Reviews

Dold, Yvonne; Dauben, Joseph; Folkerts, Menso; van Dalen, Benno (Eds.): *From China to Paris: Two Thousand Years Transmission of Mathematical Ideas*, Stuttgart: Steiner, 2002 (Boethius, Vol. 46). IX + 470 pp.

This book is the written version of papers read at a conference at the Rockefeller Foundation's Research and Conference Center in Bellagio in May 2000. The first item (pp. 1-7), however, is an English translation of Kurt Vogel's "Ein Vermessungsproblem reist von China nach Paris" (1983). This explains the title of the volume and establishes its leitmotif: the transmission of mathematical ideas, particularly the sometimes mysterious transmission of recreational mathematics. All the contributions, except two in French, are in English.

Vogel studied the problem of finding the height and distance of an island by aligning two poles with its high point. First in ancient and medieval China, then in medieval India - here as the mathematically equivalent problem of finding the height of a lamp with the two poles. From India the problem travelled to the Arabic-Islamic world, to al-Biruni's *Book of Shadows*. From there it travelled to the Latin world - to the *Geometria incerti auctoris*, which also used the shadow quadrant on the back of an astrolabe - and to Hugh of St. Victor.

J. Høyrup (pp. 9-29) describes some Babylonian collections of mathematical problems - e.g. about the sides and diagonal of a rectangle or about the height of a pole leaning against a wall and the distance of its lower end from the wall. Their origin is ascribed to a "sub-scientific", mainly oral "'surveyers' tradition". Some of the Seleucid problems, e.g. on leaning poles, are remarkably similar to problems in two Demotic sources (perhaps 2c. AD), which also contain material on the summation of series. It seems that the Egyptian mathematicians were copying the common problems from the Babylonians. In Latin, the *Liber mensurationum*, translated by Gerard of Cremona from the Arabic of one Abu Bakr, and Leonardo of Pisa's *Practica geometrie* have almost all the Seleucid problems. Further similarities are found in Greek, Indian and Chinese sources.

J. L. Berggren (pp. 31-44) presents seven methods for determining approximate square roots. Finding many of these methods in various cultures, he makes suggestions for routes of transmission (e.g. with origin in Babylonia), but warns that independent invention is always possible. Also, deductions made from individual approximations are often difficult, since one approximation is often obtainable from several procedures. An entertaining coda on the value of π is added.

Sesiano (pp. 45-56) collects evidence for the form of ancient Greek multiplication tables from an Arabic description of Coptic practice, Coptic fragments and tables in Armenian and Byzantine sources. Since little remains of the ancient Greek tables, the massive documentation given in this article is very welcome.

A. Bréard (pp. 57-86) describes several problems of meeting and pursuit, in which two men or animals move on the same path at various speeds in the same or opposite direction. These are to be found in ancient and medieval collections. Some of these problems are explicitly astronomical and some may be interpreted astronomically (as referring to the conjunction of planets). Similar problems turn up in Indian astronomy and even in medieval Latin texts, such as Alcuin's *Propositiones ad acuendos iuvenes*. China may be assumed as the origin of these problems, but details of transmission to other parts of the world remain unclear.

K. Chemla and A. Keller (pp. 87-132) point to interesting similarities, in China and India, in the understanding and manipulation of irrationals, but come to no definite conclusion about the question of transmission. Since al-Khwārizmī's operations are very similar, they suggest an Indian influence on Arabic algebra.

S. Sarma (pp. 133-156) outlines the history of the Rule of Three and its developments within India. Some of his examples are from recreational mathematics. He briefly discusses the transmission of the rule to the Islamic world and Europe.

In his treatment of Double False Position, Liu Dun (pp. 157-166) quotes an example from the *Nine Chapters on the Mathematical Art* (China, 1c. AD). This problem is similar to that of Hiero's crown in the famous story about Archimedes. The method, somewhat transformed, was transmitted to Europe and returned, together with the Archimedes story, in the sixteenth century.

K. Plofker (pp. 167-186) shows the iterative approximations, though known in Greek writings, seem to make an independent appearance in Indian astronomical and mathematical works; some of these methods found their way into Islamic science - e.g. in the works of Ḥabash and al-Bīrūnī. Iterative methods were further developed in Indian mathematics, with its emphasis on computation rather than proof.

J. Hogendijk (pp. 187-202) describes the treatment of anthyphairetic ratios (in which the definitions of equal and greater ratios depends upon procedures equivalent in modern terms to those of continued fractions) in al-Mahānī (9c.), al-Nayrīzī (9c.) and al-Khayyāmī (d. 1131). He tentatively suggests a lost Greek original, thus opening a new window on Greek theories of ratio.

U. Rebstock (pp. 203-212) presents a description of the arithmetical text, found thirty years ago in a library in Medina, by Abu 'l-Ḥasan ᶜAlī al-Uthmānī (fl. mid-11c., Syria). It is a summary of a longer, but lost, work by the same author. Rebstock shows that the text is an early forerunner of thirteenth-century *ḥisāb* texts.

A. Djebbar (pp. 213-235) treats the various aspects of transmission within Islam, including matters of terminology. Some Eastern Arabic works and ideas were not known in the West. Finally, the circulation of some Andalusian and Maghrebi mathematical writings in the East are discussed.

C. Burnett (pp. 237-288) presents a richly illustrated account of the two basic forms of the Hindu-Arabic numerals, the eastern and the western. The eastern forms were used by Latin scholars, particularly the early translators; they were probably displaced by the forms used by the Toledan translators. The treatment is enriched by a wealth of information and suggestions about the association, or even collaboration, of scholars, deduced, for instance, from the places where they worked and the coexistence of their works in early codices.

R. Franci (pp. 289-306) traces the problem of the Jealous Husbands Crossing the River from Alcuin (9c.) to Tartaglia (ca. 1505-1557), mostly in Latin and Italian sources. In this problem three men with their wives (or sisters) must cross a river in a boat only big enough for two, on the condition that a woman is never in the presence of a man without her husband's (or brother's) being present. Although the problem is seldom mentioned in the *Trattati d'abaco* tradition, which often had a place for problems in recreational mathematics, Franci points to numerous treatments, some with deviant interpretations of the "jealousy" condition, and some with extension to more couples than three.

T. Levy (pp. 307-326) presents a concise and informative survey (with a generous bibliography) of medieval mathematics in Hebrew in Spain, Provence, Italy and Byzantium. Special reference is made to the translations from Arabic, but something of the complexity of this rich tradition is also described.

In B. van Dalen's "Islamic and Chinese Astronomy under the Mongols" (pp. 327-356) we find a good summary of present knowledge of the exchange of astronomical ideas between Chinese and Islamic scholars, inter alia in calendrical matters. Islamic *zījes* were admired by the Chinese astronomers for their accuracy; and several were translated into Chinese. Chinese influence on Islamic science may be seen, for instance, in the establishment of the Persian solar-lunar calendar. At the end of the article is a section on methods of investigating relationships between tables, one of van Dalen's specialisms.

M. Bagheri's paper (pp. 357-368) is on the depression of the horizon, or the question of how much more of the heaven does one see because of one's height. He appends an Arabic text, which he gives reasons for ascribing to Jamshīd al-Kāshī, with English translation.

A. Volkov (pp. 369-410) describes the Vietnamese arithmetical work *Toan phap dai thanh*, a treatise in the Chinese style attributed to Luong The Vinh (15c.). Some of the problems it contains are on such standard mathematical procedures as root extraction or the determination of the areas of figures, but there are also sections on land taxation and numerical divination. Chinese sources are indicated, but it is hard to specify them.

M. Folkerts (pp. 411-428) discusses mathematical problems in three collections in Regiomontanus' hand (including the unedited collection in MS Plimpton 188). Some of the problems might be described as recreational mathematics; others are algebraic or geometrical. Most have an Italian origin. Many reappeared in later German treatises. Thus Regiomontanus, who spent some years in Italy, may be seen as an important figure in the transmission of mathematical ideas from Italy to central Europe.

The last paper (pp. 429-453) is an account by D. Pingree of the Sanskrit renderings of de la Hire's *Tabulae astronomicae* in the eighteenth century. The first, in verse, was the most popular, but contained only rules. Only the third version attempted to give the geometrical basis. The paper describes how the tables were brought into Indian culture.

Richard Lorch

S.M. Razaullah Ansari (ed.), *History of Oriental Astronomy. Proceedings of the Joint Discussion-17 at the 23rd General Assembly of the International Astronomical Union, organised by the Commission 41 (History of Astronomy), held in Kyoto, August 25-26, 1997.* Astrophysics and Space Science Library, vol. 274. Kluwer Academic Publishers. Dordrecht/ Boston/ London, 2002, XIII+ 282 pp.

This volume compiles the Proceedings of a Symposium on Oriental Astronomy (mainly Chinese, Japanese and Korean, but also Islamic and Indian) during Medieval and Modern times. The collection contains 19 papers accompanied by an introduction written by the editor, a full programme of the meeting (p. 245), a detailed summary of the *c.v.* of the contributors (pp. 247-259) and a good alphabetical index of names, titles of works and subjects. Of the 19 papers, four are significant for the History of Islamic Astronomy:

Benno van Dalen ("Islamic Astronomical Tables in China. The Sources for the Huihui li", pp. 19-31) and Michio Yano ("The First Equation Table for Mercury in the *Huihui li*", pp. 33-43) are conducting a joint research project into the *Huihui li* or *Huihui lifa*, a Chinese translation, made in 1382-1383, of an Islamic (most probably Iranian) *zīj*: the original Arabic or Persian text seems to have been preserved in a MS of the library of the Pulkovo Observatory, described in 1882 by A. Wagner, which was still there at the time of the fire of 1997 and may have been destroyed then. This Chinese *zīj* is the result of the work undertaken in the Islamic Astronomical Bureau, an institution founded in 1271 in Peking whose first director was a certain Zhamaluding (identified with Jamāl al-Dīn Muḥammad ibn Ṭāhir ibn Muḥammad al-Zaydī) who had arrived in China in 1267. To the materials gathered from the lost Arabic or Persian source, the *Huihui li* added the results of fresh observations, made towards the end of the thirteenth century, which included a catalogue of 277 stars with new coordinates independent of the Ptolemaic ones. Van Dalen's paper presents a description of the various sources which contain information on the *Huihui li*. Among them we find the famous *zīj* of al-Sanjufīnī, completed in 1366 in Tibet and studied during the last fifteen years by E.S. Kennedy and B. van Dalen: it includes a large number of tables in common with the *Huihui li*. This work was introduced in Korea in the first half of the 15th c. and two adaptations for its use in this country were prepared ca. 1430 and in 1442. Other Chinese sources containing information about the *Huihui li* are much later (17th - 18th c.).

Michio Yano's paper describes the tables of the computation of the planetary equation of anomaly in the *Huihui li*, which have an interesting characteristic, for they give the equation of anomaly at the apogee instead of at mean distance (used in the tradition of the *Handy Tables*), a table for the difference of the equation of anomaly in the apogee and the perigee and, finally an interpolation function. This seems to be the same structure as that found in Kūshyār ibn Labbān's *Jāmi*^{c} *Zīj* (G. van Brummelen, "Mathematical Methods in the Tables of Planetary Motion in Kūshyār ibn Labbān's *Jāmi*^{c} *Zīj*", *Historia Mathematica* 25 (1998), 265-280), as well as in the aforementioned *Zīj* of al-Sanjufīnī. It also reminds me strongly of the technique used by Ibn al-Bannā' to compute the equation of anomaly for Saturn and Jupiter (see J. Samsó and E. Millás, "The computation of planetary longitudes in the *zīj* of Ibn al-Bannā', *Arabic Sciences and Philosophy* 8 (1998), 259-286) and it reappears (applied to all the planets) in the tables of John Vimond (see my review of Chabás and Goldstein, *The Alfonsine Tables of Toledo* in this issue of *Suhayl*). The bulk of Yano's paper concentrates, however, on the computation of the equation of the centre for Mercury. It is well known that the *Almagest* separates this equation into two components: c_3 (value of the equation considering that the centre of the equant coincides with the centre of the deferent) and c_4 (the correction needed in order to shift the actual position of the centre of the equant). The tradition represented by the *Handy Tables* gives directly the value of the equation (q) on the basis that $q = c_3 + c_4$. Curiously enough the *Huihui li* gives an equation of the centre for Mercury that is not $q = c_3 + c_4$, but $q = c_3 - c_4$. It is not surprising to discover the same feature in the Sanjufīnī *zīj*, but it is amazing to find that exactly the same mistake is to be found in al-Bīrūnī's *al-Qānūn al-Masʿūdī*.

The volume also includes two papers dealing with the introduction of modern European astronomy in India: David Pingree ("Philippe de La Hire at the Court of Jayasimha", pp. 123-131) and S.M. Razaullah Ansari ("European Astronomy in Indo-Persian Writings", pp. 133-144). Savai Jayasimha II or Jay Singh is the well known maharaja of Amber (1699-1743) who gathered an important collection of Sanskrit, Persian and Arabic astronomical MSS, as well as printed European books. Among them we find the 1727 Paris reprint of La Hire's *Tabulae astronomicae*, brought to him from Portugal in 1730, among other European books and astronomical instruments, by the Jesuit missionary Manuel de Figueredo, who arrived with a Portuguese astronomer, Pedro da Silva. David Pingree's paper analyses all the information available about the influence of this work in India, which marks the beginning of the introduction of European astronomy in this country. La Hire's tables were copied by hand by Joseph du Bois and at least two Sanskrit versions of it were made. Computations of lunar longitudes made with them were compared to lunar observations made at the observatory of Jaypur and to positions calculated with Ulugh Beg's *Zīj-i Jadīd* between 1727 and 1737. Discrepancies between the observed and computed positions led Jay Singh to ask (1732) for clarifications, and this led to the arrival (1734) of two other Jesuit astronomers (Fathers Boudier and Pons) equipped with modern astronomical instruments, including a 17-foot telescope. A group of Muslim astronomers, in Jay Singh's court, worked from the 1720's on the compilation of the Persian *Zīj-i-Muḥammad Shāhī*, finished about 1735. A good part of this *zīj* is based on Ulugh Beg's *Zīj-i Jadīd* but two papers by Mercier (1984) and van Dalen (2000) have established that the mean motion tables are the result of an adaptation of those of La Hire to the Muslim calendar.

Ansari's paper completes Pingree's information during the second half of the eighteenth and the first half of the nineteenth century: it deals with Indian scientists who came into contact with the scholar-administrators of the East India Company and some of them had the opportunity to visit England and other European countries and returned with updated knowledge about the recent developments of modern astronomy. Ansari summarizes the works of five of these scientists, most of which have been preserved in manuscripts in Persian, written particularly during the first half of the nineteenth century. It is remarkable to see that an adequate knowledge of contemporary astronomy does not imply the abandonment of the Islamic (and Hindu) traditions: an author such as Mirzā Abū Ṭālib (1752-1805-6), who has a detailed knowledge of European astronomy of the early 19th c., when he deals with transits of Venus and Mercury across the solar disk, refers to observations of the same kind made by Ibn Sīnā, Ibn Bājja and Quṭb al-Dīn al-Shīrāzī. Similarly, Ghulām Ḥusayn Jawnpūrī (1790-1862), who made observations of Pallas with a telescope in 1826, wrote, in 1818, a book on the construction and use of the astrolabe.

J. Samsó

Charles Burnett, Keiji Yamamoto, Michio Yano, *Al-Qabīṣī (Alcabitius): The Introduction to Astrology. Editions of the Arabic and Latin texts and an English translation*. Warburg Institute Studies and Texts, 2. The Warburg Institute - Nino Aragno Editore. London- Turin, 2004, VIII + 515 pp.

The team formed by Burnett, Yamamoto and Yano began, in 1994, a large scale project of editions of important Arabic astrological texts which were diffused in medieval Europe through Latin translations. In that year they published Abū Maᶜshar's *Madkhal* or *Mudkhal Ṣaghīr*, which was followed, in 2000, by the *Kitāb al-Milal wa'l-Duwal* of the same author (edited by Yamamoto & Burnett). To this we should add that Yano edited Kushyār ibn Labbān's *Madkhal* in 1997 and that other scholars have also had their share in this kind of work: I am thinking of the nine volumes of Abū Maᶜshar's *Madkhal Kabīr* published in 1995 by the late Richard Lemay and of the most recent publication (Zaragoza, 2005) of G. Hilty's edition of books VI-VIII of the *Libro conplido en los iudizios de las estrellas* (*Kitāb al-bāriᶜ fī aḥkām al-nujūm*) of ᶜAlī ibn Abī'l-Rijāl. All this amounts to a large number of editions of astrological classical texts (mainly Eastern, but most of them well known in the Maghrib) and it is very clear that the task undertaken by the three editors of this volume has acquired an outstanding position, for reasons I will try to explain.

We have here the edition of the *Kitāb al-mudkhal ilā ṣināᶜat aḥkām al-nujūm* written by Abū 'l-Ṣaqr ᶜAbd al-ᶜAzīz ibn ᶜUthmān ibn ᶜAlī al-Mawṣilī al-Qabīṣī, known in the Latin world as Alcabitius. He was an astrologer at the court of the Ḥamdānid Emir of Aleppo Sayf al-Dawla (945-967) to whom the *Mudkhal*, as well as three other works, is dedicated. In their introduction (pp. 1-13), Burnett, Yamamoto and Yano list thirteen works written by al-Qabīṣī. Among them we find the *Risāla fī imtiḥān al-munajjimīn mimman huwa muttasim bi-hādhā 'l-ism* ("On the testing of those who call themselves astrologers"), which contains a list of questions (both astronomical and astrological), with their corresponding answers, which should be used to test the capacities of those who aspire to become professional astrologers. The work is one of those dedicated to Sayf al-Dawla and it reflects the fact that men in power wish to know how far they can trust the predictions of their astrologers. The recent publication of vol. II-1 of the *Muqtabis* by Ibn Ḥayyān, a chronicle of the kingdom of the Cordovan emir ᶜAbd al-Raḥmān II (822-847), has provided us with multiple anecdotes in which the emir tries to examine the capacity of his astrologers. The data furnished by the Andalusī source are, however, anecdotal and have a literary character which contrasts with the highly technical contents of al-Qabīṣī's *Imtiḥān*. To the best of my knowledge this is the only known source in which there is evidence of a test of the competence of astrologers although, as the authors remark (p. 5, n. 15) several extant sources show attempts to examine the professional capacities of medical doctors: to those mentioned by the editors one should add al-Rāzī's *Miḥnat al-ṭabīb* (ed. by A.Z. Iskandar in *al-Mashriq* 54 (1960), 478-517). I know that Burnett *et al.* have prepared a critical edition of al-Qabīṣī's *Imtiḥān*: I hope they publish it very soon, for it is a most interesting text. Other astronomical works by the same author show that he was competent as an astronomer and that he was interested by certain problems that had attracted the attention of other Muslim astronomers of the 9th and 10th centuries: such is the case of his *Risāla fī 'l-abᶜād wa'l-ajrām* ("On distances and sizes [of heavenly bodies]", in which, surprisingly, al-Qabīṣī says that Ptolemy only described the distances of the Sun and the Moon), or of his (non extant) *Shukūk fī'l-Majisṭī* ("Doubts/Problems on the *Almagest*) and of his (also non extant) *Kitāb ᶜilal al-zījāt* ("Failings/Geometrical Proofs in *zīj*es).

The *Mudkhal* is a standard astrological handbook, much more detailed than Abū Maᶜshar's *Madkhal Ṣagīr* and more or less equivalent in size to Kūshyār ibn Labbān's *Introduction*. It is divided into five *fuṣūl* which deal with 1) the zodiacal circle in itself (signification of the twelve signs) and in relation to the local horizon (the houses); 2) the signification of the planets (and the lunar nodes) in their own nature; 3) the planets in their relations to other planets and their accidents depending on the places they occupy; 4) different kinds of predictions (general and historical, nativities, elections, meteorological; the *haylāj* and the *tasyīr*).

The *Mudkhal* seems to have been quite successful in Arabic countries: the editors list 24 MSS (see pp. 14-17), none of which, surprisingly enough, is Maghribī. However the work met with astonishing success in Latin Europe: the Latin (and derived English, French and German) translations are preserved in some 212 MSS and 12 printed editions of the 15th and 16th centuries (see pp. 156-198, 504-510). Following the standard technique applied by Burnett and his collaborators to Abū Maᶜshar's *Madkhal Ṣaghīr* and *al-Milal wa'l-Duwal* the volume contains a careful critical edition of the Arabic original, based on the three oldest MSS, with occasional references to five others. An annotated English translation appears on facing pages (see pp. 18-155). Keiji Yamamoto has been mainly responsible for the Arabic edition. This is followed by an extraordinary critical edition of the Latin translation by John of Seville (pp. 225-364), prepared by Charles Burnett on the basis of 12 MSS with occasional readings of four others. A detailed analysis of the Latin manuscript tradition can be found on pp. 205-223. The edition includes three different apparatuses: the first one records the glosses found in MS Vat. Reg. Lat. 1285, which contains a copy of John of Seville's translation with corrections made by an editor or reader who was comparing it to the Arabic text; the second apparatus contains a careful comparison, made by Burnett, with the Arabic edition (in the edition alternative translations and interpretative additions are marked in italics); finally, the third apparatus gives the manuscript variants. This, as well as the volume in its entirety, is a model to be followed. I believe nobody could ask for more from a work of this kind and if such a task was repeated with a well selected sample of Arabic texts and their corresponding Latin translations, we could think of the possibility of writing a comprehensive history of medieval scientific translations. Besides, following the example set by the two aforementioned editions of Abū Maᶜshar's works, the volume includes exhaustive Arabic-Latin (1558 Arabic words, recording all the passages in the text in which the word appears) and Latin-Arabic glossaries. This kind of information will be most useful for the preparation of something we really need: a dictionary of medieval astronomical Arabic. Finally, the volume also includes four appendixes: 1) edition and English translation of an *urjūza* by the early Islamic astronomer al-Fazārī on *ḥudūd* (terms) (pp. 365-369); 2) an edition (prepared by David Pingree) of a Greek fragment of *faṣl* 4 of the *Mudkhal*, belonging to an early Byzantine translation (11th c.) (pp. 371-374); 3) an edition and English translation of a work attributed to Alcabitius entitled *Tractatus Alchabitii de conjunctionibus planetarum* (pp. 375-385). This is a translation, extant in two manuscripts and in one Renaissance printed edition, of an unidentified Arabic original which was also translated into Castilian and French (both apparently made from the printed edition). The text deals with the significance of planetary conjunctions in every zodiacal sign; 4) edition of the

Arabic text and Latin translation (by Robert of Ketton) of some excerpts of al-Kindī's *Forty chapters* (see Burnett in *Ar. Sci. and Phil.* 3 (1993), pp. 77-117), which seem to be one of the sources used by al-Qabīṣī for the compilation of his *Mudkhal* (pp. 386-393). The volume also contains, finally, a bibliography (pp. 394-398), an index of all the manuscripts and early editions mentioned (pp. 504-510) and a general alphabetical index (pp. 511-515).

J. Samsó

Mūsà ibn Nawbajt, *Kitāb al-azmina wa-l-duhūr. Tratado de astrología mundial.* Edición del texto árabe, introducción y notas por Ana Labarta. Análisis del contenido astronómico por Àngel Mestres. Área de Estudios Árabes e Islámicos. Universidad de Valencia. Valencia, 2005. 62 + 80 pp.

Ana Labarta published (Madrid-Bellaterra, 1982) Mūsā b. al-Ḥasan b. Nawbakht's collection of 93 historical horoscopes, entitled *al-Kitāb al-Kāmil.* This interesting collection attracted the attention of, at least, two scholars: on the one hand, John North (*Horoscopes and History*, London, 1986, pp. 52-56) analyzed the problems involved with the positions of ascendant and midheaven and tried to ascertain both the epoch used by the author and the latitudes for which these horoscopes were computed; more recently (*Centaurus* 41 (1999), 213-243) G. van Brummelen has published a most illuminating analysis of the astronomical information related to the solar and planetary positions in these horoscopes. In her study about the *Kāmil*, Labarta used information gathered in the *Kitāb al-azmina*, the other work of Ibn Nawbakht which is extant, but no edition was available. The purpose of the present book is to present such an edition, without a translation, but with two detailed commentaries of its contents prepared by the editor herself (in Spanish) and by A. Mestres (in English). The complete work constitutes an excellent piece of scholarship and brilliantly rounds off a task which Labarta began more than twenty years ago.

The edition is based in the only extant manuscript: Istanbul University Library A-315, fols. 56v - 160r, foliated by a modern hand, though there is an older one, used here, which assigns an independent number to the folios corresponding to this work (fols. 1r - 105r). This MS was probably copied in Egypt in the 15th c. Labarta has prepared an extremely conservative text, which shows great respect to its source and she acknowledges sincerely that she has doubts in some of her readings and hopes that a future editor might understand better the text and correct the doubtful passages which, in my opinion, are very few and for which I cannot give a better alternative.

Mūsā ibn Nawbakht was a member of a prestigious family of Iranian astrologers, translators and scholars which goes back to Nawbakht al-Fārisī (d. 777), who predicted the accession to the caliphate of al-Manṣūr (754-775) and participated in casting the fundational horoscope of Baghdad in 762. A history of the Nawbakht family between ca. 750-950 (with the addition of an offspring in the 13th c.) appeared in the introduction to the *Kāmil* (pp. 15-21) and is updated in the *Azmina* (pp. 0.9-0.14). The very little that is known about the biography of the author of both works, Mūsā b. Nawbakht (fl. ca. 860-940) is summarized in the introductions to the *Kāmil* (pp. 23-27) and to the *Azmina* (pp. 0.15-0.18, 0.27). Arabic sources ascribe to Mūsā a book named *al-Kitāb al-Kāfī fī aḥdāth al-azmān* a title that does not agree with those of his two extant works. Labarta (0.17-0.18, see also Mestres pp. 0.28-0.29) emphasizes the fact that the *Azmina* and the *Kāmil* were written in two consecutive years: the *Azmina* is dated 936 while the *Kāmil* was completed in 937. This is one of the arguments she uses to establish the convincing hypothesis that they are the two parts of a single book, the *al-Kitāb al-Kāfī fī aḥdāth al-azmān*, of which the *Azmina* deals with the theory of world astrology, while the *Kāmil* contains a collection of "examples" of historical horoscopes, dated between -2129 and 947 A.D.

Labarta's introduction in Spanish (pp. 0.19-0.26) deals with the manuscript and with its contents. The work contains a detailed explanation of the cycles used in world astrology (Saturn-Jupiter conjunctions, thousands, *fardāriyyas*, *qismas* or *tasyīrs* and *dawrs* or *intihā's*: see Mestres' commentary on pp. 0.43-0.50). The number of revolutions of Saturn and Jupiter, as quoted in the text, in a period of 360000 years is identical to that used by Abū Maᶜshar and is one of the many instances showing that Ibn Nawbakht follows an Indo-Iranian tradition. Surprisingly enough van Brummelen (pp. 231-232) has shown that the times and positions of the mean great conjunctions (with shift in the triplicity) of the two superior planets, when computed from the actual horoscopes in the *Kāmil*, do not use sidereal mean motion parameters, but tropical ones clearly derived from the Ptolemaic tradition. On the other hand, the *Azmina* gives information about the maximum equations of Saturn and Jupiter, which, again, are Sassanian. It is obvious that Ibn Nawbakht uses technical information gathered from different sources. Thus, he seems to refer, in the *Azmina*, to two different lengths of the solar year (6,5;15,36,17,16,48 days and 6,5;15,33,30,31,40,48 days). The second value is, probably, more accurate and it is near the one calculated by van Brummelen who has established (pp. 220-221), using horoscopes 78, 82 and 86 (confirmed by 54. 58, 62, assuming a logical error) of the *Kāmil*, that the parameter used is 6,5;15,30,22,30, which is the *Sindhind* value. Ibn Nawbakht was clearly a sloppy computer and this is shown in Labarta's calculation of the length of the year using the whole set of horoscopes of spring equinoxes of consecutive years in the *Kāmil* (horoscopes 38-90): she obtains (p. 0.24) 6,5;15,12,12, the last digit being sometimes replaced by 10 or 9. A different set of computations made by Mestres (pp. 0.52-0.53), and based on a limited set of spring equinox horoscopes dated between 940 and 946, leads to a value of the excess of revolution between $6;12,9^h$ and $6;12,12^h$, which is near the value used by al-Khwārizmī ($6;12,9^h$) and is obviously, in agreement with van Brummelen's approximation. What is clear in all cases is that Ibn Nawbakht is using a sidereal year.

Both Labarta and Mestres deal with astrological geography (pp. 0.25-0.26, 0.27-0.41) and both underline the strange character of the place-names corresponding to the seven climates, which seem impossible to identify with any known location. A chapter of the *Kitāb al-azmina* (see pp. 14-19 of the Arabic edition) contains the coordinates of 60 fixed stars belonging to the first (15) and second (45) magnitudes, derived from al-Ḥajjāj's translation of the *Almagest*, with their longitudes increased by 7;56°: this corresponds to a period of 795 years after the date of Ptolemy's star catalogue (137 AD) (137+795=932 AD) using a Ptolemaic rate of precession (1° per century) (pp. 0.26, 0.41-0.42).

A. Mestres makes (p. 0.28) an important point regarding the purpose of the astrological history represented both in the *Azmina* and in the *Kāmil*: it has a clear Shīᶜī character and is "an attempt to introduce the astrological methods of investigation into the theological doctrine of the imamate". Both works insist on the importance of the *al-Qā'im* and most of the conjunctions of Saturn and Jupiter with change of triplicity have their own *Qā'im*. Most of the ideas related to general astrology (natures of the planets and signs, on pp. 0.32-0.36) seem to derive from Ptolemy's *Tetrabiblos*, while those concerned with world astrology (pp. 0.43-0.50) have a Sassanian origin. Mestres ends his commentary with a recomputation of 13 horoscopes, corresponding to years comprised between 333 (horoscope 14) and 947 A.D. (horoscope 93). For that purpose he uses a computer programme, prepared by Prof. E.S. Kennedy and revised by Dr. H. Mielgo, which yields the planetary longitudes with the parameters and theory of al-Khwārizmī's *zīj*. In spite of the fact that Mestres acknowledges that he has selected those horoscopes for which the recomputation gives the best results, there is no doubt that they are excellent and confirm the hypothesis formulated in 1999 by van Brummelen: al-Khwārizmī's *zīj* is, quite probably, the tool used by Ibn Nawbakht for the computation of his horoscopes and this seems correspond to a tradition of sidereal astrology which, at least in al-Andalus and the Maghrib, lasted for a very long time. There is, here, a clear contrast with the fact that Ibn Nawbakht is working in the first half of the 10th c. and is perfectly aware of the existence of a different kind of astronomy, in the Ptolemaic tradition: it is clear that he uses the *Tetrabiblos*, the star catalogue of the *Almagest* and, as van Brummelen has proved, Ptolemaic parameters for the computation of the great conjunctions of Saturn and Jupiter.

J. Samsó

Ibn al-Haytham: *Kitāb al-manāẓir li l-Ḥasan Ibn al-Haytham, al-maqālatān ar-rābiᶜa wa l-khāmisa fī inᶜikās al-aḍwā' wa-mawāḍiᶜ al-khayālāt al-mubṣara bi l-inᶜikās* [al-Ḥasan Ibn al-Haytham's Treatise on Optics. Books four and five on the reflection of light and the place of images seen by reflection]. A. I. Sabra (ed.), Kuwayt, al-Majlis al-waṭanī li 'l-thaqāfa wa 'l-funūn wa 'l-ādāb, 2002. Vol. 1, XIV + 426 pp. Vol. 2, 297 pp.

For those who specialize in the history of optics, Ibn al-Haytham's *Kitāb al-manāẓir*, written in Cairo during the first quarter of the eleventh century, is the most important scientific contribution to this discipline during the period between the second and the seventeenth centuries, that is until the publications of Kepler and Descartes. It represents the final stage of a long Arabic tradition which began with the translation and assimilation of Greek works related to the study of light (especially those of Aristotle, Euclid, Anthemius of Tralles, Ptolemy and Diocles). This tradition was continued, from the ninth century onwards, by the contributions of al-Kindī, Qusṭā ibn Lūqā, Aḥmad ibn ᶜĪsā, ᶜUṭārid, Abū 'l-Wafā', Ibn Sahl and others.

The *Kitāb al-manāẓir* implies two important changes in relation to the earlier Greek and Arabic contributions. On the one hand, it abandons the theory of the emission of rays by the eye and adopts a new approach: that of considering that the eye receives the visual forms of light and colour. The second change is to be found in the method of research which introduces a close association between experimentation (as a research tool and as a way to establish physical laws) and mathematics and, especially, geometry (considered as another tool for devising theories describing these laws).

One should also remember that, although the publication of this work was not immediately followed by new research, it was not the last Islamic production in the field of Optics. In the East, al-Fārisī (d. 1319) became a productive follower when he wrote the *Kitāb tanqīḥ al-manāẓir li-*

dhawī 'l-abṣār wa 'l-baṣā'ir [Book on the Revision of Optics for those who have good sight and penetrating intelligence], in which we can find an improvement on Ibn al-Haytham's ideas on the rainbow, for which he gives an adequate explanation. In al-Andalus, the mathematician al-Mu'taman (d. 1085) planned to include a chapter on Optics in the second volume of his great treatise *Kitāb al-Istikmāl* [Book of Perfection]. It is also possible to believe, if one accepts the authority of Ibn Khaldūn (d. 1406), that this chapter was published independently. In fact we know that al-Mu'taman owned a certain number of Ibn al-Haytham's works such as his *Kitāb al-taḥlīl wa'l-tarkīb* [On analysis and synthesis] and his *Book on Optics*, and that he adapted six geometrical lemmas of the fifth book of this latter work, precisely those which allow him to solve the well known "problem of Alhazen". It is, therefore, reasonable to imagine that the work or the project on Optics was conceived as an extension or a clarification of the contributions of Ibn al-Haytham.

The *Kitāb al-manāẓir* deals with visual perception from a physical, mathematical, physiological and psychological point of view. It contains seven books which deal with three main topics: the straightline propagation of light and colours and the psychology of vision (*Books* I-III), the reflection of light and the vision through rays reflected on plane surfaces or mirrors (*Books* IV-VI) and, finally, refraction (*Book* VII). After the important study on the *Treatise on Optics*, published in the early nineteen forties by Muṣṭafā Naẓīf, we needed a complete and reliable critical edition which would allow scholars to undertake two complementary tasks: to exploit the contents of the *Treatise* in the framework of new research and to place it within both the Arabic and the Latin traditions, the latter developed from the thirteenth century onwards as a result of the Latin translation of the work. A.I. Sabra began this important editing task in the nineteen seventies. The first part of this project was published in 1983 and contained the Arabic text of the three first books, together with a substantial introduction on the optical work of Ibn al-Haytham. This was followed, in 1989, by the English translation of these three books. The second part of the treatise is the object of this new publication and it contains the edition of *Books* IV and V, which deal, respectively, with "the reflection of light and the perception of objects by reflection", and "the place of images seen by reflection". In *Book* IV we find the results of experimental research which establish the general laws of the reflection of light and colours. These experiments are made with plane, cylindrical, spherical and conical mirrors, having in mind the convexity and concavity of the three latter models. Book V deals with results obtained using mathematical techniques and we find here the famous "problem of Alhazen", concerned with the determination of the point of reflection of a ray of light coming from a luminous source having a known position, on the surface of a convex spherical mirror which reaches the eye, whose position is also known. We also find similar problems related to mirrors with other shapes and which have been the object of experimentations in *Book* IV.

In his introduction to the first volume, Sabra analyses the specific problems posed by the edition of these two books, which are the result of the textual history of the *Kitāb al-Manāẓir*, in both its Eastern Arabic and Latin stages. The second part contains the critical edition. The volume also contains an English introduction in which the editor summarises Ibn al-Haytham's project, presents the documents used for his edition, and describes the difficulties he has faced and the reasons which led him to abandon the idea of preparing a bilingual Arabic-Latin lexicon, as he had done previously with *Books* I-III. This introduction is accompanied by a table of concordances of the contents of the two manuscripts of the *Kitāb al-manāẓir* used (Fātiḥ 3215 and Köprülü 952) as well as of al-Fārisī's *Tanqīḥ*.

The second volume contains the critical apparatus, the figures and three appendices. The first one is the edition of a text by al-Fārisī which describes, with the help of a diagram, an instrument, called "copper plate", designed by Ibn al-Haytham to determine "how reflection takes place". The second appendix is a list of corrections to his own edition of Books I-III. Finally the third one is a most useful analytical index which gives the reader a quick and precise idea of the contents of the different sections of *Books* IV and V.

In order to establish the text of these two books of the *Kitāb al-manāẓir*, A.I. Sabra had only three manuscripts, belonging to two different families, but he completed his information by using five copies of the text of al-Fārisī's *Tanqīḥ al-manāẓir* as well as the edition of this latter work made in Hyderabad between 1928 and 1930. This work has been most useful for the reconstruction of the numerous figures which are missing in the known copies of Ibn al-Haytham's treatise. As for the Latin translation, the editor has willingly given up the idea of using it for his critical edition, due to the large number of extant copies and, especially, due to the substantial differences (in *Books* IV and V) between its contents and those of the Arabic version and of al-Fārisī's *Revision*. We find, in fact, a large number of additions both in the diagrams and in the texts accompanying them.

As they wait for the English translation announced by the editor, scholars have at their disposal a large part of Ibn al-Haytham's *Optics*, presented according to the rules of critical edition and complemented by the historical, bibliographical and terminological materials necessary for continuing research on this exceptional work. The quality of what has already been produced augurs well for the project of the edition of the whole work. One can only hope that it will be completed promptly and thus provide scholars with a most useful tool.

Ahmed Djebbar

José Chabás and Bernard R. Goldstein, *The Alfonsine Tables of Toledo*. Archimedes. New Studies in the History and Philosophy of Science and Technology. Volume 8. Kluwer Academic Publishers. Dordrecht/ Boston/ London, 2003. XIV + 341 pp.

When Manuel Rico y Sinobas published (Madrid, 1863-1867) the five volumes of his edition of the Alfonsine *Libros del Saber de Astronomía*, he included (IV, 111-183) a text that was, apparently, unrelated to the collection: the Castilian canons of the Alfonsine Tables. He used, for that purpose, the only extant manuscript (Biblioteca Nacional MS 3306) and it is well known that his edition (like that of the *Libros del Saber*) was full of defects. In spite of the fact that better editions of the *Libros* have been prepared by scholars like Kasten *et al.* (1997, in CD-ROM), and by Cárdenas (1974, Ph.D. thesis, not available in print), these works were not accompanied by an adequate astronomical commentary. Most fortunately, this task has been undertaken by Chabás and Goldstein who present, here, a reliable edition of the *Libro de las tablas* (pp. 19-94), with an introduction (pp. 1-19), a detailed astronomical commentary (pp. 135-224), a glossary of technical terms (pp. 95-133), a summary of the Alfonsine astronomical corpus (pp. 225-241), and, finally, a chapter on the legacy of Alfonsine astronomy (pp. 243-306). All this is accompanied by lists of manuscripts and parameters, as well as by a detailed alphabetical index. This work has been accomplished by two authors who, in recent years, have made very important contributions to the clarification of the origin and of the European diffusion of these tables.

The *Alfonsine Tables* are a most problematic source, mainly because the Castilian canons are not accompanied by a set of numerical tables, while the latter appear, with Latin headings, mainly between 1320 and 1330, together with canons written by astronomers who, like John of Saxony, were active in Paris. On the other hand, the Latin tables do not seem to correspond at all to the description of the Castilian canons, which compute sidereal longitudes that can be reduced to tropical using a set of trepidation tables, apparently related to Ibn al-Zarqālluh's third model of trepidation, for they include a table for the computation of the variable obliquity of the ecliptic (see pp. 90, 220-221): all this seems to be in the tradition of the *Toledan Tables*. The Latin *Alfonsine Tables*, for their part, compute tropical longitudes and a set of tables which combine constant precession with variable trepidation are only used to calculate the displacement of stars and solar and planetary apogees. To this, one should add several changes in the presentation of the tables, of which I will give only one example: the Castilian canons describe a set of mean motion tables which use the Julian calendar and are structured in the standard way (*anni collecti*, *anni expansi*, months, days and hours); the Latin tables, in their standard form (represented by the *editio princeps* with the canons of John of Saxony, Venice, 1483), are independent of calendars, because the only unit of time used in the mean motion tables is the day and, in order to calculate the mean position of a planet on a given date, one has to begin by establishing, in a sexagesimal form, the number of days elapsed since one of the many radix eras used in the tables. This structure was abandoned in the so-called *Tabulae resolutae* which seem to have appeared between 1420 and 1430.

The Alfonsine tables (at least in the form which corresponds to the Castilian canons) were compiled between 1262 and 1272, during which time Isḥāq b. Sīd and Yehudah b. Mosheh made astronomical observations about which we only have details of three lunar (1265 and two in 1266) and one solar eclipse (1263), thanks to a report transmitted by Isaac Israeli (ca. 1310), analysed here by Chabás and Goldstein (pp. 140-143). In spite of this dating, the *Alfonsine Tables* disappear from the scene until the Parisian versions begin to appear ca. 1320, and there is no sound evidence of their circulation in Spain until the end of the fourteenth century, in which we have a manuscript of the Parisian tables, adapted to Morella, in the kingdom of Valencia, with the canons of John of Saxony (pp. 292-300).

This situation has led a scholar like Emmanuel Poulle to defend, since 1985, that the Latin *Alfonsine Tables* are a Parisian creation and that they have little to do with the Toledan version represented by the Castilian canons. This theory was seriously discussed by John North (1996) and I have often argued that the Castilian canons represent a first version of the tables, in the Andalusī tradition, while the Latin tables correspond to an Alfonsine revision, influenced by al-Battānī, whose canons were translated into Castilian in the Alfonsine circle (Bossong, 1978). Chabás and Goldstein plainly disagree with this idea of mine and the authors believe that this revision was made in Paris, on the basis of the Alfonsine materials mainly represented by the Castilian canons (see pp. 267, 279). The effort of the authors concentrates on establishing the relations between the Latin Parisian tables and their Alfonsine Toledan or, more generally, Andalusī predecessors. The chapter on "The legacy of Alfonsine astronomy" (pp. 243-306) deals with the main characteristics of the Latin tables (chronology, signs of 60°, solar and lunar equations, equations of centre for Venus and Jupiter, planetary velocities, sidereal and tropical years, precession and trepidation) and makes a serious attempt to relate them to Andalusī and Maghribī astronomy. On the other hand it also traces a very complete history of the Parisian versions of the *Alfonsine Tables*, which begin with a new source: the Tables of John Vimond (1320), of which a more detailed survey was published by Chabás and Goldstein in *Suhayl* 4 (2004), 207-294. He was followed by five other Johns: John of Murs, John of Lignères, John of Saxony, John of Genoa and John of Montfort. All this ends with shorter surveys related to the diffusion of the Tables in England, Italy and Spain.

The efforts of the authors to establish links between the Parisian Alfonsine Tables and their Andalusī precedents are particularly difficult because the Castilian canons lack, almost entirely, numerical parameters: see however chapter 29 (pp. 53-55, comm. pp. 185-188), where the maximum value of the equation of time is quoted, as well as the mean and true solar positions for the beginning of the Alfonsine era are given, and it is established that these two values are in agreement with the 11^{th} c. *Toledan Tables*. Chabás and Goldstein (see Chabás, 2003 and the present book pp. 153-155, 251-252) have argued convincingly that the maximum solar equation was 2;10°, the same as in the Latin *Alfonsine Tables*. The Castilian text mentions an obliquity of the ecliptic of 23;33° (p. 60) and the authors draw our attention (pp. 160-162) to a similar parameter, 23;32,30°, well attested in other Alfonsine astronomical works. This parameter, according to a late Maghribī source (ca. 1513-1515), was established in an observation made in Meknes in 1205-1206 which reappears in the Tunisian recension of the *zīj* of Ibn Isḥāq (fl. ca. 1193-1222). All this poses the problem of the extent to which Alfonsine astronomers were aware of the astronomical work undertaken in the Maghrib.

Another extremely interesting item appears in chapter 27 of the Castilian canons (pp. 47-52, commentary pp. 170-180, 254), which deals with the use of lunar and planetary velocity tables. In a paper published in 1994 by Goldstein, Chabás and Mancha, the authors established the close relation between chapter 27 and canon 44 of John of Lignères's *Priores astrologi*. In fact the velocity tables described in both texts have been preserved in 41 MSS corresponding to both the Toledan and Alfonsine traditions, as well as in a *zīj* by a later Maghribī astronomer. A new edition of the tables of planetary and lunar velocity, based on the new MSS discovered by the authors, appears here (pp. 176-182). As they state (p. 173) "every early edition of the Alfonsine Tables, but for the *editio princeps*, included this planetary velocity table".

Chapter 17 of the Castilian canons (pp. 37-38) uses the Zarqāllian correction to the Ptolemaic lunar model (see Puig, 2000), according to which the lunar mean longitude should be increased or decreased by an amount equivalent to 0;0,5,30° x (λ_m - λ_a), where λ_m is the mean longitude of the moon and λ_a is the longitude of the solar apogee. In their commentary (p. 156), Chabás and Goldstein establish that the origin of this correction is to be found in the Andalusī-Maghribī tradition in which the expression used is 0;0,24° x (λ_m - λ_a) but, for reasons unknown to me, they say that the constant should be 0;24° (in spite of their remark, Ibn al-Bannā' uses 0;0,24°). The authors are absolutely correct when they say that "the astronomical significance of this correction has not been explained satisfactorily". I wonder whether this correction bears any relation to the fact that La Hire's astronomical tables give the Moon an equation which reaches a maximum of about 0;13° whose arguments are the difference of longitudes of the Moon and the Sun and $\lambda_m - \lambda_a$ (Delambre, *Hist. de l'Astronomie Moderne*, II, p. 667). Whatever the case, the Andalusī and Maghribī sources insist that this correction is used only when a very precise computation is required (the examples used are the visibility of the lunar crescent and the computation of eclipses). I believe one should study this correction in relation to the computation of solar and lunar eclipses which could have been observed by Ibn al-Zarqālluh in the second half of the eleventh century. The same methodology could be applied to the eclipses observed by Alfonsine astronomers between 1263 and 1266 (see pp. 141-143), to find a reason for the change of the constant factor.

On pp. 234-237 we find a discussion about the origin of the constant of precession used in the *Libro de las estrellas de la ochaua espera* (17;8°) and in the Latin Alfonsine tables, not only in the star catalogue (which uses Gerard of Cremona's translation of the star catalogue of the *Almagest*) but, most importantly, in the precession-trepidation tables in which 17;8° is the value of total precession + trepidation corresponding to the Alfonsine epoch used in this source (31st May 1252). The authors believe that "the Parisians took the total precession of 17;8° from a Castilian source, and applied it to their epoch for Alfonso... We think it most unlikely that the 17;8° was derived from the theory of trepidation as presented in the Parisian Alfonsine Tables (for which there is no evidence in Castilian); rather, it was one of the parameters incorporated in that theory, fixing the total precession for the epoch of the Parisian Alfonsine era." (p. 234). Chabás and Goldstein explain the 17;8° = 12;42° + 4;26°, in which 12;42° is the constant of precession used by al-Ṣūfī (the main source of the *Ochaua Espera*) to increase the Ptolemaic stellar longitudes for year 964 (al-Ṣūfī's radix for his catalogue), while 4;26° would represent the corresponding increase of longitude between 964 and 1256 (the year of the first version of the *Ochaua Espera*) applying al-Battānī's and al-Ṣūfī's constant of precession of 1° in every 66 years. This explanation is not new, for it was already used by Abraham Zacut (1452-ca. 1515) and, later, by J.B. Riccioli and others. In my opinion, it is difficult to accept, for two reasons: 1) the text of *Ochaua Espera* was revised in 1276, and one may ask why, if the year 1256 was in the mind of the Alfonsine collaborators when they calculated the precessional constant, they did not correct it for a later date. This would not be the case if they were computing an increase of longitude for a more significant date such as 1252, the year of Alfonso's accession to the throne; 2) constant precession is an idea totally alien to the astronomy of the Iberian Peninsula until the time of Zacut and, in the Maghrib, until the beginning of the 15th century. Reasonable explanations of the compound model of precession + trepidation have been given by Casanovas (1987) and North (1996); see however pp. 255-266.

In the chapter related to the "Legacy of Alfonsine Astronomy", the *Tables* of John Vimond (pp. 267-277) are particularly interesting for they may represent an intermediate stage in the process of adaptation of Alfonsine Toledan materials. They use sidereal mean motions (like the Toledan Alfonsine Tables) but Chabás and

Goldstein show that if we add the proper motion of the apogees to a precessional constant (they use 1° in every 66 years) and to the mean motion parameters of the Sun, Saturn, Jupiter and Mars, the results obtained coincide (up to the fourth sexagesimal fraction) with the parameters of the Latin Alfonsine Tables. The proper motion of the apogees corresponds to an idea developed by some Andalusī and Maghribī astronomers who applied to all the planets the proper motion of the solar apogee discovered by Ibn al-Zarqālluh (see on this the very recent paper by M. Díaz Fajardo, "*Al-Zīŷ al-Mustawfā* de Ibn al-Raqqām y los apogeos planetarios en la tradición andaluso-magrebí", *Al-Qanṭara* 26 (2005), 19-30). The same idea is to be found in the *Tables of Barcelona* compiled for King Peter the Ceremonious. The authors do not say this explicitly but one may wonder whether the Toledan Alfonsine Tables do not refer to the proper motion of the apogees because such a motion had already been incorporated into their mean motion solar and planetary parameters. On the other hand John Vimond's solar and planetary apogees seem to be related to those of the 11th c. *Toledan Tables* to which the proper motion of the apogees has been added. Another point of interest appears in the tables for the equation of anomaly which are not standard but follow a technique which was applied by Ibn al-Bannā' to the computation of this equation for Saturn and Jupiter, though not for the other planets. The disposition of the tables of planetary latitudes introduces a third component for the latitudes of Venus and Mercury which is also to be found described in chapter 22 of the Castilian Alfonsine Tables.

This is all I can say about the general contents of this brilliant book which is, in my opinion, a most complete survey, full of new ideas, of all the information we have about a topic which is full of mystery and which will probably never be completely clarified. Here follow a few remarks of detail:

The terminology used in the Castilian texts is strongly influenced by that used in Andalusī and Maghribī astronomical tradition. The authors have already remarked this in relation to the terms used to denote tropical (*natural*, *ṭabīʿī*) or sidereal (*propio*, *dhātī*) longitudes or motions (pp. 217-218). Other examples can be given: in p. 171 (comm. to chapter 27) the authors remark that slow planets are called *pesados*, while the term applied to swift planets is *livianos*. These expressions translate a standard terminology used for higher (*thaqīl*) and lower (*ḥafīf*) planets. In a similar way (p. 183) ecliptic degrees are called *grados yguales* which correspond to the Western Arabic usage of *daraj al-sawā'*.

Pp.232-233: a facsimile edition of MS Universidad Complutense 156 has been published in Barcelona, 1999 (Planeta-Agostini).

P. 238: the *Libro de la açafeha* corresponds, as the authors say, to a description of the construction and use of the *ṣafīḥa zarqāliyya* and the Arabic original of the treatise on the use of the instrument is divided into 100 chapters. The Latin translation prepared between 1225 and 1231 by Yehudah ben Mosheh corresponds to the Arabic text (60 chapters) on the use of the *shakkāziyya*: see my paper "Sevilla y la obra científica de Alfonso X", in M. González Jiménez (ed.), *Sevilla 1248*, Madrid, 2000, pp. 567-577 (see p. 575).

P. 239: on the *Libro de las laminas de los siete planetas* see M. Comes, *Ecuatorios andalusíes. Ibn al-Samḥ, al-Zarqālluh y Abū-l-Ṣalt*, Barcelona, 1991 (which includes editions of the Italian translations of both texts).

Pp. 239-240: the *Libro de las formas et de las ymagenes* is a magical rather than an astrological text. See Roderic C. Diman and Lynn W. Winget (eds.), *Lapidario and Libro de las formas e ymagenes*, Madison, 1980 ; Alfonso D'Agostino, *Astromagia*. Napoli, 1992.

P. 240: the Latin (Alfonsine?) translation of the *Ghāyat al-ḥakīm/ Picatrix* has been edited by David Pingree, *Picatrix. The Latin Version of the* Ghāyat al-Ḥakīm. London, The Warburg Institute, 1986.

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