Reviews

Vernet, Joan and Parès, Ramón (eds.): *La Ciència en la Historia dels Països Catalans*. Vol. I: Dels àrabs al Renaixement. Institut d'Estudis Catalans and Uni-versitat de València, 2004. 629 pp.

This monumental book is a comprehensive survey of what is presently known of the revival, under Arabic influence, and further development of the sciences in Catalonia from the late tenth century on. The ground for such studies has been laid by J.M. Millàs Vallicrosa by the publication, in 1931, of his famous *Assaig d'història de les idees físiques i matemàtiques a la Catalunya medieval*. As J. Vernet and J. Samsó explain in the introductory chapter (pp. 31-43) (Catalan "countries", in the English version of the list of contents on p. 25, seems to be a misprint for "counties" (comtats catalans)), already Millàs thought of the continuation of his studies through all periods into modern times. But after the *Assaig*, called "vol. I" in 1931, no further volumes in this intended series appeared. Instead Millàs published numerous studies of individual items from later periods in the history of the sciences in Catalonia. The present project, edited by J. Vernet, Millàs' disciple and successor, and R. Parès, now resumes and realizes Millas' former project and will draw a complete survey of the history of the sciences in Catalonia of which the volume under discussion here is the first and will be followed by two more volumes. A survey of the contents of the entire project is here given in pp. 15-20.

Vol. I falls into two parts, Part 1 on the "hums" (*remors*, echoes or influences) of the Arabs on the Catalonian counties in a first period (pp. 45-235), and Part 2 on the succeeding developments into Renaissance times (pp. 237-595). Pp. 597-602 follow biographic profiles of the various authors who have contributed to this volume, and pp. 603-626 the index of personal and geographical names.

Part 1 contains articles by M. Forcada on the situation of the sciences in the Arabic area south of Catalonia (which itself had remained a Christian area), by R. M. Comes on the intellectual environment in Catalonia in the 10th and 11th centuries, by J. Samsó on the first contacts with Arabic science in Catalonia and its radiation into other regions in Europe, by D. A. King on astrolabes of medieval Catalonia and by M. Viladrich on agricultural and pre-industrial techniques in the Catalonia of this period.

As through the whole book, all articles were written by first hand specialists and offer the present state of knowledge, based on the most recent studies published in each field.

While it is, of course, impossible to go into the details of each article in a review of such a huge work treating so many fields, let me here just touch two individual items.

In discussing the so-called 'Carolingian astrolabe', once acquired by the late M. Destombes and now housed in the Institut du Monde Arabe, Paris, King (p. 175) speaks of the incapability of European astrolabe makers of rendering the Arabic star names in Latin. One may here compare the case of the drawings of the astrolabe of Khalaf ibn al-Muʿādh in MS Paris, BnF lat. 7412 (cf. also here, Samsó, pp. 121, 133). While the draftsman here drew all the parts of the astrolabe faithfully including the Arabic inscriptions (in Arabic script!), even the maker's signature, he treated the drawing of the rete, on fol. 19v, differently. Here he did not render the star names in Arabic script like the inscriptions on the plates etc., but rather he wrote the Arabic names in Latin transliteration, in two series: one series added to the star pointers in the rete itself, and an alternative series, with different forms and spellings, in a separate list below the drawing. This separate treatment of the star names seems to point to a special problem around these names. King may therefore be right to assume that the scholar who provided the old layer of Latin inscriptions on the 'Carolingian astrolabe' was not capable to transform these names into Latin script or, at the moment of his work, had no source at hands from which to collect the names and put them in their correct places on the rete.

A word on two star names in the Catalonian astrolabe of ca. 1300 (King, p. 186): MENCER: perhaps here the maker of the instrument, having other (Arabic or Western?) instruments in front, misplaced the name from the position of the pointer of the neighbouring star alpha Ceti (called *mencar*, *menkar* and the like in Latin sources) to the pointer of alpha Orionis; Latin forms of Arabic *mankib* (for alpha Orionis) do otherwise not appear in the family of names here used. ELAYYE, alpha Ophiuchi: while this form of the name seems to echo Arabic *al-ḥayya*, the name of the constellation Serpens (and perhaps a star in it), one may assume that the maker misread two V's in his source for Y's. The name then corresponds correctly to forms like *Elhavve* or the like, for Ophiuchus (*al-ḥawwāʼ*).

Part 2 of the book contains, after a general introduction, again by J. Vernet and J. Samsó, eleven chapters treating the development of various branches of the sciences in Catalonia into Renaissance times. It begins with a survey of the transmission of scientific Arabic material into the north-east of the Iberian peninsula in the 12th century (J. Samsó). There follows a very instructive chapter on the less known Jewish contribution to the transmission of sciences in Catalonia and in Languedoc and the Provence (J. Samsó). Ll. Cifuentes then discusses the use of Catalan in the scientific texts during the late Middle Ages and the early Renaissance. Hereafter follow chapters on medicine (M. R. McVaugh), on universities (J. Arrizabalga), on Ramon Llull (L. Badia), on Arnald of Villeneuve (M. R. McVaugh), on alchemy (M. Pereira), astronomy (J. Chabás), cartography (M. Comes; unfortunately, most of the map illustrations appear too dark and, therefore, almost illegible), and on hydraulic, agricultural and pre-industrial technology (M. Viladrich).

The mass information here assembled, according to the most up-to-date state of knowledge, is overwhelming. The editors are to be praised and deserve the gratitude and acknowledgment of the scholarly community for having invested this huge amount of work and organisation necessary for presenting a comprehensive volume of this kind. Readers should, however, keep in mind that this admirable piece of work is centered on the developments in Catalonia. It is not a general history of sciences in medieval to Renaissance Spain. All those acquainted with Millàs *Assaig* of 1931 find here a worthy continuation of these earlier endeavours, and it is to be hoped that many will feel tempted to continue the study of these intriguing materials – notwithstanding the unfavourable conditions that are presently prevailing in many places towards such historical research.

Paul Kunitzsch

George Saliba, *Islamic Science and the Making of the European Renaissance*. Transformations: Studies in the History of Science and Technology. The MIT Press. Cambridge, Mass. & London, England. Cambridge, 2007. 315 pp.

1998 saw the publication of two important essays on the origins of Islamic Science and its connections with its Greek predecessors: on the one hand, Dimitri Gutas published *Greek Thought, Arabic Culture. The Graeco-Arabic Translation Movement in Baghdad and Early ʿAbbāsid Society (2nd-4th/8th-10th centuries)* (Routledge, London), which stressed the significance of the ʿAbbāsid period in the process of transmission of Graeco-Arabic science, and argued that the previous stage, the Umayyad Caliphate, was less important. In the same year George Saliba published, in Arabic, *al-Fikr al-ʿIlmī al-ʿArabī. Nash'atu-hu wa-taṭawwuru-hu* (Markaz al-Dirāsāt al-Masīḥiyya-al-Islāmiyya, Balamand University, Lebanon), a book that has many points of contact with the one I am presenting here and which defended the opposite view: that is, that the Umayyad period is vital to an understanding of the beginnings of this transmission. Both books were published independently of each other and were clearly complementary.

Islamic Science and the Making of the European Renaissance is a new, updated, English version of *al-Fikr al-ʿIlmī al-ʿArabī*. It is not a translation of the Arabic work and it has clearly been rewritten and fully annotated with a different kind of reader in mind, though the common centres of interest are obvious. One thing should be said before anything else: both *al-Fikr al-ʿIlmī al-ʿArabī* and *Islamic Science* bear titles that do not entirely reflect their content. In spite of the frequent references to other sciences (for example, Ibn al-Nafīs's discovery of the lesser circulation and its influence on European Renaissance anatomists), both books deal with Astronomy, considered as a case study (Saliba uses the word *template*) that may provide an accurate representation of the origins and development of the other sciences. This approach is no surprise, given the author's standing in the history of this particular science.

The volume has two main centres of interest: the origins of Islamic astronomy and science and the influences that its later developments (from the Marāgha school, in the 13th c. onwards) had in the European Astronomy of the Renaissance (particularly Copernicus). This latter topic has been thoroughly discussed since the first evidence began to appear towards the end of the nineteen fifties and Saliba has published several syntheses (see, for example, his collection of articles in the volume *A History of Arabic Astronomy. Planetary Theories during the Golden Age of Islam*, New York U.P., New York & London, 1994, or his contributions to the first volume of the *Encyclopaedia of the History of Arabic Science*, ed. by R. Rashed and R. Morelon, London & New York, 1996). His ideas on the origins of Islamic Science are less well known and they begin with a criticism of what he calls "the classical narrative" in its different forms: 1) the nascent Islamic civilization came into contact with the ancient Byzantine and Sasanian civilizations as a consequence of the political expansion of the Islamic State ("the contact theory"); 2) the survival of scientific and philosophical texts in a few cities in Byzantium and Iran – like Antioch, Ḥarrān or Jundīshāpūr – is the basis of "the pocket transmission theory"; 3) Transmission began to take place indirectly, through the Syriac medium. All these contacts began mainly during the Abbasid period, due to the rise of the "Persian elements" or the ascent of al-Ma'mūn to the Caliphate in 813 and his reliance on Muʿtazilite theology. This picture is convincingly discussed by Saliba who argues that scientific knowledge and practice in both Byzantium and Iran was extremely limited, representing hardly any advance on pre-Islamic Arabia, while the Syriac texts written by authors such as Severus Sebokht (ca. 660) and others were also elementary. Thus, even though ancient Greek and Iranian texts were preserved, no native Byzantine, Syriac or Persian scholars would have been able to understand them and thus become the masters of the first Muslim scholars. On the other hand, the level of expertise of the Muslim scientists and Arabic translations during al-Ma'mūn's Caliphate suggests that the transmission was not recent. Indian Astronomy seems to have been introduced during al-Manṣūr's Caliphate (754-775) and al-Fazārī was able to compute his own *zīj* using the Islamic calendar, a task that probably would have been beyond a beginner. Several astrologers, among whom we find the Arab-born al-Fazārī himself, were able to cast the horoscope of the foundation of Baghdad in 762 using the Iranian *Zīj al-Shāh*: who taught al-Fazārī and his Persian colleagues (Māshā'allāh and Nawbakht) to use a *zīj*?

All this leads the author to construct an "alternative narrative". In order to do so, he reviews and reinterprets four legendary stories related to the origins of transmission which were collected in the *Fihrist* of Ibn al-Nadīm (Saliba prefers to call him al-Nadīm, see p. 28), for two of which the sources are Abū Sahl b. Nawbakht (fl. end of the 8th c.) and Abū Maʿshar (d. 886). In the fourth story Ibn al-Nadīm apparently links the alchemical translations patronized by Khālid b. Yazīd b. Muʿāwiya (ca. 668-ca. 709) with the process of Arabization of the *dīwān* in Iraq in the days of ʿAbd al-Malik (r. 685-705) and in Syria during the Caliphate of his son Hishām (r. 724-743). This leads Saliba to formulate a new theory concerning the reasons for the new interest in ancient sciences in Islamic civilization: the Arabization of the *dīwān* affected only the administration of revenues (the rest of the administrative tasks already used Arabic) which required certain knowledge of elementary arithmetic and other sciences. This process had obvious social consequences: the secretaries of the administration who had hitherto used Persian and Greek – and who were precisely the ones with the required elementary scientific knowledge – lost their posts to Arabic speakers who did not necessarily have the same level of competence. To recover their positions, these Iranian and Greek-Syriac secretaries (probably in this chronological order) had to develop their knowledge of the sciences of the ancients for which they were well prepared linguistically and in which they had already acquired a sound scientific background. They were also obliged to learn good Arabic; indeed, the most important grammarian of the 8th c. was an Iranian (Sībawayh, see p. 77). This situation is considered by Saliba (p. 73) as the origin of the opposition between partisans of the sciences of the Ancients and traditionalists dedicated to the religious sciences, who were the natural allies of the new Arabic-speaking bureaucracy. According to Saliba (p. 78), the former soon became aware of the need to develop an astronomy uncontaminated by astrology and that this was the origin of the creation of *hay'a* and, from the 11th c. onwards, *mīqāt*. The situation is not so clear in the case of *hay'a* which, in Saliba's opinion, has an early origin. The author gives two examples: Qusṭā b. Lūqā (p. 18) and Muḥammad b. Mūsā b. Shākir (pp. 92-93), the first of which does not seem to have been studied. This leads me to wonder what the exact meaning of this term would have been in the 9th c. It is clear that the *hay'a* cultivated in the Mashriq from the 11th c. onwards did not deal with astrology, but I am not sure that this was the case in the 9th c. Saliba returns to this topic, namely the non-astrological character of the *hay'a* of the 13th and following centuries, in chapter 5 of this book (pp. 171-191) in which he insists on the Islamic acceptability of this discipline: *hay'a* texts were written in Arabic in Iran during the Safavid period, to be taught in religious schools, while *zīj*es, produced because of their astrological applications, were written in Persian.

The early introduction of Greek science, as a result of the crisis produced by the Arabization of the *dīwān*, had immediate consequences: new generations of bureaucrats, the heirs of those who had previously lost their jobs, became indispensable to the government during the early years of the ʿAbbāsid Empire and sponsored the translation process. Saliba reminds us of the account by Ḥunayn ibn Isḥāq who gives us a list of 129 translations of Galen's books, most of which were done for the Banū Mūsā b. Shākir, and none for the Caliph (pp. 64, 71). Saliba seems to ignore the importance of caliphal patronage, although he reminds us, obviously, of the Ma'mūnī observations and of the measuring of the length of a degree of the meridian. Perhaps Saliba goes a little too far here: his position is diametrically opposed to that of Gutas, who extends the patronage practically to the whole of ʿAbbāsid society (*Greek Thought* p. 5): "Patrons were Arabs and non-Arabs, Muslims and non-Muslims, Sunnīs and Shīʿites, generals and civilians, merchants and land-owners etc."

Although I do not completely agree with the starting point of Saliba's argument (his interpretation of Ibn al-Nadīm's fourth story seems far-fetched), his new hypothesis is, in my opinion, full of good sense: it explains the chronological aspects of the problem well and it has important implications. He recovers the old idea of *appropriation* formulated, some years ago, by Prof. A.I. Sabra when he says (p. 66): "…the translation movement was not a movement to imitate a higher culture that was there standing in competition with one's own. Instead, the acquiring culture had to dig out texts, that is *really appropriate* those texts which were practically forgotten in the source culture." As a consequence: there is a Graeco-Arabic cycle in the history of scientific culture.

The "alternative narrative" has its best basis in the early critical assimilation of Greek mathematical and observational astronomy, explained in chapter 3 (pp. 73-129), which the author soon links to another kind of criticism: that represented by the *Shukūk* literature which began in the 11th c. with Ibn al-Haytham, who criticized the inconsistencies of Ptolemy's planetary models and their inability to provide an accurate representation of the physical world. The first attempts to design alternative models both in the East (al-Jūzjānī, d. ca. 1070) and in al-Andalus (al-Biṭrūjī, second half of the 12th c) were totally unsuccessful and we have to wait until the 13th c. to find the first adequate non-Ptolemaic planetary models, designed by al-ʿUrḍī (d. 1266) and Naṣīr al-Dīn al-Ṭūsī (d. 1274) who did their theoretical research while making their astronomical observations at the Marāgha observatory. Saliba deals with this topic, in which he stresses the mathematical innovations such as the "Ṭūsī couple" and al-ʿUrḍī's lemma, in chapter 4 (pp. 131-170). In it he traces the evolution of the problem in the works of al-Ṭūsī's student, Quṭb al-Dīn al-Shīrāzī (d. 1311), Ibn al-Shāṭir (d. 1375), ending with the very interesting new approach of Shams al-Dīn al-Khafrī (d. 1550) who designed four different, but mathematically equivalent, models for Mercury, all of which represented the physical reality adequately, though none of them could be considered to be "truer" or more "correct" than the others.

After chapter 5 ("Science between Philosophy and Religion: The Case of Astronomy", pp. 171-191), which I have already mentioned, Saliba enters the vast topic of Copernicus' knowledge of the new planetary models of the *hay'a* tradition (pp. 193-232). This is something that, in my opinion, no serious historian of astronomy can doubt today, after all the research published during the last half century, and presented, in careful syntheses, by Saliba himself during the last twenty years. Nonetheless, this new general presentation of the problem, in book form, will be a particularly useful instrument for convincing the sceptics, especially because it incorporates some novelties. The author traces (pp. 193-209) the history of the discovery: Ibn al-Shāṭir's lunar model reproduced by Copernicus, his use and proof of Ṭūsī's couple (Hartner discovered that, in Copernicus' illustration of the proof the letters are placed exactly in the same position as in al-Ṭūsī's manuscript, with only one difference which is explained here by the author) and al-ʿUrḍī's lemma (without proof), Copernicus' adaptation to heliocentrism of Ibn al-Shāṭir's models for the superior planets and his use of the model for Mercury designed by the same author, in the *Commentariolus*, without an adequate understanding of its implications. We have, here, the two ends of the same chain but the connecting link is missing. How did Copernicus obtain all this knowledge? (pp. 210-232). One of the main difficulties is that we cannot single out an Arabic source containing all the elements known to Copernicus. One of the possible answers was given by Neugebauer, who suggested Byzantine Greek translations as the source after his discovery of MS Vatican Gr. 211 which contained a qualitative description of Ṭūsī's couple. Although this suggestion was entirely reasonable and one can assume that Copernicus knew Greek, the study of MS Vatican Gr. 211 has not produced any further results. This is why the new route proposed by Saliba (pp. 217-221) is extremely interesting: he studies the figure of Guillaume Postel (1510-1581) a French Arabist contemporary of Copernicus, who bought a manuscript of al-Kharaqī's *Muntahā al-idrāk* in Constantinople in 1536, to which he added marginal notes (extant in the Bibliothèque Nationale in Paris) and who also owned a manuscript of al-Ṭūsī's *Tadhkira* which, obviously, contains the proof of Ṭūsī's couple. A complete survey of Postel's biography and works can be found in Saliba's contribution to this issue of *Suhayl*. Although, obviously, Postel does not give all the answers to our problem, it is clear that the new route opened up by Saliba has an enormous interest: there were European Arabists able to read and understand highly technical Arabic astronomical texts and the possibility of an oral transmission of its contents to Copernicus, without the need for a translation, clearly exists. The author also suggests other interesting names such as that of the Syriac Jacobite patriarch Niʿmatallāh/ Nehemias (d. 1590) who arrived in Rome ca. 1577, bringing with him Arabic astronomical books, and was appointed a member of the committee created by Pope Gregory XIII to reform the Julian calendar. This new route of transmission, as Saliba remarks, could explain the lack of a single Arabic source containing all the elements known to Copernicus: an interested European reader of Arabic manuscripts could have transmitted the contents of several different sources.

This new book by George Saliba offers a highly satisfactory explanation of the origins of the *appropriation* of Greek scientific texts by Arabic scholars, a justification of the role of Arabic astronomy in the general history of astronomy, a clear synthesis of the development of *hay'a* and of the appearance of new planetary models from the 13th c. onwards, which were influential in Copernicus, and a new and extremely interesting hypothesis on a possible way of transmission through European Arabists who read Arabic astronomical manuscripts. He also insists on a point that is well known: that we should reject the traditional ideas of a decay of Arabic science provoked by a conflict between science and religion, symbolized by al-Ghazālī's *Tahāfut al-falāsifa* (d. 1111), or by the destruction of Baghdad by the Mongols in 1258. There was no such decay and the latter date marks the beginning of what Saliba himself has named "the Golden Age of Islam". The trends of the new astronomy which began with the foundation of the Marāgha observatory have been studied until the 16th c. and research should continue into the results obtained by Islamic astronomy during the following centuries. What we have here is a first attempt to trace a general history of the subject of which the first and last (until the 16th c.) chapters have been written by Saliba. I believe somebody should now write the chapters in the middle: Arabic astronomy is not only *hay'a* but includes other kinds of disciplines such as *zīj*es, *mīqāt*, instruments and observations; the making of the European Renaissance is not only the result of the transmission of the *hay'a* planetary models but also of other kinds of more humble information which reached Europe via Latin translations. Attempts to write this history have been made in collective works such as the first volume of

Rashed's *Encyclopedia* but I think that a version written by a single author would be extremely useful for general historians of science. Nobody is better qualified to write such a book than George Saliba.

Julio Samsó

David Juste, *Les Alchandreana primitifs. Étude sur les plus anciens traités astrologiques latins d'origine arabe (Xe siècle)*. Brill's Studies in Intellectual History Vol. 152. Brill's Texts and Sources in Intellectual History Vol. 2. Leiden-Boston, 2007. XVI + 726 pp + 6 plates.

In 1931, Josep M[a] Millàs Vallicrosa published his *Assaig d'història de les idees físiques i matemàtiques a la Catalunya Medieval* which contained, among many other things, a critical edition of the "old corpus" (Kunitzsch) or "old collection" (Burnett) of Latin texts, based on Arabic sources, on the construction and use of the astrolabe, the astronomical quadrant, and a few other instruments. In 2004 I was invited to write a state of the art concerning the collection and I carefully revised all the available sources, discovering, to my surprise, that they contained very few astrological materials. I have now found the answer to this intriguing puzzle in David Juste's book which is, to the best of my knowledge, the most important documenttary contribution to the study of the early introduction of Arabic astronomy and astrology in Europe since Millàs Vallicrosa's work.

Juste's book contains a critical edition and very complete study of a series of eight astrological texts which share common prediction techniques: the data of the horoscope are calculated using numerological procedures (numerical values of the letters forming the name of the subject) and the prediction is based on isolated elements (the onomatomantic ascendant, the planetary hours, the position of the planets in the triplicities or in the lunar mansions, etc.). This kind of very simplified astrology is represented in two other works written in the Iberian Peninsula during the Middle Ages: the Alfonsine *Libro de las Cruzes* and Raimundus Lullius' *Tractatus de nova astronomia*. Both books represent the same tendency towards simplification as the *Alchandreana* collection, although they have very little in common with it.

The books contained are either anonymous or attributed to a mysterious writer called Alchandreus. Apart from him, the other authorities quoted are Alexander Macedo, Ascalu Hismaelita, Argafalau/ Arfarfau Caldeus and Aluaten Sarracenus. Quite convincingly, Juste establishes relations between Ascalu and the 18th lunar mansion (*al-Qalb* spelt *Alcalu* in several sources of the collection), between Argafalau and the 26th mansion (*al-Fargh al-Awwal*, *Algarfalaul*) and between Aluaten and the 28th mansion (*Baṭn al-Ḥūt, Aluaten*). As for Alchandreus, Juste is inclined to equate this name with a corruption of al-Kindī but, given the degree of creativity shown by the texts' author, who invents names of scholars very similar to those of lunar mansions, I will repeat a hypothesis I made a few years ago when reviewing one of the papers published by Juste on the *Alchandreana*. Bearing in mind that one of the derivations of the corpus is the *Liber Arcandam*, very popular from the 16th c. onwards, I believe that Alchandreus may be a corruption of the *Arkand*, an Indian astronomical book known with this name in Arabic: the name, at least, circulated in al-Andalus towards the middle of the 9th c.

David Juste's volume contains a presentation of the books which form the corpus (pp. 29-98) and of which he has made a very careful critical edition (pp. 433-652; editorial criteria pp. 391-431). They are: 1) *Liber Alchandrei*; 2) *Epistola Argafalau ad Alexandrum*; 3) *Breviarium Alhandrei summi astrologi*; 4) *Quicumque nosse desiderat legem astrorum*; 5) *Proportiones competentes in astrorum industria*; 6) *In principio fecit Deus caelum et terram*; 7) *Benedictum nomen Domini* and 8) a collection of *Fragmenta Alchandreana* (22 chapters extant in several MSS which do not appear in the other works). Of these Juste considers that 6) and 7) are "vulgar" texts consisting in translations or adaptations of Arabic originals, while 1), 2), 3), 4) and 5) are more elaborate versions based on previous translations from the Arabic but which also use other sources. It is very difficult to establish the Arabic sources used by the authors of the collection: it is only clear that they derive from a milieu in which we find *Sarraceni. Iudaei, Barbari, Romani/ Christiani* and *Melli* (*mawālī* ?) (*Benedictum*, see pp. 79, 609-610). Place names in the Iberian Peninsula (*Corduba, Serragoza, Ciscitra?)* appear in the *Proportiones* (pp. 197, 556). Similarities with an Andalusī source on the making of talismans related to the lunar mansions and dated towards the middle of the 10th c. (Ibn al-Ḥātim's *De imaginibus*) have been underlined by Juste in the *Benedictum* (pp. 81-82). To this he adds the use of a Maghribī alphanumerical system (*abjad*) (pp. 153-154) and the Western names of the planets *al-Muqātil* (Saturn), *al-Aḥmar* (Mars) and *al-Kātib* (Mercury) (pp. 75, 222, 653-654), to which one could add names of zodiacal signs also common in al-Andalus: *al-Kabsh* (Aries) and *al-Taw'amān* (Gemini) (pp. 655-656). All this points to an Andalusī source or group of sources circulating in Cordova towards the middle of the 10th c. at a time when, under the conservative Caliphate of ʿAbd al-Raḥmān III (912-961), astrology survived only in secret, and books like the *Ghāyat al-ḥakīm/ Picatrix* (with a strong interest in lunar mansions) and the *De imaginibus* were written. The atmosphere of the period fits very well the non-mathematical character of the astrology represented in the *Alchandreana* collection. This is not contradicted by the fact that Juste has found a few references to Eastern astrological sources: Māshā'allāh's (fl. 762-809) *Liber de interrogationibus*, for example, is identified with the *Breviarium* in one of the MSS (p. 50), while two MSS of the *Proportiones* consider that this book is Māshā'allāh's *Liber iudiciorum* (p. 60). As for actual sources and, apart from the Latin ones (Martianus Capella, *Excerpta Plinii, In quo signo versetur Mars,* computus treatises, p. 219), there are parallels with the *Secretum secretorum*, a Syriac medical compilation, the Mandean Book of the Zodiac and the Book of Nativities attributed to Abū Maʿshar (d. 886) (pp. 224-226). All this forms a body of information which was available in Cordova at that time, or in the Christian lands where the translation/ adaptation was made.

The origins and subsequent development of the collection (until the 16th c.) are investigated by Juste in chapter 3 ("Histoire des Alchandreana" pp. 219-294). Juste argues convincingly that it originated in Catalonia towards the end of the 10th c. before the "old collection" of texts on the astrolabe and other instruments was compiled. He refers to the analysis made by Bernard Bischoff of the language of *In principio* (a bad Latin contaminated by the influence of a Romance dialect which he places in Catalonia) (pp. 75-77). Bischoff's examples do not seem very conclusive to me and I find a much stronger argument in Juste's analysis of the *Proportiones*. This text is particularly interesting because it contains the only reference, in the whole corpus, to a translation from the Arabic (pp. 69, 554): the author has not been able to find what he is going to explain (astrological predictions based on the vision of comets) in Christian or Hebrew sources, but in Arabic texts translated into Latin by the wisest master of the Arabs as he was instructing him. This book also contains a date: an example is given on the computation of planetary longitudes for year 4715 (although in the process of the calculation he uses 4795 systematically) *ab initio mundi*. If the Jewish chronology (year of Creation 3761 B.C.) is used, this gives 4715 – 3761 = 954, which fits neatly with what one might expect (pp. 69, 535-537), since the oldest MS (Paris BNF 17868), containing five treatises of the *Alchandreana*, is dated towards the end of the 10th c. Besides, the *Proportiones*, a revision of the *Benedictum,* and the Compilation of El Burgo de Osma (one of the MSS containing the *Fragmenta*) seem to have been written by the same author. They all use an uncommon vocabulary which apparently derives from the Glossaries compiled at the Monastery of Ripoll, and the style of this text coincides fully with the extant works of Miró Bonfill (d. 984), bishop of Gerona since 971 and correspondent of Gerbert of Aurillac who, in 984, asked him for a copy of the *De multiplicatione et divisione numerorum* written by a mysterious Joseph Sapiens. Miró Bonfill would, therefore, be the author of the *Proportiones* and the two other related texts. Besides, Juste considers that the traditional identification of the *Liber de astrologia* which Gerbert requested, also in 984, from its "translator" (*translatum a te*), Lupitus Barchinonensis (fl. 975-995), with one of the Latin texts on the astrolabe is unjustified and that a better hypothesis would be to identify it with the three first treatises of the Alchandreana collection (*Liber Alchandrei, Epistola Argafalau* and *Breviarium Alhandrei*), given the fact that the first, at least, of these books bears the title of *Liber de astrologia*. If this very reasonable hypothesis proved to be true, Lupitus would be the name of another of the authors of the collection (see pp. 249-257). There are, therefore, at least two Christian scholars (Miró Bonfill and, perhaps, Lupitus), an Arab (who helped Miró with the translation) and, without any doubt, a Jewish collaborator who, in Juste's opinion, made a serious effort to hebraize the Arabic sources used by the compilers of the collection. This explains the appearance in it of the Hebrew alphabet used as an alphanumerical system and the Hebrew names of the planets, and zodiacal signs which we find, especially, in the *Liber Alchandrei,* but also in the *Breviarium, Quicumque* and *Benedictum*.

Chapter 2 (pp. 99-217) deals at length with the technical contents of the collection: periods of revolution of the planets (101-104), domiciles, exaltations and falls (104-105), planetary apogees (109-111), *Thema mundi* (111-112), astrological characteristics of planets (112-119), zodiacal signs and triplicities (119-123), lunar mansions (123-126), houses of the horoscope identified with zodiacal signs (126-128), "Egyptian" terms (135-137), planetary and zodiacal hours (137-141), sign and planet of birth (141-147), numerical alphabets (147-155) and prognostications based on single elements, such as the sign or planet at birth, the planetary hour (for interrogations), the ascending sign at the moment of interrogation, the ascending triplicity, the position of the planets in the houses, the four quadrants or the triplicities, the Moon in the lunar mansions etc. (pp. 156-217). The computation of the planetary positions has an astronomical logic, as it uses the planetary periods of revolution and the number of years since the moment of the creation of the world, for which a horoscope (with the position of the planets in the signs) is supposed to be known (as a matter of fact, two different horoscopes are attested in our sources). The procedure appears in two variants which Juste calls "System A" and "System B" (which bear no relation whatsoever to the systems with the same denomination in Babylonian astronomy) and the pages dedicated to its study here (pp. 105-109) are a summary of the most important paper published by the author himself in the *Studies in the History of the Exact Sciences in Honour of David Pingree* (Leiden-Boston, 2004, pp. 181-222). The method explained by Juste gives a clear solution of a problem that worried me many years ago: how could astrologers working in al-Andalus towards the beginning of the 9th c. cast a horoscope at a time when no astronomical tables were available? In 1985 I suggested the same kind of solution as Juste but I was unable to examine the contemporary sources, as he has done now. Juste seems to have solved the problem quite definitively.

In many instances, however, the procedures explained in these texts to determine the ascendant (and therefore the signs corresponding to the houses), the sign and planet of birth are independent of any astronomical consideration and base themselves on numerological speculations. This is in spite of the fact that the system of zodiacal hours (pp. 140-141) contains the embryo of a vaguely approximate method to determine the ascendant and that the *In principio* (pp. 204-205, 579, 599) seems to be aware of a more sophisticated kind of astronomy when it explains the stations and retrogradations of the superior planets as a function of their elongation from the Sun. This appears to be an instance of the use of a different kind of source from those that are standard in the *Alchandreana*. Juste also notes some instances (pp. 199-203) in which astrological predictions take into consideration several predictive elements, something which bears witness to a more developed kind of astrology.

This excellent volume contains a careful description of the 71 extant MSS and a 16th c. edition which document the spread of the collection (pp. 297-390) and an important series of careful appendices which summarize, in tables, the spellings, in the different sources, of Arabic names of planets, zodiacal signs, lunar mansions and letters of the alphabet (pp. 653-666); the Hebrew names of planets, signs and letters of the Hebrew alphabet (pp. 667-674); the numerical alphabets (pp. 675-682) and the list of subjects in the *Alchandreana*. The book ends with a list of sources and bibliography (pp. 687-710) and indexes of Latin technical terms (pp. 711-714), Latin proper names (pp. 715-716), a general index of names and titles of works (pp. 717-722) and another of MSS (pp. 723-726). To conclude: this is a brilliant book on a subject which, at least in my opinion, is important.

Julio Samsó

Roshdi Rashed, *Les mathématiques infinitésimales du IX^e^ au XI^e^ siècle. Volume V: Ibn al-Haytham, Astronomie, Géométrie sphérique et trigonométrie*. Al-Furqān, Islamic Heritage Foundation. London, 1427/2006. XIV + 972 + V (Arabic summary of the introduction) pp.

In 1996, Rashed began this impressive collection of editions, French translations and thorough studies of Arabic mathematical texts related to infinitesimal mathematics which has now reached its fifth volume. Most, if not all, of the texts edited in vols. II-V are due to Ibn al-Haytham and make an enormous contribution to our knowledge of the mathematical aspects of his work. Rashed here adds a collection of four of Ibn al-Haytham's works dealing with mathematical astronomy and in which infinitesimal geometry is used. This is an important contribution given the limited number of Ibn al-Haytham's astronomical books that have, so far, received due attention. Among other examples, I will only mention Sabra and Shehaby's edition of the *Shukūk* (1971), Tzvi Langermann's *Fī hay'at al-ʿālam* (1990, see below) and some minor works such as the *Ḥall shukūk ḥarakat al-iltifāf* (Sabra, 1979), *Fī ru'yat al-kawākib* (Sabra & Heinen. 1991-92), the treatise on the computation of the *qibla* using the well-known "method of the *zīj*es" (Dallal, 1995), and the *Māhiyyat al-athar alladhī yabdū ʿalā wajh al-qamar* (Sabra, 1977; Yūsuf Zaydān, 1996, re-printed, with English, French and German translations in Alexandria, 2002). Al-though much research is still to be done before we have a clear view of Ibn al-Haytham's astronomy (see Rosenfeld and Ihsanoğlu's *M.A.S.I.C.* pp. 135-137), the new information gathered by Rashed is important.

In addition to a general introduction, of which an English summary has been published by the author himself in *Arabic Sciences and Philosophy* 17 (2007), 7-55, the present volume contains introductions, detailed mathematical commentaries, critical editions and French translations of the following works by Ibn al-Haytham:

1. *Fī hay'at ḥarakāt kull wāḥid min al-kawākib al-sabʿa* (pp. 49-615)
2. *Fīmā yaʿriḍ min al-ikhtilāf fī irtifāʿāt al-kawākib* (pp. 617-679)
3. *Fī khuṭūṭ al-sāʿāt* (pp. 687-801)
4. *Fī l-rukhāmāt al-ufuqiyya* (pp. 803-849)

A fifth work, unrelated to astronomy, is also edited in this volume. It deals with an instrument designed by Ibn al-Haytham which can be used to trace circles with large radii and which cannot be drawn with an ordinary pair of dividers:

5. *Fī birkār al-dawā'ir al-ʿiẓām* (pp. 851-879)

The most important of the five edited texts is, no doubt, the first one, originally comprising three books of which only the first is extant and is edited here by Rashed. The second dealt with "all operations of calculation", while the third one was a description of a small observational instrument which was easy to handle and with which astronomers would be able to determine the altitude of celestial bodies to the precision of fractions of minutes. Unfortunately we know no details about this instrument (see Appendix II, pp. 895-898).

The extant book 1 has been preserved in only one MS and, in it, Ibn al-Haytham begins with the presentation and proof of 15 geometrical and trigonometrical propositions (see pp. 49-172, 266-389), followed by propositions 16-36 (pp. 173-259, 390-615) dealing with a series of very specific problems in mathematical astronomy. One of the main things to underline here is that, in spite of its title, there is no *hay'a* in the usual sense of the term (*i.e.* cosmology): Rashed adequately translates this term by "configuration". There is no criticism of Ptolemy, either, and the *Almagest* is only quoted to confirm Ibn al-Haytham's assertions. Nor is there a single, developed description of any lunar or planetary model or any mention of numerical parameters (those appearing in the commentary have been added by Rashed). What we find is a very thorough mathematical study of the apparent motion of the Moon, Sun and the five planets during a limited period of time (between the rising of the celestial body and its passing the meridian, or between its meridian crossing and its setting), taking into consideration the different kinds of motion involved which, in the case of the Moon, are the daily motion from East to West, its motion in longitude on its inclined orb and the retrograde motion of the lunar nodes (explained by a rotation of the pole of the inclined orb around the pole of the ecliptic). In the case of the Sun only two motions are involved (motion in longitude and daily motion of the celestial sphere) because the precession of the equinoxes is not significant in the period of time involved. In the case of the planets, Ibn al-Haytham has also to bear in mind stations and retrogradations (caused by the motion of the planet on its epicycle), the inclination of the planet's orb in relation to the ecliptic (practically constant for the superior planets but variable for Mercury and Venus) and (for the inferior planets) the variations of the inclination of the epicycle with respect to their orb. In this context Ibn al-Haytham also studies the variations in velocity of the celestial bodies according to their positions in relation to their apogee and perigee. In the third place, he also studies the changes in altitude, with respect to the local horizon, and proves that, when we bear in mind all the variables involved, the maximum altitude does not coincide (except in specific cases) with the meridian crossing. The final proposition (36) considers the particular case of sites with latitude 0º. Throughout the book Ibn al-Haytham uses predominantly equatorial coordinates which allow him to define two concepts that he applies continuously: the required time (*al-zamān al-muḥaṣṣal*) – which is the difference in right ascension between two observed positions of the body – and the proper inclination for the required time (*al-mayl alladhī yaḥuṣṣu al-zamān al-muḥaṣṣal*).

The second text (*Fīmā yaʿriḍ min al-ikhtilāf fī irtifāʿāt al-kawākib*), also extant in only one manuscript, is a study of the variation of the altitude of celestial bodies between rising and setting. He begins with definitions, among which we find those related to horizontal coordinates – azimuthal /vertical circles (*dawā'ir al-irtifāʿ*) and almucantars (*dawā'ir al-zamān*) – followed by seven propositions of plane geometry, and by propositions 8-16 in which he studies changes of altitude as a function of time. In contrast to the *Fī hay'at ḥarakāt*, here Ibn al-Haytham considers the motion of celestial bodies in circles parallel to the equator.

The third (*Fī khuṭūṭ al-sāʿāt*) and fourth (*Fī l-rukhāmāt al-ufuqiyya*) works deal with sundials. The latter (extant in two manuscripts) is a practical treatise on the construction of a horizontal sundial of the standard type, with very few proofs: those missing are added by Rashed in the commentary. *Fī khuṭūṭ al-sāʿāt* (also pre-served in two manuscripts) begins with six propositions of a geometrical and trigonometrical character, followed by propositions 7-11 directly related to sundial theory. Here Ibn al-Haytham challenges the opinion of Ibrāhīm b. Sinān (909-946) – in his *Fī ālāt al-aẓlāl* – who, like his grandfather Thābit b. Qurra, stated that the hour lines joining the beginnings of the hours throughout the solar year are not straight lines. Ibn al-Haytham studies the problem carefully and proves that the difference between the line traced with exactitude and the straight line is negligible. Ibn Sinān did not realize that a straight line traced on a sundial is not a mathematical line without any thickness, but a physical line whose thickness will conceal the error made.

On the whole, considering the four astronomical works published here, my impression is that their importance is mainly mathematical rather than astronomical. There is little in them that can be related to planetary astronomy, while there are hints that Ibn al-Haytham is attracted by problems of timekeeping; this is obvious in the two texts on the sundial, and can also be inferred from the main points of interest of the *Fī hay'at ḥarakāt* and *al-Ikhtilāf fī irtifāʿāt*: changes in altitude of celestial bodies in short periods of time are topics characteristic of *mīqāt*. The very little information we have about the observational instrument described by Ibn al-Haytham in part 3 of the *Fī hay'at ḥarakāt* stresses only that it is extremely precise for the determination of altitudes. There are, of course, other topics, not related to problems of this kind, such as velocities of celestial bodies, which are dealt with very competently: I only wonder whether one can translate, as Rashed does, *ḥaraka zā'ida* by "mouvement accéléré" (see pp. 486-491, 510-527). Another debatable translation is that of *al-dā'ir min al-falak* (the hour angle since sunrise) by "le tracé de l'orbite" (pp. 896-897).

The volume contains two appendices, the second one on Ibn al-Haytham's aforementioned instrument of observation. In the first appendix (pp. 881-894) Rashed reiterates his well-known hypothesis of the existence of two Ibn al-Haythams: Abū ʿAlī al-Ḥasan ibn al-Ḥasan, our mathematician and optician, and Abū ʿAlī Muḥammad ibn al-Ḥasan, a physician-philosopher who would be the author, among many other works, of both the *Fī hay'at al-ʿālam* and of the commentary on the *Almagest*. The appendix deals mainly with the authorship of the extant *Fī hay'at al-ʿālam* which Rashed ascribes to Muḥammad, proposing that al-Ḥasan is the author of another lost work with the same title. His arguments are mainly based on his interpretation of an ambiguous colophon in MS Kastamonu 2298 (see a facsimile of the significant page in A.I. Sabra's paper in *ZGAIW* 12 (1998), p. 50). Sabra, obviously, interprets it differently (Sabra, 1998, pp. 19-21) and I believe that both interpretations are possible. I can only add that Sabra's paper had a conclusion in *ZGAIW* 15 (2002-03), pp. 95-108, which is not mentioned by Rashed, and that there are at least two Latin translations of *Fī hay'at al-ʿālam* (see p. 881), one of them retranslated from the Castilian translation patronized by Alfonso X.

The book ends with a set of complementary notes to *Hay'at ḥara-*

kāt (pp. 899-905), an Arabic-French glossary of technical terminology (pp. 907-955), and very complete indices of proper names (pp. 957-958), topics (pp. 958-965), titles of sources quoted (pp. 966-967) and manuscripts (p. 968), followed by lists of sources and bibliography (pp. 969-972). Concerning the bibliography, I wonder why the only translation of the *Almagest* quoted is the old French translation by N. Halma (Paris, 1813 and 1816) (see pp. 697 and 971). Two other sources are quoted through manuscripts, in spite of the fact that they have been edited: al-Farghānī's *al-Kāmil fī l-asṭurlāb* (p. 654), edited very recently by Richard Lorch (2005) and Abū l-Wafā's *Fīmā yaḥtāju ilay-hi al-ṣāniʿ min ʿamal [ʿilm?] al-handasa* ed. by Ṣāliḥ Aḥmad al-ʿAlī (Baghdad, 1979).

Leaving aside these small details, this volume is a great contribution, both in size and importance, to our knowledge of Ibn al-Haytham's mathematical astronomy, written by a first rate scholar who has dedicated his life to research on the history of Islamic mathematics. The editions have been prepared with the utmost care and skill, the translations are excellent and the mathematical commentaries are detailed and clear. I can only thank the author for presenting us with this gift.

Julio Samsó

Menso Folkerts, *The development of mathematics in medieval Europe: The Arabs*, Euclid, Regiomontanus. Aldershot: Variorum collected studies series: CS811, 2006. 354 pages, ISBN 0-86078-957-8, price 62.50 pounds.

The volume under review contains twelve articles by Menso Folkerts on the history of medieval as well as Renaissance mathematics. Eight articles had been previously published between 1974 and 2002; the articles on Arabic mathematics in the West (I), Euclid in the Middle Ages (III) and Regiomontanus' approach to Euclid (VII) are revised versions, and article XII, "Algebra in Germany in the Fifteenth Century" is new. Articles I and VII appear in English translation for the first time.

The main emphasis of the book is on Euclid's Elements, its medieval transmission, and its influence in the works of some Renaissance authors. Folkerts' book is a good introduction to this important but complicated subject. Several articles in Folkerts' book deal with Renaissance arithmetic and algebra on the basis of unpublished manuscripts of Regiomontanus (1436-1476).

In a review of this size it is impossible to do justice to the book as a whole. I will therefore restrict myself to the question why Folkerts' book is important for the history of medieval Islamic science. Folkerts discovered the complete version of the arithmetic of al-Khwārizmī, see the summary and analysis in article II. Article I is a concise introduction to the transmission of Arabic mathematics to the West. Folkers arrives at the surprising conclusion that the medieval translations from Arabic to Latin were "the basis of the mathematics of the seventeenth century" and had in the seventeenth century "a greater influence than Renaissance mathematics" (I p. 13). In the wonderfully clear article no. III, Folkerts details the way in which Latin version of Euclid's Elements are related to Arabic versions. In III, p. 12 footnote 63 add Rüdiger Arnzen's edition of al-Nayrīzī's commentary to Elements book 1 (Köln -Essen, 2002, ISBN 3-00-009172-6) on the basis of the newly discovered manuscript in Qom.

Folkerts makes clear that many aspects of the transmission of medieval Islamic science to Europe are still shrouded in mystery. There are curious coincidences between European and Arabic writings, such as: semi-regular polyhedra in the work of Piero della Francesca (died 1492), which are the same as in the work of Abu'l-Wafā' (died 998; X, p. 307-308); approximate rules for the determination of sides of regular polygons, probably of Arabic origin, in a circle in the work of Regiomontanus (V, 283); and mathematical problems in the works of Leonardo Fibonacci (ca. 1200; IX, 14-15) which are also found in the Algebras of al-Karajī (ca. 1000) and al-Khayyām (ca. 1100), even though the standard view holds that these works were unknown in the Western part of the Islamic world. In all these examples, the question is whether the coincidences are the result of transmission from the Arabic, and if so, in what way. Folkerts also mentions tantalizing coincidences between European mathematics and other cultures. Two examples from the work of Regiomontanus are: his determination of the diagonals from the sides of a concyclic quadrilateral, which is related to the work of the Indian mathematician Brahmagupta (VIII, 425); and his use of the Chinese remainder theorem (V, p. 200). Regiomontanus is not unique, because Leonardo Fibonacci uses a result which was also known to Indian mathematicians and which can be expressed in modern terms by the formula $(a^2 + b^2)(c^2 + d^2)=(ac + bd)^2 +(ad - bc)^2$. If knowledge of Indian and Chinese mathematics was transmitted to Fibonacci and Regiomontanus, the only plausible channel would have been through the Islamic world. But no traces of these problems and results have yet been found in medieval Arabic texts. This may of course reflect our own ignorance about the medieval Islamic mathematical tradition. Thus, the later European tradition can provide a wealth of fascinating subjects of research which may substantially enrich our knowledge of the Islamic mathematical tradition as well.

Together with the previous volume on Essays in early Medieval Mathematics, (Aldershot 2003), the book under review is indispensable for all research scholars in the history of science in antiquity, the Islamic and European medieval period, and the Renaissance.

Jan P. Hogendijk

Edson, Evelyn and Savage-Smith, Emilie: *Medieval Views of the Cosmos: Picturing the Universe in the Christian and Islamic Middle Ages*. Oxford: Bodleian Library (University of Oxford), 2004, 128 pp.

This book is a survey of the perception and mapping of the heavens and the earth in the Islamic and European traditions from the middle ages up to the Renaissance. It is divided in two main sections, the first one devoted to cosmology, and the second, which is lengthier, to geography and terrestrial cartography. Each section offers comparative materials alternatively from each tradition, in order to show the contrast between Islamic and Christian products of the same period. Emphasis is put on the differing ways in which the earlier thought reached the medieval scholars and how they profited from it. The selected items, presented with a brief commentary and reproduction, are helpful to the historian of cartography. In addition, a multiplicity of concepts is explained concisely and accessibly for the non-specialized reader. Such is the case of the medieval flat earth misconception that was promoted in the 19th century (p. 67). The titles of Arabic works are given only in English translation.

The original contribution of the *Book of Curiosities* (Egypt, 1020-50) is described with more detail, as the manuscript has been subject of a research project by E. Savage-Smith (with J. Johns and Y. Rapoport). Its cartographical contents are contextualized with relevant examples of Islamic mapmaking, like the circular world map that is identical with the one associated with al-Idrīsī (fl. 1154).

The first section opens with a general introduction to the structure of the heavens (The Medieval Cosmos, pp. 9–20) and covers chapters 1 (Greek and Roman Heritage, pp. 22–29), 2 (Science in the Islamic Regions, pp. 30–43), 3 (Twelfth–Century European Renaissance, pp. 44–45) and 4 (Microcosm/Macrocosm, pp. 46–48). These concentrate on the impact of Plato's cosmology on Christianity, and the transmission role of Roman popularisers and encyclopaedists, to contrast with the direct reception of Aristotle and Ptolemy's writings in the early Arabic sciences. The authors focus on 12th-century Spain for the transfer of Arabic versions of Greek texts and Arabic treatises to the Latin West. This legacy led to the renovation of the European sciences.

The geographical section starts with chapter 5 (The Geographical Inheritance from Antiquity, pp. 49–56). Islamic geography and mapmaking are discussed in chapters 7 (Medieval Islamic Geography, pp. 61–66), 9 (Medieval Islamic Mapping of the World, pp. 75–81) and 10 (Medieval Islamic Regional Mapping, pp. 85–95), beginning with Ptolemy's contribution to the development of Islamic mathematical geography. The cartography is categorized in five main approaches, that are those of the Balkhī school (10th cent.), al-Bīrūnī's sketch of seas and landmasses (early 11th-cent.), the *Book of Curiosities*, al-Idrīsī's Geography and the Islamic sacred geography. Elements of Islamic influence that are pinpointed on European world maps, in particular the one by Pietro Vesconte (1321), partly illustrate the *interchange of intellectual commodities* that took place across the Mediterranean (p. 81).

European geography and mapmaking are examined in chapters 6 (Medieval Western Geography, pp. 58–60), 8 (Mapping the Earth in the European Middle Ages, pp. 67–74) and 11 (Regional Mapping in Medieval Europe, pp. 99–109). Most examples are representative of English cartography and include the T-O map from St. Johns' College, Oxford (1110), the Holy Land map of Mathew Paris (mid-13th cent.), the world map of Ranulf Hidgen (d. 1363) and the Gough Map (mid-14th cent.). The European nautical chartmaking, appearing in the late 13th century, is highlighted through Vesconte's works, and for the Ottoman context reference is made to Pīrī Re'īs' *Kitāb-i Baḥrīye* (1521, 1526). Unfortunately, the nautical production of the Maghribi chartmakers (14th cent. – 1600) is entirely omitted. The geographical section ends with chapter 12 (Travellers and Traders, pp. 112–16) that shortly outlines the updating of the world view by means of long distance journeys for reasons of pilgrimage, commerce, warfare and, eventually, exploration.

The book is beautifully illustrated with 59 colour figures of excellent printing quality, so that the visual aspects of the selected materials are fully displayed. The majority belongs to the collections of the Bodleian Library, Oxford. Some diagrams and maps are accompanied with additional translation and identification of the basic data and toponymy. As a whole, this is a useful and handy overview of comparative cartography.

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