periods and a demand for micro-historical studies below the societal level. The final section picks up the theme of conflict, exclusion and closure. I discuss some of their causes, trends and actors. I oppose the most radical trends and their representatives with a call for greater solidity and fairness when criticizing the works of previous scholars. Given the continuous attacks against past historians of science engaged in uncovering and analyzing the technical content of texts, instruments, maps and other scientific objects, I feel obliged to raise my voice in their defense. From the perspective of methodology, I therefore ask for contextualizing the work not only of scholars in past Islamicate societies but also of past historians of science in our own times.

2. General Survey

The History of Science in Islamicate societies¹ is a field with multiple orientations and numerous limitations at the cross-roads of History of Science and Islamic Studies, as well as several other, mostly historical, disciplines. On the one hand, these richly textured research activities have grown from professional opportunities that graduate students and subsequently early career scholars have created in the university departments in which they do their teaching and researching in a wide range of disciplines and thematic fields. Intellectual history, history of knowledge, art history, history of book art and material culture were particularly relevant for the diversification of the field of History of Science in Islamicate societies. More specialized regional and dynastically or communally defined fields of Islamicate history such as Andalusí and Maghribí history and Mamluk and Ottoman history equally supported a greater diversification in History of Science. Jewish and Oriental Christian history have also contributed their share. On the other hand, the multiplicity of academic affiliations, which is much richer than in previous decades, reflects the increasing extension of cooperation between historians of science and colleagues with other disciplinary and research orientations. This broadening of the group interested in studies on past sciences was, in turn, a direct result of a number of shared conceptual, thematic and methodical changes. The multiplication of disciplinary affiliations and hence qualifications has opened up new questions and introduced a number of new analytical methods, some of which have crossed the disciplinary boundaries between the various fields. This applies, as I mention below, to microhistory, contextualization, network studies or the promises of the Digital Humanities.

Despite the broadening of cooperation and audiences, History of Science is still less integrated into Islamic Studies or the various specialized fields of Islamicate history than is the History of Philosophy. The History of Philosophy has been recognized for at least two decades as a field of core relevance to the understanding of a number of Islamicate societies, but the importance of History of Science is growing. Its source materials are now no longer regarded as exclusively relevant to the so-called “Golden Age” (8th–11th centuries). I use the term “Golden Age” merely as an abbreviation for the about ten different Islamicate societies between northern India and the Iberian Peninsula whose dynasties heavily sponsored scholars working in the mathematical, philosophical or medical sciences in those centuries.

The shift in perspective from a focus on the “Golden Age” to later dynasties between about the 13th and 17th centuries is one of the major trends of change since about the late 1980s. This shift was set in motion by leading representatives from the generation of

scholars who built the field as a whole in the post-WWII period. Its central driver was the interest in individual scholars, texts and instruments. On the one hand, such interests led to the discovery of scientific practices that were specific to religious obligations in particular of Sunni societies (King 1973, 1977, 1981, 1983, 1993a, 1993b, 1999; Charette 2003; Rius 2013). On the other hand, an increased engagement with theoretical developments in Ptolemaic-type astronomy in Mongol Iran in the thirteenth century emerged (Kennedy and Ghanem 1976; Saliba and Kennedy 1991; Saliba 1987, 1996; Ragep 1987). All these changes toward a greater historicization of past sciences within specific contexts took place under a conceptual umbrella that assumed a unified history of science valid for all Islamicate societies between the Iberian Peninsula and South Asia. This historiographical perspective remained dominant until the early 21st century. It has not been fully abandoned even today. The move toward the study of the sciences in later centuries received a new impulse by two further trends in the last two decades of the 20th century. One trend was based on two overlapping goals that fostered the installation of nation-based approaches and institutions. Founding national teaching and research institutes and curricula mobilized History of Science in Islamicate societies for national identity formation, as well as for the promotion of modern sciences. It allowed participation in international institutions. This applies in particular in Muslim nation states and countries with a substantial Muslim minority population. Part of this development toward a national History of Science was the formation of specific ideological claims such as the everlasting compatibility of Islam and the sciences which aimed at uniting modern sciences with religious beliefs (Nasr 1978; Iqbal 2002, 2007).

The second trend grew out of historiographically motivated debates within History of Science at large. The interest of national research communities to investigate past sciences in the framework of a national history gave rise to concepts such as Ottoman sciences (Ihsanoğlu 2001, 2008). The historiographical impetus for increasing research on sciences in later centuries came from debates against the notions of marginalization and decline. Within the field of History of Science, the challenge against marginalization was raised by A. I. Sabra, a leading representative of the generation who stabilized, enlarged and enriched the field after WWII (Sabra 1987). Sabra called for reorienting research away from a study of the intermediary role of scholars in the Abbasid caliphate and Umayyad al-Andalus between “Greek” and “Latin” histories. He challenged us to ask for the causes of scientific developments within Islamicate societies and to investigate the properties of those developments within specific intellectual and institutional contexts. Sabra’s call for action appealed above all to younger scholars who received their training in Islamic Studies or Area Studies departments. Researchers trained in departments of mathematics, the sciences, medicine, History of Science or language studies overwhelmingly either continued to focus on the necessary study of the content of texts and instruments in different regions and times or undertook (not always successful) efforts to integrate studies of the sciences, such as those in the Ottoman Empire, into Western History of Science (Sidoli and Isahaya 2018; van Dalen 2022; Abdeljaouad and Oaks 2021; Küçük 2019).

The debates about or against “decline” gained momentum above all outside of History of Science. By now, questioning and rejecting the notion of “decline” are an important aspect of methodological and historical discussions in many of the fields with which History of Science shares points of contact (van Hees 2017; Dziri and Güneş 2020). History of Philosophy and Logic, closely related to History of Science, proved particularly vibrant and successful in dismantling those older evaluations of the fates of the sciences in Islamicate societies (el-Rouayheb 2017). The debates in those two fields successfully provided inspiration for studies in History of Science. This applies in particular to topics such as the alleged rejection of all types of causation in the natural world by religious scholars, the detrimental influence of al-Ghazālī on the intellectual history in Islamicate societies or the prevalently inimical attitude of scholars of the religious sciences toward the fields of knowledge appropriated from pre- or non-Islamic sources (Griffel 2009; Perler and Rudolph 2000).

New theories and methodologies, developed in the Humanities at large such as microhistory, postcolonialism or contextualized History of Science and various postmodern turns, for instance, the turns toward materiality or practices, strengthened the shift toward the study of later centuries. They also opened the way for including the range of knowledge fields that today are no longer considered scientific. Young scholars, mostly with training in other fields than History of Science, pushed for the admission of their research interests in the occult sciences—this term is one of the actors' categories for this part of classifications of the sciences—into History of Science (Melvin-Koushki 2012; Şen 2016). The described shifts in time frames and disciplinary orientations became the major components in the historiographically grounded changes challenging the field today. Previous research interests, methods and foci have increasingly been dismissed by the much over-simplified term “positivism”. This is an unfortunate development, because the study of past sciences cannot prosper when the engagement with their technical content is devalued. I return to this point below.

In addition to the temporary and disciplinary re-orientations, two further trends with overarching significance have shaped research during the last two decades and three more are on the rise. These are (1) contextualization and (2) content-focused exploration of texts and instruments. Three further trends on the rise consist of (1) a further temporal re-orientation, this time toward the modern period, including occasionally even the 20th century (Saif 2012; Günergün 2000, 2019a; Stolz 2018; Martykánová 2020) (2) an opening to studies of cross-cultural relationships in Asia beyond the traditional focus on Christian or colonial Europe (Weil 2016a, 2016b, 2022; Isahaya 2021, 2022) and (3) a call for extending the studied Islamicate societies beyond those so far in the center of investigations, in particular early modern India and Morocco (Speziale 2018; Stearns 2021). On the one hand, they reflect disappointments with the three larger and older trends toward contextualization, regionalization and localization and their underlying historiographical debates. On the other hand, they are inspired by developments in East Asian History and History of Science.

With regard to Europe, two developments seem to interact and at least partially re-enforce each other. First, an important discovery about mathematical astronomy in Arabic and Persian from the 1950s rapidly stimulated new investigations. Second, a blooming research landscape in Ottoman Studies crossed over into History of Science. This evolving interrelationship encompasses (1) the study of the possible impact of Islamicate planetary models on astronomical works of Regiomontanus or Copernicus and other theoretical questions such as whether the earth rotates or not and whether comets are terrestrially formed or celestial bodies (Ragep 2001a, 2005) and (2) the investigation of interactions between the Ottoman Empire, in particular its court, dragomans and scholars belonging to different knowledge communities, and Venice, the Hapsburg Empire, France or England (Morrison 2003; Rothman 2011, 2021; Brancaforte and Brentjes 2012; Brentjes 2010; Günergün 2009, 2011; Arbel 2002, 2014).

Almost all of these trends led to thematic and methodological pluralism and an increased historicization of the investigations of past sciences. They reflect the growing interaction of the field of the History of Science with various other disciplines in the Humanities. This applies, first and foremost, to other fields of history, both with regard to methodologies and methods, as well as with regard to themes, periods, regions, dynasties or cities. The premodern sciences in Islamicate societies that profited most from these trends in research include the astral sciences, medicine, alchemy, as well as other occult sciences and their institutional settings, including teaching (Niazi 2014; Fancy 2009, 2013b; Shefer-Mossensohn 2010, 2015; Varlık 2015; Forster 2006, 2021; Moureau 2021; Günergün 2019b; Leoni et al. 2020). The latter also extends to other mathematical sciences such as geometry or algebra (Abdeljaouad 2012; Abdeljaouad and Ageron 2019).

3. Contextualizing the Sciences

The demands to contextualize the sciences started in the debates about the definition of what History of Science should or could be, which took place in the 1970s and 1980s.

This question was set up rather dualistically, which is to say, the study of the internal conditions and features of the sciences in different historical periods was defined as one option and the study of the external frames and conditions that enable scientific activities as the alternative one. In History of Science in Islamicate societies this dualism was primarily conceived of as one of science versus politics. At that point in time, it was firmly believed that the number of relevant edited texts was insufficient for knowing what the sciences in those societies embodied. Hence internal history was seen as the task of the day. Moreover, politics was seen at best as an outside condition and better done by historians (Hartner 1977, p. 10). The first argument continued to be made in the next phase of historiographical debate, which began approximately in the 1990s. At that time, the pair internal/external was superseded and redefined by the pair content/context, following developments in History of Science at large. Context was no longer understood as confined to politics alone. Cross-disciplinary intellectual contexts became integrated beyond the previously standard comparisons with disciplinary predecessors or successors (Ragep 2001b, 2010; Sabra 2006, 2009). Institutional contexts, which in the earlier period were acknowledged but rarely studied in depth, became a second area of consolidated contextual studies. This applies in particular to patronage, teaching and medical institutions such as market places and hospitals and practices involved in argumentation, demonstration or innovation (Brentjes 2002, 2008, 2009; Endress 2006; Ragep 2016; Chipman 2009). The move to institutional studies challenged or buried older historiographical positions about marginalization, decline and the exclusion of the sciences from the madrasa.

Important contextual research focused on parts of the occult sciences (a similar trend had already taken place in the 20th century with regard to early modern sciences in parts of Europe). As emphasized above, the term “occult sciences” is an actors’ category. Other designations in addition to occult were also used, among them hidden, exceptional or rare. The standard members of this group are alchemy, physiognomy, several types of magic, for instance, the science of the letters or the production of amulets, and various kinds of divination, for example, geomancy. Some historical actors also included parts of astrology, bibliomancy, divination from parts of cooked sheep or flights of birds and divinatory games in this group. Not all research on those fields of knowledge can be briefly summarized here. Moreover, I am not certain that these areas always and unconditionally belong to the History of Science, as opposed to being assigned to Religious Studies, anthropology or the history of knowledge. Four examples shall suffice for indicating new research directions: physiognomy, alchemy, geomancy and the science of the letters or lettrism.

During the last two decades, physiognomy was studied in different intellectual (Sufism) and political (Ottoman court) contexts. As a result, methodical and conceptual connections with other disciplines such as medicine or astrology came to light. Saif argues that induction as well as forces having effects over distance linked physiognomy with medicine and astrology, which, on the one hand, gave them scientific status and, on the other, conceptual uncertainty (Saif 2022). Lelic studied the administrative and political relevance of physiognomy as a scientific practice for selecting suitable candidates for court and religious offices in the Ottoman Empire (Lelic 2017). A trend in studies of alchemy, brought about both by contextual as well as content investigations, consists in seeing alchemy more clearly as allied with other knowledge fields, in particular magic, religious doctrines and poetry (Todd 2021). This corpus of studies also entails moving beyond the “Golden Age” and to seemingly peripheral regions such as the Maghrib, which are the main themes of Section 3 (Forster 2016, 2022). Because most scholars studying alchemy edit, translate and comment on texts, they embed their historical practices in the standard methods of philology privileged in the study of the various mathematical sciences.

The combination of contextual and content studies proved fruitful and led to two interpretive changes. One consists in the recognition that the two traditionally separated components of this field of knowledge—chemical practice and philosophical or metaphysical theories—belonged together. Thus, alchemy needs to be studied as a unified whole,

although the named, as well as other, authors represent them in different combinations and quantitative textual presence (de Callatay and Moureau 2021; Martelli 2021).

An important contextual shift with regard to geomancy and the science of the letters was acknowledged in recent studies of these two fields. It concerns their classification in the entire system of disciplines and hence their status. During the periods of Mongol rule and their immediate successors, geomancy and the science of letters were designated as mathematical sciences. In contrast, the affiliation of astrology mostly oscillated between a branch of the natural sciences and the mathematical sciences. At times, astrology also was classified as part of the occult disciplines.

While such classificatory changes are definitely important intellectual contextual issues with implications for geographical and social contexts, more research is needed to clarify three points: (1) which Arabic terms are translated by modern interpreters as “mathematical” instead, for instance, as “propaedeutic”, what did they mean to their historical users and what do they mean to modern scholars; (2) what did it mean to the historical actors to speak of geomancy and lettrism as “mathematical” sciences and how did it alter their scholarly practices and contexts and (2) whether the different classifications of astrology had different kinds of impact on the social status and intellectual practices of astrologers. Melvin-Koushki argues that under the Timurid prince Iskandar Sultan (r. 1410–1415), lettrism became the leading philosophical discipline of the day and the royal road of knowledge to imperial expansion and success (Melvin-Koushki 2014, 2016). The main figure in this development was the court scholar Ibn Turka (1369–1432), who entertained a widely stretched network across Iran reaching in the West to Mamluk Cairo and into Ottoman circles and in the East to Herat and Samarqand (Melvin-Koushki and Gardiner 2017). The latter claim might be of particular importance to the history of the mathematical sciences at Ulugh Beg’s court, who is seen since Timurid times as the leading member of the family in those sciences.

Studies of courtly patronage of the mathematical sciences, geography and philosophy changed the traditional view that this institutional basis of the sciences in Islamicate societies was no longer functional after the fall of the Abbasid dynasty in 1258 after the Mongol conquest of Baghdad, although an exception was made for the work of Ulugh Beg and his court scholars in the first half of the 15th century.

Studies by Samsó, who has just published a magisterial work on the astral sciences in al-Andalus and the Maghrib, their technical content, practices and intellectual as well as political contexts, and Forcada confirm for this western region of the Islamicate world the importance of the ruling elites until the fall of the Nasrids (r. 1230–1492), the last Muslim dynasty on the Iberian Peninsula (Samsó 2020; Forcada 2005). Parallel to inquiries in courtly support for the sciences in al-Andalus, Forcada also investigated the formation of scholarly communities in that region and the relationships between their members (Forcada 2011). Efforts to trace members of scholarly communities among the religious minorities in Islamicate societies are also growing (Lev 2021).

Other patronage studies revealed the interests in and substantial support of the mathematical sciences, medicine, philosophy and agriculture in Iran, central Asia and India by the Mongol rulers of Iran, eastern Anatolia and Iraq from the middle of the 13th century to the fourth decade of the 14th centuries, as well as by smaller and larger successor dynasties from the second half of the 14th to the late 17th centuries (Caiozzo 2003, 2011; Subtelny 1997; Porter 1994, 2011).

Research on educational practices including their institutional forms such as libraries, study circles and schools are another important field of contextual studies. They have a long history in Islamic Studies. As a rule, they mostly focused on the religious disciplines, although in some cases, medicine was the main subject matter (Leiser 1983).

Since the beginning of the 21st century, more attention has been paid to educational practices from the perspective of the History of Science (Ihsanoğlu 2019; Brentjes 2017). This has produced interesting, albeit contradictory results. For the centuries of the “Golden Age”, very few sources provide explicit data about teaching in the sciences. The modern

researcher needs to determine the identity of texts as teaching material on the basis of narrative analytical methods, rare introductory or explanatory statements by a text's author and evaluations of structural, argumentative or demonstrative levels of any given text either on its own or in relationship to other types of text.

With the rise of the madrasa starting in Iran and Iraq in the 11th century and its subsequent spread over the centuries into more and more regions, things changed significantly. A growing number of narrative, documentary, instrumental and other sources for a history of scientific education were produced, many of which are today available. They show the full, albeit quantitatively subordinate integration of the mathematical, medical and philosophical sciences into the madrasa education in the form of textual studies, occasional excursions into the countryside for botanical explorations and probably also the teaching of how to construct and use instruments for observations and calculations. These sources reflect a truly cultural revolution.

Its both local and regional impact was of a kind that guaranteed for centuries the continued production and reproduction of different types of scholarly and educational texts and instruments. Teachers of the sciences were integrated into these educational landscapes as polymaths. Besides the mathematical or medical sciences, they taught logic, religious disciplines such as law, rational theology or foundational disciplines, language classes and possibly history or the one or the other occult discipline. This inclusion of the sciences first into the madrasa and later also in other educational institutions determined the options for the kind of teaching practices, educational tools and social perspectives available to teachers of the sciences (Brentjes 2018).

New methodologies such as commenting or “deep reading” unfolded over the centuries. The approach called “verification” (*tahqīq*) developed in mutual interaction between philosophy and divine science (religious metaphysics) from the late 10th to the 15th centuries (Eichner 2009; Wisnovski 2013). An Ottoman Sufi scholar exiled to Mecca in the 17th century created the teaching method of “deep reading” (el-Rouayheb 2017). In particular the first, but also the second, development stimulated philosophical discussions at courts and in schools, as well as the flourishing of logic in the 13th, 15th or 17th centuries in central Asia, North Africa and the Ottoman Empire.

Biographical dictionaries and teaching manuscripts in medicine and the mathematical sciences indicate the extension of such new methods of commenting and reading and thus of teaching and learning to those sciences (Fancy 2020; Karimullah 2017; Brentjes 2019). Studies of the commentary literature in philosophy, medicine, the astral and other mathematical sciences and the occult disciplines proved—against previous beliefs in their sterile character—that scholarly and at times political debates, educational experiments and new content developments took place in this literary genre in all major and several smaller Islamicate societies not only during the “Golden Age” but until the 19th century (Ahmed 2013; Ahmed and McGinnis 2016; Fancy 2013a, 2013b).

Further important contextual studies deal with sociocultural, disciplinary and regional contexts. I mention only one regional example, namely the eastern and central Mediterranean from the 15th to the 17th centuries. The investigated contexts concern mapmaking, geography, medicine, the mathematical sciences and the field of military knowledge. Here, cross-cultural activities of different types engendered trade in scientific products, ideas and scholars, translation and cooperation (Brentjes 2013a, 2015; Morrison 2014; Langermann and Morrison 2016; Hagen 2003; Goodrich 1990). A major international cooperation project in translation, geography and mapmaking unfolded in Istanbul from 1675 to 1685 headed by an Arabic madrasa scholar of the mathematical sciences (Brentjes 2014).

These studies yielded four major results. First, they prove false the belief that the cultural contacts between the Latin scholarly world in Europe and Islamicate societies ended in the later 13th century to lay dormant until Napoleon's invasion of Egypt in 1798. Second, they show that in the early modern period, translation once again became an important cultural phenomenon in the sciences (but not only in them) on both sides of the Mediterranean (Mills 2020; Dew 2009; Bevilacqua 2018). Third, the mutual interest in

scholarly works and texts across the Mediterranean highlights that until about the mid-17th century, the distance between the sciences in Christian societies in Europe and Islamicate societies in Europe, North Africa, western Asia and South Asia was still minor as far as the content of most of the sciences is concerned, with some greater differences in medicine, geometry and algebra (Brentjes 2010). Fourth, mapmaking emerged as a major field of cross-cultural exchange and cooperation beyond texts in the 14th century. It kept this property until the end of the early modern period, but now also including the translation of texts and cultural symbols (Casais 2009, 2010; de Castro León and Tiburcio 2021; Ducène 2017).

4. The Shift from an Assumed Universal History of Science in Islam to Medium- and Micro-Historical Studies in Concrete Islamicate Societies

Two of the main features of History of Science in the second half of the 20th century were the claims of its professional practitioners that their local or regional results were characteristic for the entire Islamicate world and that the sciences were dominantly practiced in Arabic. Both ideas continue to be expressed until today but have been increasingly contested by studies on translations and production of scholarly texts and instruments in Persian, Ottoman Turkish, Sanskrit and to a lesser degree Syriac. The study of Persian and Turkish scientific texts, including translations, has gained in momentum since the last decade of the 20th century. Persian scientific texts from later Islamicate societies are edited, translated and interpreted as theses or postdoctoral works (Mahdavi 2009; Niazi 2022). Courtly and private library holdings have been analyzed for rulers, princes or scholars in three dynasties (Ayyubids, Mamluks and Ottomans) between the 13th and 18th centuries (Behrens-Abouseif 2018; Hirschler 2016, 2020; Liebrecht 2013, 2016; Necipoğlu et al. 2019). They document the continued and shared interest in scientific material among these different social groups thus offering further evidence against the marginalization of the sciences.

Studies of the occult sciences have in part localized the development of those fields of knowledge under specific dynasties and in concrete cities (Gardiner 2017a, 2017b, 2019, 2020; Şen 2016, 2017a, 2017b; Melvin-Koishki 2018, 2021; Orthmann 2005, 2006, 2011, 2018). At the same time, they try to re-establish a universalized interpretive framework. They span a curve from the Maghrib to central and South Asia on two levels—(1) the study of scholarly or textual networks and (2) interpretations of the changed meanings of kingship since the Mongol period.

In the History of Mathematics, efforts to regionalize investigations of mathematical texts have been undertaken since the 1980s in conjunction with institution building in Morocco, Algeria and Tunisia. Manuscripts from local libraries, whether royal, national or private, are explored to find texts of any production time with new mathematical results. The institution-building efforts and hence the discussion of contemporary methodological debates in other countries than those in North Africa were undermined by the Algerian civil war and the aftermath of the so-called Arab Spring. Nonetheless, colleagues in the three countries try to keep the study of their heritage in the mathematical sciences alive. A conceptually different, albeit methodologically similar, sequence of research projects is being carried out in Tunisia. It aims at reconstructing the history of early modern and modern educational programs and institutions in the mathematical sciences during the Regency of Tunis from the late 16th century to 1881 and the following French Protectorate (ended in 1956). The approach combines three elements: the study of individual manuscripts; the study of libraries and legal documents; the construction of a virtual collection of all of the written heritage of Tunisia in its various historical configurations (Abdeljaouad and Hedfi 2021).

In History of Medicine and Alchemy, a particularly interesting project of regionalization and localization concerns the translation efforts in the Mughal Empire and the cross-cultural rapprochement of Muslim and Hindu and maybe Jain physicians (Speziale 2018). It shows that Ayurvedic medical concepts and practices, including alchemical ideas, were studied by Muslim doctors who practiced their profession primarily in Persian. In

parallel, Hindu and Jain doctors assimilated elements of Galenic-Avicennan medicine, in India called Unani after the Arabic word for Ionian meaning Greek.

In the History of Astronomy and Astrology, four main projects of regionalization have been undertaken since the 20th century. The first project concerns astronomical tables, astrology, instrumentation and calendars in al-Andalus and North Africa. The second project focuses on planetary theory with its developments of non-Ptolemaic models to overcome problems embodied in Ptolemy's models for each of the planetary orbits and their newly created mathematical tools. In its first decades of study research focused on Mongol Iran, in particular the capitals Maragha and Tabriz, and Mamluk Syria, mainly Damascus. In the last three decades, the attention has shifted to Safavid Iran, mainly Shiraz and recently to Isfahan. The two other projects deal with the development of timekeeping in Mamluk Egypt and Syria and astral and agricultural literature and practices in Yemen, mainly during the Rasulid dynasty (1228–1454). In all four of them, new publications have recently appeared (Samsó 2020; Saliba 1993, 1994; King 2004, 2005, 2015; Varisco 1994, 1997, 2002; Schmidl 2007, 2012).

Among the many different results of these efforts toward regionalization and localization in the astral sciences, two seem to me particularly challenging. The first result concerns the transmission of planetary theory. Its westward spread to Damascus, Istanbul, Florence and perhaps also Padua, studied in the second project, seems to have remained a highly localized trend. In contrast, the eastward spread through Iran, central Asia and India apparently represents a regionalization of planetary theory sustained primarily through the madrasa system. The westward transmission seems to have been carried in a sustainable fashion by a small number of individuals and inter-personal contacts. The eastward transmission also started out as a local phenomenon but then unfolded on a regional level. This process presupposes larger and more stable networks of scholars and texts, migration and book trade. More substantial studies of the contexts of the individual scholars, their mobility, and the formation of medium- or long-term networks are thus an urgent task.

A seemingly local device, the wind catcher, turned out to have had a much deeper regional history in combination with an impressive range of sociocultural contexts. In disciplinary terms, wind catchers relied on skills and training of madrasa scholars in a specific astronomical discipline called timekeeping, which had emerged in the late 13th or early 14th century, in the Mamluk Empire, in cooperation with craftsmen (King 2020). Moreover, it also acquired a trans-regional component of long-durée beyond the sciences, which reflects the regional developments in the eastern and central Mediterranean briefly mentioned in Section 2.

Although not a peripheral region but within History of Science a peripheral discipline, Shopov's discovery of the importance of agricultural literature as a scientific enterprise in parts of Ottoman urban society is another important recent insight (Shopov 2019). His studies include reflections on significant new economic and material practices and far-reaching social changes, above all in the milieu of Sufi orders, which open up localized studies in an individual science to new interdisciplinary perspectives.

Across disciplinary boundaries, the study of how a believer engaged in a science that contradicted religious tenets and how they negotiated conflicts has produced several new studies, which opened up new territories for research, including religious literature such as treatises on the exegesis of the Qur'an or the Bible or inter-religious polemics (Morrison 2002, 2007, 2013; Aparicio 2018).

Although many more studies of local or regional scholarly activities in Islamicate societies have been published during the last two decades, those briefly summarized in this section already highlight the fruitfulness of this move away from a universal history of science in Islam expressed in Arabic only.

5. Historiographical Challenges

In the previous sections, I highlighted two main overarching trends in History of Science—methodological pluralism and historicization. This is, however, only correct in

a limited sense. Numerous smaller and bigger conflicts indicate that these processes are uneven and not far reaching enough. It is clearly not fully accepted (yet) to treat with critical respect other approaches and methods than those that a single author or a group of authors prefers to pursue. A trend to increasingly express critiques in ideological or political forms is clearly recognizable and endangers cooperation and cohesion. In a true practice of methodological pluralism, it does not matter for the legitimacy of an object of historical investigation whether its “science” continues to be considered “science” today and whether the form of knowledge in which it was embodied and acknowledged as a legitimate form of meaning making *then* is seen *today* as a flawed epistemic program. In my view, all historical efforts of knowledge production together with their contexts are acceptable as legitimate objects of historical study. The engagement for the inclusion of past sciences such as some of the occult disciplines into the History of Science should not be executed by delegitimizing the traditional main members of this academic field, i.e., the mathematical sciences, philosophy and medicine, and their practitioners.

I find it particularly troublesome that the generations who built the field in the 20th century and my own generation are by now summarily, as well as individually, accused of Eurocentrism, racism, scientism, positivism, orientalism or other -isms. This kind of politicized rejection of previous research increasingly assumes a tone of denunciation. Two cases are particularly improper. One case is George Saliba’s construction of a single so-called “classical narrative” about the history of past sciences (mainly related to the eighth, ninth and tenth centuries) by scholars who worked in the 20th century before and after WW II (Saliba 2007). While I do not agree with a number of their claims and approaches, they deserve the same fair treatment and respect as each one of us expects for his or her own work. There never was a unified “classical narrative” but several evaluations, which differed sometimes more, sometimes less among each other. A second case are Ahmed Ragab’s misrepresentations of the criticism raised by a group of colleagues, me included, against the complex project by lay people called *1001 Inventions* and the various products developed around it (Brentjes 2013b; Brentjes et al. 2016). I consider his claims that we are Eurocentrists, supporters of colonialism and inimical toward Muslims not merely as factually wrong but as a violation of academic standards of fair critique and ethical behavior (Ragab 2019). His is a kind of intervention that I firmly reject.

Admittedly, these two publications are extreme cases. Nonetheless, terms such as positivism, orientalism, Eurocentrism or racism are often superficially used, that is without proof, which is to say without serious arguments about specific content, methods and approaches and without any efforts to understand the contexts of such earlier works or to acquire knowledge about the practical academic activities of numerous of my colleagues, among them Edward S. Kennedy and his wife Mary Helen, Ahmed Djebbar, Ulrich Rebstock, Jan P. Hogendijk or Jens Høyrup. A particularly unpleasant kind of such condemnations of the works of scholars of previous generations is the combination of the empty ideological or political rhetoric with claims about a young scholar’s discovery in her thesis of the only right way to salvage History of Science from all our corrupting interpretive practices (de Block 2020).

Another variant of dismissing previous positions together with their results is the demand that certain scholars or studies of the mathematical sciences should have included in History of Science those of the occult sciences that historical actors called “mathematical”. In some of these cases, the critics overlook the fact that previous scholars had indeed studied aspects of astrology, alchemy, magic or divination. Their work included editing relevant texts, translating and analyzing them. I wish to refer the reader to the works of Kennedy, Pingree, Hogendijk, Burnett, Yano and Yamamoto, as well as Samsó and his students (Kennedy and Pingree 1971; Kennedy 1998, 2009; Hogendijk 2015; Burnett and Yamamoto 2019; Burnett et al. 2004, 2008; Burnett and Bos 2000; Samsó 2007; Casulleras and Hogendijk 2012).

A somewhat surprising component of the intellectual and social conflicts about whether something belongs to the History of Science or not is the strongly made argu-

ment that the occult sciences have been accepted in Western History of Science as valid contributors to the new sciences in the early modern period and that is why researchers on Islamicate societies should follow their lead (Melvin-Koushki 2020a, 2020b). I find this turn surprising because of two reasons. First, it is in methodological conflict with Sabra's abovementioned appeal to turn away from using ancient Greek or medieval Latin scientific communities and their results as yardsticks for evaluating those in Islamicate societies. Turning to early modern or modern sciences in western Europe for support for studies of the occult sciences in contemporary Islamicate societies differs only in chronology, not in methodology. Second, I do not see a development to new sciences in Islamicate societies inspired by the heavy investment into the occult disciplines. In my view, the intellectual cultures went in very different directions. This does not mean that the developments in Islamicate societies should not be studied under the umbrella of the History of Science. Rather, it means to practice more systematically and carefully Sabra's invitation to historians of science to focus on the relevant intellectual processes in their own spaces within Islamicate societies.

Some historiographical changes in Western but also East or South Asian History of Science did reach the History of Science in Islamicate societies. One example of such relatively new arrivals is the concept of actors' categories. Respectable arguments speak in favor of its application. Above, I pointed, for instance, to the changes in the classifications of the intellectual disciplines in Islamicate societies and their impact on social, ideological and political conditions. However, the question arises whether it suffices to rely on such categories of the past without questioning their own historical meaning and contexts and without relating them to our own categories.

Other concepts and theories from the Humanities have not yet reached the study of the sciences as practices in past Islamicate societies, among them self-reflexivity and grounded theory. It is possible that they never will, because even the representatives of the newly added fields of research are often not very courageous and experimental in trying out new methods of analysis and interpretation. One admirable, but also contested, exception is the field of plague studies (Varlık 2017; Fancy and Green 2021; Fancy forthcoming).

But engaging self-critically in reflections on why we wish to include certain fields of knowledge and approaches in History of Science when we also could include them in some other academic field, for instance, the broader field of History of Knowledge, seems to me a fruitful and as of yet underdeveloped discussion. We should ask what we lose or gain by taking the one or the other decision. We also need to ask how we can integrate content studies with context studies since it is indisputable that neither one isolated from the other will give us full access to the historical meaning and significance of past sciences. Observing this unequal absorption of new developments whether with respect to methodology or to methods in different areas of History of Science, more discussion on the question is needed as to how we can profit from the recent developments in manuscript studies, narrative or discourse theoretical analysis or visual studies, to name only a few examples. As in the previous sections, it is necessary to state that there are further historiographical challenges relevant to the various compartments of the History of Science and addressed in a variety of manners. But highlighting them all goes far beyond the scope of this invitation to report on major trends in the field.

6. A Personal Note

I am neither an arbiter nor a diviner. Hence, I do not wish to take a position of final judgment nor can I predict the future. There are trends in History of Science that I appreciate and am happy to see emerging and flourishing. This applies in particular to contextualized studies of scientific practices of all kinds. It also applies to studies that look with a critical eye at the content of the material the researcher wishes to claim as an expression of significance for the society he or she studies. Looking at historical material with a critical eye means to recognize the contradictions, mistakes or relative simplicity in an authorial or artisanal product without, however, denying such a product and its maker

the right to serious historical analysis. Almost all of what we create ourselves is “normal science”. Hence, the past producers of “normal science” should be taken seriously, and their works and contexts are legitimate objects for our historical analysis.

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Note

¹ Since this paper is about that part of the academic discipline “History of Science” which studies past sciences in Islamicate societies, I in most cases simply call it “History of Science”. When I occasionally refer to the entire discipline, I name it “History of Science at large,” and when I refer to other scientific cultures, I qualify “History of Science” by geographical markers. I use capital letters when I talk about academic disciplines or subdisciplines and lower cases when I refer to the sciences in history.

References

- Abdeljaouad, Mahdi, and Hmida Hedfi, eds. 2021. *Makhtūṭāt ‘ilmīyya bi-l-maktaba al-abḥmadiyya (riyādiyyāt—falak—tanjīm)*. Tūnis: Dār al-kutub al-waṭaniyya.
- Abdeljaouad, Mahdi, and Jeffrey Oaks. 2021. *Al-Hawārī’s Essential Commentary*. Arabic Arithmetic in the Fourteenth Century, Edition Open Sources, Sources 14. Berlin: MPG.
- Abdeljaouad, Mahdi, and Pierre Ageron. 2019. Eastern and Western Instruments in Osman Efendi’s Hadiyyat al-Muhtadi (The Gift of the Convert), 1779. In *Scientific Instruments between East and West*. Edited by Neil Brown, Silke Ackermann and Feza Günergun. Leiden and Boston: Brill, pp. 16–38.
- Abdeljaouad, Mahdi. 2012. Teaching European mathematics in the Ottoman Empire during the eighteenth and nineteenth centuries: Between admiration and rejection. *Mathematics Education* 44: 483–98. [CrossRef]
- Ahmed, Asad Q. 2013. Post-Classical Philosophical Commentaries/Glosses: Innovation in the Margins. *Oriens* 41: 317–48. [CrossRef]
- Ahmed, Asad Q., and Jon McGinnis. 2016. Arabo-Islamic Physics in the Late Pre-Modern Period: The Hadiyya Sa’idiyya of Faḍl-i Ḥaqq Khayrābādī. In *Oxford Handbook of Islamic Philosophy*. Edited by Khaled El-Rouayheb and Sabine Schmidtke. Oxford: Oxford University Press, pp. 535–59.
- Aparicio, Mònica Colominas. 2018. *The Religious Polemics of the Muslims of Late Medieval Christian Iberia. Identity and Religious Authority in Mudejar Islam (The Medieval and Early Modern Iberian World 64)*. Leiden and Boston: Brill.
- Arbel, Benjamin. 2002. Maps of the world for ottoman princes? Further evidence and questions concerning the mappamondo of Hajji Ahmed. *Imago Mundi* 54: 19–29. [CrossRef]
- Arbel, Benjamin. 2014. Translating the Orient for the Serenissima: Michiel Membrè in the Service of Sixteenth Century Venice. In *La frontiere Méditerranéenne du XVe au XVIIe Siècles. Échanges, Circulations et Affrontements (Études Renaissance 12)*. Edited by Bernard Heyberger and Albrecht Fuess. Turnhout: Brepols, pp. 253–83.
- Behrens-Abouseif, Doris. 2018. *The Book in Mamluk Egypt and Syria (1250–1517): Scribes, Libraries and Market*. Leiden and Boston: Brill.
- Bevilacqua, Alexander. 2018. *The Republic of Arabic Letters: Islam and the European Enlightenment*. Cambridge: Belknap Press of Harvard University Press.
- de Block, Fien. 2020. (Re)drawing the Lines: The Science of the Stars in the Late Fifteenth Century Sultanate of Cairo. Ph.D thesis, University of Gent, Ghent, Belgium. Available online: <https://core.ac.uk/download/pdf/323232713.pdf> (accessed on 23 February 2022).
- Brancaforte, Elio, and Sonja Brentjes. 2012. From Rhubarb to Rubies: European Travels to Safavid Iran (1550–1700). The Lands of the Sophi: Iran in Early Modern European Maps (1550–1700). *Harvard Library Bulletin* 23. [CrossRef]
- Brentjes, Sonja, Taner Edis, and Lutz Richter-Bernburg, eds. 2016. *1001 Distortion. On How (Not) to Narrate History of Science, Medicine and Technology in Non-Western Cultures (Bibliotheca Academica: Orientalistik 25)*. Würzburg: Ergon.
- Brentjes, Sonja. 2002. On the Location of the Ancient or ‘Rational’ Sciences in Muslim Educational Landscapes (AH 500–1100). *Bulletin of the Royal Institute of the Inter-Faith Studies* 4: 47–71.
- Brentjes, Sonja. 2008. Courtly Patronage of the Ancient Sciences in Post-Classical Islamic Societies. *Al-Qantara* 29: 403–36. [CrossRef]
- Brentjes, Sonja. 2009. Patronage of the mathematical sciences in Islamic societies. In *The Oxford Handbook of the History of Mathematics*. Edited by Eleanor Robson and Jacqueline Stedall. Oxford: Oxford University Press, pp. 301–27.
- Brentjes, Sonja. 2010. *Travellers from Europe in the Ottoman and Safavid Empires, 16th–17th Centuries. Seeking, Transforming, Discarding Knowledge*. Aldershot: Ashgate.

- Brentjes, Sonja. 2013a. Giacomo Gastaldi's maps of Anatolia: The evolution of a shared Venetian-Ottoman cultural space? In *The Renaissance and the Ottoman World*. Edited by Anna Contadini and Claire Norton. Farnham: Ashgate, pp. 123–41.
- Brentjes, Sonja. 2013b. Review of: Salim T. S.al-Hassani (ed.), 1001 Inventions: The enduring legacy of Muslim civilization, Washington, DC: National Geographic, 2012. *Aestimatio* 10: 119–53.
- Brentjes, Sonja. 2014. Abū Bakr al-Dimashqī's (d. 1691) hemispheric map of the New World and the representation of the seas in his maps of the world and the continents. In *Seapower, Technology and Trade: Studies in Turkish Maritime Histor.* Edited by Dejanirah Couto, Feza Günergun and Maria Pia Pedani. Istanbul: Piri Reis University/Denizler Kitabevi, pp. 398–411.
- Brentjes, Sonja. 2015. Fourteenth-century Portolan charts: Challenges to our understanding of cross-cultural relationships in the Mediterranean and Black Sea regions and of (knowledge?) practices of chart-makers. *Journal of Transcultural Medieval Studies* 2: 79–112. [CrossRef]
- Brentjes, Sonja. 2017. Teaching the Sciences in Ninth-Century Baghdad as a Question in the History of the Book: The Case of Abū Yūsuf Ya'qūb b. Ishāq al-Kindī (d. after 256/870). *Intellectual History of the Islamicate World* 5: 1–27. [CrossRef]
- Brentjes, Sonja. 2018. *Teaching and Learning the Sciences in Islamicate Societies (800–1700)*. Turnhout: Brepols.
- Brentjes, Sonja. 2019. Ms Munich, Bayerische Staatsbibliothek, Codex Arab. 2697 And Its Properties. *Micrologus* 27: 443–66.
- Burnett, Charles, and Gerrit Bos. 2000. *Scientific Weather Forecasting in the Middle Ages: The Writings of Al-Kindi*. Studies, Editions, and Translations of the Arabic, Hebrew and Latin Texts. London: Routledge.
- Burnett, Charles, and Keiji Yamamoto, eds. 2019. *The Great Introduction to Astrology by Abū Ma' šar, with an Edition of the Greek Version by David Pingree*. 2 vols. Leiden and Boston: Brill.
- Burnett, Charles, Keiji Yamamoto, and Michio Yano. 2004. *Al-Qabīṣī (Alcabitius): The Introduction to Astrology*. Editions of the Arabic and Latin texts, and an English translation (Warburg Institute Studies and Texts 2). London: Warburg Institute.
- Burnett, Charles, Anna Akasoy, and Ronit Yoeli-Tlalim, eds. 2008. *Astro-Medicine: Astrology and Medicine, East and West (Micrologus' Library 25)*. Florence: Sismel-Edizioni del Galluzzo.
- Caiozzo, Anna. 2003. *Images du ciel d'Orient au Moyen Âges*. Paris: Presses Universitaires de la Sorbonne, Collection Islam.
- Caiozzo, Anna. 2011. *Réminiscence de la Royauté dans les Représentations dans l'Orient Médiéval*. Cairo: IFAO.
- de Callatay, Godefroid, and Sébastien Moureau. 2021. In Code We Trust. The Concept of Rumūz in Andalusī Alchemical Literature and related texts. In *Alchemy in the Islamicate World*. Edited by Regula Forster. Berlin: Asiatische Studien—Études Asiatiques, vol. 75, pp. 429–47.
- de Castro León, Victor, and Alberto Tiburcio. 2021. 'Alī al-Sharafī's 1551 Atlas: A Construct Full of Riddles. In *Übersetzen in der Frühen Neuzeit—Konzepte und Methoden/Concepts and Practices of Translation in the Early Modern Period*. Edited by Regina Töpfer, Peter Burschel and Jörg Wesche. Berlin/Heidelberg: Springer, pp. 259–85.
- Casulleras, Josep, and Jan P. Hogendijk. 2012. Josep Casulleras, Jan P. Hogendijk, Progressions, Rays and Houses in medieval Islamic astrology: A mathematical classification. *Suḥayl* 11: 33–102.
- Charette, François. 2003. *Mathematical Instrumentation in Fourteenth-Century Egypt and Syria. The Illustrated Treatise of Najm al-Dīn al-Miṣrī*. Islamic Philosophy, Theology and Science. Texts and Studies, 51. Leiden and Boston: Brill.
- Chipman, Leigh. 2009. *The World of Pharmacy and Pharmacists in Mamlūk Cairo*. Leiden and Boston: Brill.
- Dew, Nicholas. 2009. *Orientalism in Louis XIV's France*. Oxford and New York: Oxford University Press.
- Ducène, Charles. 2017. Abū Bakr ibn Bahrām al-Dimashqī (m. 1102/1691) et sa Risāla fi-l-juḥrāfiyā. In *Contacts and Interaction. Proceedings of the 27th Congress of the Union Européenne des Arabisants et Islamisants (Orientalia Lovaniensia Analecta 254)*. Edited by Jaakko M. Hämeen-Anttila, Petteri Koskikallio and Illka J. Lindstedt. Leuven: Peeters, pp. 143–57.
- Dziri, Bacem, and Merdan Güneş, eds. 2020. *Niedergangsthesen auf dem Prüfstand/Narratives of Decline Revisited (ROI—Reihe für Osnabrücker Islamstudien Book 38)*. Berlin: Peter Lang.
- Eichner, Heidrun. 2009. The Post-Avicennian Philosophical Tradition and Islamic Orthodoxy. Philosophical and Theological in Context. Ph.D. dissertation, Martin Luther University Halle-Wittenberg, Halle, Germany. unpublished.
- Endress, G. 2006. Reading Avicenna in the Madrasa: Intellectual Genealogies and Chains of Transmission of Philosophy and the Sciences in the Islamic East. In *Arabic Theology, Arabic Philosophy*. From the Many to the One: Essays in Celebration of Richard M. Frank. Edited by James E. Montgomery. Leuven: Peeters, pp. 371–422.
- Fancy, Nahyan, and Monica Green. 2021. Plague and the Fall of Baghdad (1258). *Medical History* 65: 157–77. [CrossRef]
- Fancy, Nahyan. 2009. The Virtuous Son of the Rational: A Traditionalist's Response to the Falāsifa. In *Avicenna and His Legacy: A Golden Age of Science and Philosophy*. Edited by Y. Tzvi Langermann. Turnhout: Brepols Publishers.
- Fancy, Nahyan. 2013a. Medical Commentaries: A Preliminary Examination of Ibn al-Nafīs's Shurūh., the Mūjaz and Subsequent Commentaries on the Mūjaz. *Oriens* 41: 525–45. [CrossRef]
- Fancy, Nahyan. 2013b. *Science and Religion in Mamluk Egypt: Ibn al-Nafīs, Pulmonary Transit and Bodily Resurrection*. New York: Routledge.
- Fancy, Nahyan. 2020. Verification and Utility in the Arabic Commentaries on the Canon of Medicine: Examples from the Works of Fakhr al-Dīn al-Rāzī (d. 1210) and Ibn al-Nafīs (d. 1288). *Journal of the History of Medicine and Allied Sciences* 75: 361–82. [CrossRef]
- Fancy, Nahyan. forthcoming. Knowing the Signs of Disease: Plague in the Arabic Medical Commentaries Between the First and Second Pandemics. In *Death and Disease in the Long Middle Ages*. Edited by Lori Jones and Nükhet Varlık. York: York Medieval Press.
- Forcada, Miquel. 2005. Síntesis y contexto de las ciencias de los antiguos en época almohade. In *Los Almohades: Problemas y Perspectivas*. Edited by Patrick Cressier, Maribel Fierro and Luis Molina. Madrid: CasaVelázquez, vol. 2, pp. 1091–135.
- Forcada, Miquel. 2011. *Ética e ideología de la ciencia: El médico filósofo en al-Andalus (siglos X-XII)*. Almería: Fundación Ibn Ṭufayl.

- Forster, Regula. 2006. *Das Geheimnis der Geheimnisse. Die Arabischen und Deutschen Fassungen des Pseudo-aris-Totelischen Sirr al-asrār/Secretum Secretorum*. Wiesbaden: Reichert.
- Forster, Regula, ed. 2016. Arabic Alchemy. Texts and Contexts. *Al-Qanṭara* 37.
- Forster, Regula, ed. 2021. Alchemy in the Islamic World. *Asiatische Studien—Études Asiatiques* 75.
- Forster, Regula. 2022. Culture and Science: Alchemy's Scientific Contexts and Critiques: Islamic World. In *A Cultural History of Chemistry*. Edited by Charles Burnett and Sébastien Moureau. London: Bloomsbury Academic, vol. 2, pp. 71–80.
- Gardiner, Noah. 2017a. Esotericist Reading Communities and the Early Circulation of the Sufi Occultist Ahmad al-Buni's Work. *Arabica* 64: 405–41. [\[CrossRef\]](#)
- Gardiner, Noah. 2017b. Stars and Saints: The Esotericist Astrology of the Sufi Occultist Ahmad al-Buni. *Journal of Magic, Ritual, and Witchcraft* 12: 39–65. [\[CrossRef\]](#)
- Gardiner, Noah. 2019. Books on Occult Sciences. In *Treasures of Knowledge: An Inventory of the Ottoman Palace Library (1502/3–1503/4)*. Edited by Gülru Necipoğlu, Cemal Kafadar and Cornell H. Fleischer. Leiden and Boston: Brill, vol. 1, pp. 735–65.
- Gardiner, Noah. 2020. *Ibn Khaldūn versus the Occultists at Barqūq's Court: The Critique of Lettrism in al-Muqaddimah*. Berlin: EB Verlag.
- Goodrich, Thomas D. 1990. *The Ottoman Turks and the New World: A Study of Tarih-i Hind-i Garbi and Sixteenth-Century Ottoman Americana*. Wiesbaden: O. Harrassowitz.
- Griffel, Frank. 2009. *Al-Ghazālī's Philosophical Theology*. Oxford: Oxford University Press.
- Günergun, Feza. 2000. Diseases in Turkey: A Preliminary study for the second half of the 19th century. In *The Imagination of the Body and the History of Bodily Experience*. International Symposium January 18–22 January. Kyoto: International Research Centre for Japanese Studies, pp. 169–91.
- Günergun, Feza. 2009. Ottoman encounters with European science: Sixteenth- and seventeenth-century translations into Turkish. In *Cultural Translation in Early Modern Europe*. Edited by Peter Burke. Cambridge: Cambridge University Press.
- Günergun, Feza. 2011. The Ottoman Ambassador's Curiosity Coffin: Eclipse Prediction with De La Hire's "Machine" Crafted by Bion of Paris. In *Science Between Europe and Asia, Historical Studies on the Transmission, Adoption and Adaptation of Knowledge*. Edited by Feza Güneergun and Dhruv Raina. Dordrecht, Heidelberg, London and New York: Springer, pp. 103–23.
- Günergun, Feza. 2019a. Paul Mentré: 1926–1928 yıllarında İstanbul'da bir Fransız matematikçi—Mühendis/Paul Mentré: A French mathematician—Engineer in Istanbul in 1926–1928. *Osmanlı Bilimi Araştırmaları* 20: 92–101.
- Günergun, Feza. 2019b. Convergences in and around Bursa: Sufism, Alchemy, Iatrochemistry in Turkey, 1500–1750. In *Entangled Itineraries: Materials, Practices, and Knowledges across Eurasia*. Edited by Pamela H. Smith. Pittsburgh: University of Pittsburgh Press, pp. 227–57.
- Hagen, Gottfried. 2003. *Ein osmanischer Geograph bei der Arbeit. Entstehung und Gedankenwelt von Kātib Çelebis Ğihānnumā, (Studien zur Sprache, Geschichte und Kultur der Türkvolker)*. Berlin: Klaus Schwarz Verlag.
- Hartner, Willy. 1977. The Role of Observations in Ancient and Medieval Astronomy. *Journal for the History of Astronomy* 8: 1–11. [\[CrossRef\]](#)
- Casais, Mónica. 2009. Granada en los atlas náuticos de al-Šarafī, e identificación de un modelo mallorquín para la carta de al-Mursī. *Al-Qanṭara* 30: 221–35. [\[CrossRef\]](#)
- Casais, Mónica. 2010. Un mar para navegar, imaginary compartir: La imagen del Mediterráneo y otras geografías en la carta náutica de Ibrāhīm al-Mursī. In *Investigación, Conservación y Restauración de Materiales y Objetos Cartográficos. Actas del Curso Celebrado en el Instituto del Patrimonio Cultural de España en Noviembre de 2010*. Edited by María Domingos and Iolanda Muña. Madrid: Ministerio de Educación, Cultura y Deporte, pp. 42–55.
- Hirschler, Konrad. 2016. *Medieval Damascus: Plurality and Diversity in Arabic Library. The Ashrafiya Library Catalogue (Edinburgh Studies in Classical Islamic History and Culture)*. Edinburgh: Edinburgh University Press.
- Hirschler, Konrad. 2020. *A Monument to Medieval Syrian Book Culture—The Library of Ibn 'Abd al-Hādī (with Plates), (Edinburgh Studies in Classical Islamic History and Culture)*. Edinburgh: Edinburgh University Press.
- Hogendijk, Jan P. 2015. Al-Biruni on the Computation of Primary Progression (tasyir). In *From Masha'allah to Kepler. Theory and Practice in Medieval and Renaissance Astrology*. Edited by Charles Burnett and Dorian Gieseler Greenbaum. Ceredigion: Sophia Centre Press, pp. 279–307.
- Ihsanoğlu, Ekmeleddin. 2001. Science in the Ottoman empire. In *The Different Aspects of Islamic Culture, vol. 4: Science and Technology in Islam*. Edited by Ahmad Youssef al-Hassan, Coeds Maqbul Ahmed and Albert Zaki Iskandar. Paris: UNESCO Publishing, pp. 565–92.
- Ihsanoğlu, Ekmeleddin. 2008. Science of the Ottomans. In *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*, 2nd ed. Edited by Helaine Selin. Berlin/Heidelberg and New York: Springer, pp. 31–38.
- Ihsanoğlu, Ekmeleddin. 2019. *Medreseler Neydi, Ne Degildi: Osmanlılarda Akli İlimlerin Eğitimi ve Modern Bilimin Girişi*. Istanbul: Kronik Kitap.
- Iqbal, Muzaffar. 2002. *Islam and Science*. Aldershot: Ashgate.
- Iqbal, Muzaffar. 2007. *Science and Islam*. Westport and London: Greenwood Press.
- Isahaya, Yoichi. 2021. From Alamut to Dadu: Jamāl al-Dīn's Armillary Sphere on the Mongol Silk Roads. *Acta Orientalia Academiae Scientiarum Hungaricae* 74: 65–78.
- Isahaya, Yoichi. 2022. Geometrizing Chinese Astronomy? The View from a Diagram in the Kashf al-ḥaqā'iq by al-Nīsābūrī (d. ca. 1330). In *Overlapping Cosmologies in Asia*. Edited by Bill Mak and Eric Huntington. Leiden and Boston: Brill, pp. 139–68.

- Karimullah, Kamran I. 2017. The Emergence of Verification (taḥqīq) in Islamic Medicine. The Exegetical Legacy of Faḥr al-Dīn al-Rāzī's (d. 1210) Commentary on Avicenna's (d. 1037) Canon of Medicine. *Oriens* 47: 1–113. [CrossRef]
- Kennedy, Edward S. 1998. *Astronomy and Astrology in the Medieval Islamic World*, VCS 600. Aldershot: Variorum.
- Kennedy, Edward S. 2009. Al-Battani's Astrological History of the Prophet and the Early Caliphate. *Suḥayl* 9: 13–148.
- Kennedy, Edward S., and David Pingree. 1971. *The astrological history of Māshā'allāh*. Cambridge: Harvard University Press.
- Kennedy, Edward S., and Imad Ghanem. 1976. *The Life and Work of Ibn al-Shatir, an Arab Astronomer of the Fourteenth Century*. Aleppo: History of Arabic Science Institute, University of Aleppo.
- King, David A. 1973. al-Khalīlī's auxiliary tables for solving problems of spherical astronomy. *Journal for the History of Astronomy* 4: 99–110. [CrossRef]
- King, David A. 1977. A fourteenth century Tunisian sundial for regulating the times of Muslim prayer. In *Naturwissenschaftsgeschichtliche Studien. Festschrift für Willy Hartner*. Edited by Walter G. Saltzer and Yasukatsu Maeyama. Wiesbaden: Franz Steiner, pp. 187–202.
- King, David A. 1981. *A Catalogue of the Scientific Manuscripts in the Egyptian National Library [in Arabic], Vol. 1: A Critical Handlist of the Scientific Collections. Indexes of Copyists and Owners*. Cairo: General Egyptian Book Organization.
- King, David A. 1983. *Mathematical Astronomy in Medieval Yemen. A Bio-Bibliographical Survey*. Publications of the American Research Center in Egypt. Malibu: Undena.
- King, David A. 1993a. *Islamic Mathematical Astronomy*, 2nd revised ed. Aldershot: Variorum.
- King, David A. 1993b. *Astronomy in the Service of Islam*. Aldershot: Variorum.
- King, David A. 1999. *World-Maps for Finding the Direction and Distance to Mecca: Innovation and Tradition in Islamic Science*. Leiden: Brill, London: Al-Furqan Islamic Heritage Foundation.
- King, David A. 2004. [SATMI-1] *In Synchrony with the Heavens D Studies in Astronomical Timekeeping and Instrumentation in Islamic Civilization, vol. 1: The Call of the Muezzin. Studies I-IX, (Islamic Philosophy, Theology and Science—Texts and Studies, vol. LV:1)*. Leiden and Boston: Brill.
- King, David A. 2005. [SATMI-2] *In Synchrony with the Heavens. Studies in Astronomical Timekeeping and Instrumentation in Islamic Civilization, vol. 2: Instruments of Mass Calculation. Studies X-XVIII, (Islamic Philosophy, Theology and Science—Texts and Studies, vol. LV:2)*. Leiden and Boston: Brill.
- King, David A. 2015. Astronomy in the service of Islam. In *Handbook of Archaeoastronomy and Ethnoastronomy*. Edited by Clive Ruggles. New York: Springer Science and Business Media, vol. 1, pp. 182–96.
- King, David A. 2020. The Wind-Catchers of Medieval Cairo and their Secrets—1001 Years of Renewable Energy, 2 Parts, pt. I: Text, pt. II: Images. Available online: <http://dspace.vpmthane.org:8080/xmlui/handle/123456789/8798> (accessed on 1 July 2022).
- Küçük, Harun. 2019. *Science without Leisure. Practical Naturalism in Istanbul, 1660–1732*. Pittsburgh: Pittsburgh University Press.
- Langemann, Y. Tzvi, and Robert G. Morrison. 2016. *Texts in Transit in the Medieval Mediterranean*. Philadelphia: Penn State University Press.
- Leiser, Gary. 1983. Medical Education in Islamic Lands from the Seventh to the Fourteenth Century. *Journal of the History of Medicine and Allied Sciences* 38: 48–75. [CrossRef]
- Lelic, Emin. 2017. Physiognomy ('ilm-i firāset) and Ottoman Statecraft: Discerning Morality and Justice. *Arabica* 64: 1–37. [CrossRef]
- Leoni, Francesca, Liana Saif, Matthew Melvin-Koushki, and Yahya Farouk. 2020. *Islamicate Occult Sciences in Theory and Practice*. Leiden and Boston: Brill.
- Lev, Efraim. 2021. *Jewish Medical Practitioners in the Medieval Muslim World. A Collective Biography*. Edinburgh: Edinburgh University Press.
- Liebrez, Boris. 2013. The library of Aḥmad al-Rabbāf. Books and their audience in 12th to 13th/18th to 19th century Syria. In *Marginal Perspectives on Early Modern Ottoman Culture. Missionaries, Travelers, Booksellers*. Edited by Ralf Elger and Ute Pietruschka. Halle [Saale]: Zentrum für Interdisziplinäre Regionalstudien, pp. 17–59.
- Liebrez, Boris. 2016. *Die Rifā'ya aus Damaskus. Eine Privatbibliothek in osmanischer Zeit und ihr kulturelles Umfeld*. Leiden and Boston: Brill.
- Mahdavi, Younes. 2009. Critical Edition and Commentary of Naṣīr al-Dīn Tūsī's Exposing the Secrets of the Menelaus Theorem (Kashf al-qinā' 'an asrār al-qaṭā'). Master's thesis, University of Tehran, Tehran, Iran.
- Martelli, Matteo. 2021. Alchemical lexica in Syriac: Planetary signs, code names and medicines. In *Alchemy in the Islamicate World*. Edited by Regula Forster. Berlin: Asiatische Studien—Études Asiatiques, vol. 75, pp. 485–512.
- Martykánová, Darina. 2020. Science and Technology in the Ottoman Language of Power (1790s–1910s). Rethinking the State, the Economy, and the Elites. *European Journal of Turkish Studies* 31: 1–19.
- Melvin-Koushki, Matthew. 2012. The Quest for a Universal Science: The Occult Philosophy of Šā'in al-Dīn Turka Iṣfahānī (1369–1432) and Intellectual Millenarianism in Early Timurid Iran. Ph.D. thesis, Yale University, New Haven, CT, USA.
- Melvin-Koushli, Matthew. 2014. The Occult Challenge to Philosophy and Messianism in Early Timurid Iran: Ibn Turka's Lettrism as a New Metaphysics. In *Unity in Diversity: Mysticism, Messianism and the Construction of Religious Authority in Islam*. Edited by Orkhan Mir-Kasimov. Leiden and Boston: Brill, pp. 247–76.
- Melvin-Koushki, Matthew. 2016. Of Islamic Grammatology: Ibn Turka's Lettrist Metaphysics of Light. *Al-'Usūr al-Wustā* 24: 42–113.
- Melvin-Koishki, Matthew. 2018. Persianate Geomancy from Tūsī to the Millennium: A Preliminary Survey. In *Occult Sciences in Premodern Islamic Culture*. Edited by Nader el-Bizri and Eva Orthmann. Beirut and Würzburg: Orient-Institut Beirut and Ergon, pp. 151–99.

- Melvin-Koushki, Matthew. 2020a. Is (Islamic) Occult Science Science? *Theology and Science* 18: 303–24. [\[CrossRef\]](#)
- Melvin-Koushki, Matthew. 2020b. Toward a Neopythagorean Historiography: Kemālpaşazāde's (d.1534) Lettrist Call for the Conquest of Cairo and the Development of Ottoman Occult-Scientific Imperialism. In *Islamicate Occult Sciences in Theory and Practice*. Edited by Francesca Leoni, Liana Saif, Matthew Melvin-Koushki and Yahya Farouk. Leiden and Boston: Brill, pp. 380–419.
- Melvin-Koishki, Matthew. 2021. Divining Past, Present and Future in the Sand: A Geomantic Miscellany, ca. Sixteenth Century. In *The Ottoman World: A Cultural History Reader, 1450–1700*. Edited by Hakan T. Karateke and Helga Anetshofer. Oakland: University of California Press, pp. 244–53.
- Melvin-Koushki, Matthew, and Noah Gardiner, eds. 2017. Islamicate Occultism: New Perspectives. *Arabica* 64: 287–693.
- Mills, Simon. 2020. *A Commerce of Knowledge: Trade, Religion, and Scholarship between England and the Ottoman Empire, 1600–1760*. Oxford and New York: Oxford University Press.
- Morrison, Robert G. 2002. The Portrayal of Nature in a Medieval Qur'an Commentary. *Studia Islamica* 94: 115–38. [\[CrossRef\]](#)
- Morrison, Robert G. 2003. The Response of Ottoman Religious Scholars to European Science. *Archivum Ottomanicum* XXI: 187–95.
- Morrison, Robert G. 2007. *The Intellectual Career of Nizām al-Dīn al-Nīsābūrī*. Oxon: Routledge.
- Morrison, Robert G. 2013. What Was the Purpose of Astronomy in Ījī's Kitāb al-Mawāqif fi 'ilm al-kalām? In *Tabriz after the Mongol Conquest*. Edited by Judith Pfeiffer. Leiden and Boston: Brill, pp. 201–29.
- Morrison, Robert G. 2014. A Scholarly Intermediary Between the Ottoman Empire and Renaissance Europe. *Isis* 3: 32–57. [\[CrossRef\]](#)
- Moureau, Sébastien. 2021. Theory and Concepts: A Shared Heritage: Theorizing Alchemy in the Late Antique, Arabo-Muslim, and Latin Worlds. In *A Cultural History of Chemistry*. Edited by Charles Burnett and Sébastien Moureau. London: Bloomsbury, vol. 2, pp. 19–34.
- Nasr, Seyyid Hossein. 1978. *An Introduction to Islamic Cosmological Doctrines*, 2nd ed. London: Thames and Hudson, Revised edition: Albany: SUNY, 1993.
- Necipoglu, Gülru, Cemal Kafadar, and Cornell H. Fleischer, eds. 2019. *Treasures of Knowledge: An Inventory of the Ottoman Palace Library (1502/3–1503/4), Muqarnas, Supplements*. Leiden: Brill, vol. 14.
- Niazi, Kaveh. 2014. *Quṭb al-Dīn Shīrāzī and the Configuration of the Heavens. A Comparison of Texts and Models*. Heidelberg and Boston: Springer.
- Niazi, Kaveh. 2022. *A Princely Pandect on Astronomy: Naṣīr al-Dīn Ṭūsī's Mu'īniya Epistle and its Appendix (Archimedes 58)*. Berlin/Heidelberg: Springer.
- Orthmann, Eva. 2005. Circular Motions: Private Pleasure and Public Prognostication in the Nativities of the Mughal Emperor Akbar. In *Horoscopes and Public Spheres: Essays on the History of Astrology*. Edited by Günther Oestmann, H. Darrel Rutkin and Kocku von Stuckrad. Berlin and New York: de Gruyter, pp. 101–14.
- Orthmann, Eva. 2006. Astrologie und Propaganda. Iranische Weltzyklusmodelle im Dienst der Fāṭimiden. *Die Welt des Orients* 36: 131–42.
- Orthmann, Eva. 2011. Court Culture and Cosmology in the Mughal Empire: Humāyūn and the foundation of the dīn-i ilāhī. In *Court Culture in the Muslim World (7th–19th Centuries)*. Edited by Albrecht Fuess and Jan-Peter Hartung. London and New York: Routledge, pp. 202–20.
- Orthmann, Eva. 2018. Lettrism and magic in an early Mughal text: Muḥammad Ghawth's k. al-Jawāhir al-khams. In *The Occult Sciences in Pre-modern Islamic Cultures (Beiruter Texte und Studien 138)*. Edited by Nader el-Bizri and Eva Orthmann. Beirut and Würzburg: Orient Institut-Beirut and Ergon, pp. 223–47.
- Perler, Dominik, and Ulrich Rudolph. 2000. *Occasionalismus: Theorien der Kausalität im arabisch-islamischen und im europäischen Denken*. Abhandlungen der Akademie der Wissenschaften in Göttingen, Philologisch-Historische Klasse, Folge 3, Nr. 235. Göttingen: Vandenhoeck & Ruprecht.
- Porter, Yves. 1994. *Painters, Paintings, and Books: An Essay on Indo-Persian Technical Literature, 12–19th Centuries*. New Delhi: Manohar, Centre for Human Sciences.
- Porter, Yves. 2011. *Le Prince, L'artiste et L'alchimiste: La Céramique dans le Monde Iranien Xe-XVIIIe Siècle*. Paris: Hermann.
- Ragab, Ahmed. 2019. Islam Intensified: Snapshot historiography and the making of Muslim identities. *Journal of Postcolonial Studies* 22: 203–19. [\[CrossRef\]](#)
- Ragep, F. Jamil. 1987. The Two Versions of the Ṭūsī Couple. In *From Deferent to Equant: Studies in Honor of E.S. Kennedy*. Edited by David A. King and George Saliba. New York: The Annals of the New York Academy of Sciences, vol. 500, pp. 329–56.
- Ragep, F. Jamil. 2001a. Freeing Astronomy from Philosophy: An Aspect of Islamic Influence on Science. *Osiris* 16: 49–71. [\[CrossRef\]](#)
- Ragep, F. Jamil. 2001b. Ṭūsī and Copernicus: The Earth's Motion in Context. *Science in Context* 14: 145–63. [\[CrossRef\]](#)
- Ragep, F. Jamil. 2005. 'Alī Qushjī and Regiomontanus: Eccentric Transformations and Copernican Revolutions. *Journal for the History of Astronomy* 36: 359–71. [\[CrossRef\]](#)
- Ragep, F. Jamil. 2010. Astronomy in the Fanārī-Circle: The Critical Background for Qāḏizāde al-Rūmī and the Samarqand School. In *Uluslararası Molla Fenārî Sempozyumu (4–6 Aralık 2009 Bursa) (International Symposium on Molla Fanārî, 4–6 December 2009 Bursa)*. Edited by Tefvik Yücedoğru, Orhan Koloğlu, U. Murat Kılavuz and Kadir Gömbeyaz. Bursa: Bursa Büyükşehir Belediyesi, pp. 165–76.
- Ragep, Sally P. 2016. Jaghmīnī's Mulakhkhas. In *An Islamic Introduction to Ptolemaic Astronomy (Sources and Studies in the History of Mathematics and the Physical Sciences)*. Berlin/Heidelberg: Springer.

- Rius, Mònica. 2013. *La Alquibla en al-Andalus y al-Magrib al-Aqṣà*. Barcelona: Universitat de Barcelona.
- el-Rouayheb, Khaled. 2017. *Islamic Intellectual History in the Seventeenth Century: Scholarly Currents in the Ottoman Empire and the Maghreb*. Cambridge: Cambridge University Press.
- Rothman, Natalie. 2011. *Brokering Empire: Trans-Imperial Subjects between Venice and Istanbul*. Ithaca: Cornell University Press.
- Rothman, Natalie. 2021. *The Dragoman Renaissance: Diplomatic Interpreters and the Routes of Orientalism*. Ithaca: Cornell University Press.
- Sabra, 'Abd al-Hamid I. 1987. The Appropriation and Subsequent Naturalization of Greek Science in Medieval Islam: A Preliminary Statement. *History of Science* 25: 223–43. [CrossRef]
- Sabra, 'Abd al-Hamid I. 2006. Kalām Atomism as an Alternative Philosophy to Hellenizing Falsafa. In *Arabic Theology, Arabic Philosophy. From the One to the Many: Essays in Celebration of Richard M. Frank*. Edited by James E. Montgomery. Leuven, Paris and Dudley: Peeters, pp. 119–272.
- Sabra, 'Abd al-Hamid I. 2009. The Simple Ontology of Kalām Atomism: An Outline. *Early Science and Medicine* 14: 68–78. [CrossRef] [PubMed]
- Saif, Liana. 2012. The Arabic Theory of Astral Influences in Early Modern Occult Philosophy. Ph.D. thesis, University of London, London, UK. Published as: *The Arabic Influences on Early Modern Occult Philosophy*, New York: Palgrave Macmillan, 2015.
- Saif, Liana. 2022. Physiognomy: Science of induction. In *Routledge Handbook on the Sciences in Islamicate Societies: Practices from the 2nd/8th to 13th/19th Centuries*. Edited by Sonja Brentjes, Peter Barker and Rana Brentjes. London and New York: Routledge, (forthcoming).
- Saliba, George, and Edward S. Kennedy. 1991. The spherical case of the Tusi couple. *Arabic Sciences and Philosophy* 1: 285–91, [Reprint in Kennedy, Astronomy and Astrology in the Medieval Islamic World, Variorum, 1998, VI: 285–91]. [CrossRef]
- Saliba, George. 1987. The Rôle of Maragha in the Development of Islamic Astronomy: A scientific revolution before the renaissance. *Revue de synthèse* 108: 361–73. [CrossRef] [PubMed]
- Saliba, George. 1993. Al-Qushji's Reform of the Ptolemaic Model for Mercury. *Arabic Sciences and Philosophy* 3: 161–203. [CrossRef]
- Saliba, George. 1994. A Sixteenth-Century Arabic Critique of Ptolemaic Astronomy: The Work of Shams al-Din al-Khafri. *Journal for the History of Astronomy* 25: 15–38. [CrossRef]
- Saliba, George. 1996. Writing the History of Arabic Astronomy: Problems and Differing Perspectives. *Journal of the American Oriental Society* 116: 709–18. [CrossRef]
- Saliba, George. 2007. *Islamic Science and the Making of the European Renaissance*. Cambridge and London: MIT Press.
- Samsó, Julio. 2007. *Astronomy and Astrology in al-Andalus and the Maghrib, VCS 887*. Aldershot: Ashgate Publishing.
- Samsó, Julio. 2020. *On Both Sides of the Strait of the Gibraltar. Studies in the History of Medieval Astronomy In the Iberian Peninsula and the Maghrib (Handbook of Oriental Studies, Section 1: The Near and Middle East, 144)*. Leiden and Boston: Brill.
- Schmidl, Petra G. 2007. *Volkstümliche Astronomie im islamischen Mittelalter. Zur Bestimmung der Gebetszeiten und der Qibla bei al-Aṣḥābī, Ibn Raḥīq und al-Fārisī*. Leiden and Boston: Brill.
- Schmidl, Petra G. 2012. Magic and Medicine in a 13th c. Treatise on the Science of the Stars. The Kitāb al-Tabṣīra fī 'ilm al-nujūm of the Rasulid Sultan al-Ashraf 'Umar. In *Herbal Medicine in Yemen. Traditional Knowledge and Practice, and Their Value for Today's World*. Edited by Ingrid Heilmeyer and Hanne Schönig. Leiden and Boston: Brill, pp. 43–68.
- Şen, Ahmed Tunç. 2016. *Astrology in the Service of the Empire: Knowledge, Prognostication, and Politics at the Ottoman Court, 1450s–1550s*. Ph.D. thesis, University of Chicago, Chicago, IL, USA.
- Şen, Ahmed Tunç. 2017a. Practicing Astral Magic in Sixteenth-Century Ottoman Istanbul: A Treatise on Talismans attributed to Ibn Kemāl (d. 1534). *Journal of Magic, Ritual, and Witchcraft* 12: 66–88. [CrossRef]
- Şen, Ahmed Tunç. 2017b. Reading the Stars at the Ottoman Court: Bāyezīd II (r. 886/1481-918/1512) and his Celestial Interests. *Arabica* 64: 557–608. [CrossRef]
- Shefer-Mossensohn, Miri. 2010. *Ottoman Medicine. Healing and Medical Institutions, 1500–1700*. Albany: SUNY.
- Shefer-Mossensohn, Miri. 2015. *Science among the Ottomans. The Cultural Creation and Exchange of Knowledge*. Austin: Texas University Press.
- Shopov, Aleksandar. 2019. "Books on Agriculture (al-filāḥa) Pertaining to Medical Science" and Ottoman Agricultural Science and Practice around 1500. In *Treasures of Knowledge: An Inventory of the Ottoman Palace Library (1502/3-1503/4), Muqarnas, Supplements*. Edited by Gülru Necipoğlu, Cemal Kafadar and Cornell H. Fleischer. Leiden: Brill, vol. 14, pp. 557–68.
- Sidoli, Nathan, and Yoichi Isahaya. 2018. *Thābit ibn Qurra's Restoration of Euclid's Data: Text, Translation, Commentary*. Berlin/Heidelberg and New York: Springer.
- Speziale, Fabrizio. 2018. *Culture Persane et Médecine Ayurvédique an Asie du Sud*. Leiden and Boston: Brill.
- Stearns, Justin. 2021. *Revealed Sciences: The Natural Sciences in Islam in Seventeenth-Century Morocco*. Cambridge: Cambridge University Press.
- Stolz, Daniel A. 2018. *The Lighthouse and the Observatory: Islam, Science, and Empire in Late Ottoman Egypt, (Science in History)*. Cambridge: Cambridge University Press.
- Subtelny, Maria Eva. 1997. Agriculture and the Timurid Chaharbagh: The Evidence from a Medieval Persian Agricultural Manual. In *Gardens in the Time of the Great Muslim Empires: Theory and Design*. Edited by Attilio Petruccioli. Leiden and New York: Brill, pp. 110–28.
- Todd, Richard. 2021. Classical poetic motifs as alchemical metaphors in the Shudhūr al-dhahab and its commentaries. In *Alchemy in the Islamicate World*. Edited by Regula Forster. Berlin: Asiatische Studien—Études Asiatiques, vol. 75, pp. 665–83.

- van Dalen, Benno. 2022. *Ptolemaic Tradition and Islamic Innovation: The Astronomical Tables of Kūshyār Ibn Labbān (Ptolemaeus Arabus Et Latinus—Texts, 2)*. Turnhout: Brepols.
- van Hees, Syrinx. 2017. *Inḥitāt—The Decline Paradigm. Its Influence and Persistence in the Writing of Arab Cultural History*. Würzburg: Ergon.
- Varisco, Daniel M. 1994. Taqwīm al-Sultān ‘Umar b. Yūsuf al-Rasūlī. *Dirāsāt fī tārikh al-Yaman al-islāmī*, 144–63.
- Varisco, Daniel M. 1997. *Medieval Agriculture and Islamic Science: The Almanac of a Yemeni Sultan*. Seattle: University of Washington Press.
- Varisco, Daniel M. 2002. *Medieval Folk Astronomy and Agriculture in Arabia and the Yemen*. Aldershot: Variorum.
- Varlık, Nükhet, ed. 2017. *Plague and Contagion in the Islamic Mediterranean. New Histories of Disease in Ottoman Society*. Yorkshire: Arc Humanities Press.
- Varlık, Nükhet. 2015. *Plague and Empire in the Early Modern Mediterranean World: The Ottoman Experience, 1347–1600*. Cambridge: Cambridge University Press.
- Weil, Dror. 2016a. Islamicated China—China’s Participation in the Islamicate Book Culture during the Seventeenth and Eighteenth Centuries. *Intellectual History of the Islamicate World* 4: 36–60. [[CrossRef](#)]
- Weil, Dror. 2016b. The Vicissitudes of Late Imperial China’s Accommodation of Arabo-Persian Knowledge of the Natural World, 16th–18th Centuries. Ph.D. thesis, Princeton University, Princeton, NJ, USA.
- Weil, Dror. 2022. Chinese Muslims as Agents of Astral Knowledge in Late Imperial China. In *Overlapping Cosmologies in Asia*. Edited by Bill Mak and Eric Huntington. Leiden and Boston: Brill, pp. 116–38.
- Wisnovski, Robert. 2013. Avicennism and Exegetical Practice in the Early Commentaries on the Ishārāt. *Oriens* 41: 349–78. [[CrossRef](#)]