misinterpreted passage of Simplicius' commentary on Aristotle's *Physics*), using all the available evidence and containing, in agreement with the interests of the author, a very thorough analysis of the Medieval tradition of illustrations which appear together with Calcidius' text. A planetary model in which the motion of Mercury and Venus is circumsolar appears clearly, as it is well known, in Martianus Capella (see items I, II, IV, VII; the problem of the order of planets is also studied in paper no. V) and interpolations or glosses in medieval manuscripts seem to ascribe the same kind of ideas to other authors such as Bede, Pliny or even Plato (see item VIII). On the other hand Martianus' words were interpreted in three different ways which appear described in diagrams extant in several manuscripts: Mercury and Venus may describe circles whose centre coincides with that of the Sun, or describe intersecting circular paths around the Sun or even move somehow along *incomplete* intersecting circles or undefined curves of another kind.

One may wonder why a historian of Islamic astronomy should become interested in a set of papers like the present one as they all deal with sources unrelated to any Arabic influence. The answer is obvious, in my opinion: Eastwood's research describes the work done by centres of European scholarly learning which were interested in Astronomy, precisely the centres in which the earliest samples of this influence were to appear. Paper X ("Calcidius's Commentary on Plato's *Timaeus* in Latin Astronomy of the Ninth to Eleventh Centuries") stresses the interest Abbo of Fleury had in Calcidius and recent research by Charles Burnett ("King Ptolemy and Alchandreus the Philosopher: the Earliest Texts on the Astrolabe and Arabic Astrology at Fleury, Micy and Chartres", *Annals of Science* 55 (1998), 329-368) has shown the important role played by the monastery of St. Benoît de Fleury, precisely in the time in which Abbo was its abbot (988-1004), in the transmission and European diffusion of the old corpus of texts on the astrolabe and other matters which were based on Arabic sources of some kind but which also contain a mixture of Latin materials (see, for example, David Juste's "Les doctrines astrologiques du *Liber Alchandrei*" in I. Draelants, A. Tihon and B. van den Abeele (eds.), *Occident et Proche Orient: Contacts scientifiques au temps des Croisades,* [Louvain], 2000, pp. 277-311). One should also remember that Calcidius' texts contained clear descriptions of planetary models based on deferents and epicycles and, thus, paved the way for the future introduction of Ptolemy. Finally Eastwood's paper IV ("Origins and Contents of the Leiden Planetary Configuration (Ms. Voss, Q.79, fol. 93v), an Artistic Astronomical Scheme of the Early Middle Ages") analyses a well known Carolingian illustration which includes approximate planetary positions that can be dated on the 18th March 816: he poses the problem of how the planetary positions were calculated and suggests the use of the *Preceptum Canonis Ptolomei* (ed. D. Pingree, Louvain, 1997). Whatever the solution, the situation is similar to that of the Andalusī astrologers of the early 9th century who computed horoscopes before the introduction in al-Andalus of the first Eastern *zīj*es. Besides, the *Preceptum* appears in manuscripts containing materials of the old Arabic corpus and is quoted by the authors of the *De utilitatibus astrolabii* and of the prologue *Ad intimas...* On the whole, then, the interest of this volume for students of early European astronomy, both Latin and Arabic-Latin, is obvious.

Julio Samsó

Fritz S. Pedersen, *The Toledan Tables. A review of the manuscripts and the textual versions with an edition.* Historisk-filosofiske Skrifter 24:1-4. Det Kongelige Danske Videnskabernes Selskab. Copenhagen, 2002. 1662 pp.

The publication of this spectacular edition of the *Toledan Tables* deserves a very special welcome because editing *zījes* is the kind of task that has seldom been done in the scholarly world interested in the history of Arabic astronomy. Before 1956, the year of the publication of E.S. Kennedy's well known *Survey*, the only editions available were those of al-Battānī (Nallino, 1899-1907), al-Khwārizmī in Adelard of Bath's translation (Suter, 1914), Ibn al-Zarqālluh's *Almanac* (Millàs, 1943-50), the canons of Ibn al-Bannā's *Minhāj* (Vernet, 1952) and al-Bīrūnī's Mas^{c}udic Canon (Krause, 1954-56). A recent updating of Kennedy's book (D.A. King *et al.* in *Suhayl* 2 (2001), pp. 9-105) has only been able to add to this short list the English translation and commentary of al-Khwārizmī/Adelard of Bath by O. Neugebauer (1962, including an edition of the Latin adaptation of the same work by Petrus Alfonsi), the Byzantine version of al-Fahhād's *al-Zīj al-*^{c}*Alā'ī* (Pingree, 1985-86) and two unpublished doctoral dissertations presented in Barcelona in 1996 (Muhammad Abdurahman) and 2000 (Angel Mestres) on Ibn al-Raqqām's *Qawīm Zīj* and Ibn Isḥāq's *Zīj* (Hyderabad manuscript) respectively.

From the point of view of editions, one must acknowledge that Andalusī and Maghribī sources - including Mashriqī *zījes* (al-Khwārizmī, al-Battānī) mainly used in Western Islam - have received more attention than the Eastern ones. This tendency continues with Fritz Pedersen's masterly edition of the *Toledan Tables*, which has only one important predecessor: Toomer's analysis of the same tables published in 1968. We have now, however, something which is far more complete than the previous work: a critical edition of three sets of canons and of the numerical tables, based on more than a hundred manuscripts. In spite of the fact that the *Toledan Tables* cannot be considered original and are mainly the result of a hasty adaptation of Eastern materials that had reached al-Andalus, they definitely deserved an edition because they were the starting point of an important tradition of Maghribī *zījes* and because they were very well known in Latin Europe. It is obviously true that the manuscript tradition of these tables is a pure Latin one (see I, 11), the Arabic originals being apparently lost, but one should also remember that a revised version seems to have circulated in the Maghrib: the mean motion tables of the *zīj* of Ibn Isḥāq (Hyderabad MS) use parameters very near to those of the *Toledan Tables* and give radices both for Toledo and for Tunis. Pedersen has found traces of a revision of the tables which can be dated ca. 1110 (some ten years after the death of Azarchel in 1100) in an early Latin copy (I, 15 and III, 759): two horoscopes probably for the latitude of Toledo dated 1110 and 1106 (North, 1995) and a star table (on tables of this kind see IV, 1489-1508) with an increment on the Ptolemaic longitudes of 14;55° and in which the date is 1422 Alexander/1110-11 (Table 13A). I will discuss this latter topic below but, given the fact that Toledo was conquered by Alfonso VI in 1085, the existence of horoscopes cast for that latitude when the city was no longer under Muslim authority poses the very interesting problem of the possible survival of Islamic astronomy in Toledo until later than we thought.

Vols. I (pp. 1-323) and II (pp. 324-736) contain a General Preface and editions of the three sets of canons: 1) *Ca* ("Scito quod annus"), based on al-Battānī, carrying a plausible ascription to Ibn al-Zarqālluh/Azarchel; 2) *Cb* ("Quoniam cuiusque"), the "vulgate", a revision of *Cc* with some Christian adaptations: a previous edition of this text had been published by Pedersen himself in 1987; 3) *Cc* ("the archaic version"), modelled on al-Khwārizmī's *Sindhind*, but also strongly influenced by al-Battānī. Pedersen, 1992, published an edition of a passage of the canons (Cc 123-212) and showed that *Cc* depends on a version of al-Khwārizmī's rules which corresponds to fragments of Ibn al-Muthannā, i.e. a version of the *zīj* independent of Maslama's revision (II, 571). *Cb* and *Cc* derive ultimately from the same Arabic exemplar, *Cb* being a thorough stylistic revision of the Latin text of *Cc* (II, 337). The attribution of the authorship of *Cb* to Azarchel and of the Latin translation to Gerard of Cremona does not seem well founded (see II, 331 and 338). The earliest dated reference to the Latin Toledan Tables corresponds to 1141 (see III, 754), but the oldest MSS of the three versions date from the late 12th or early 13th c., canons *Cb* dominating the scene in the late 13th c. They were still copied in the 15th c. although, from c. 1320 onwards, they faced competition from the *Alfonsine Tables*.

Vols. 3 (pp. 737-1237) and 4 (pp. 1241-1662) contain a general preface to the tables, a critical edition of them, without an explicit recomputation but with an extremely careful control of errors (which implies a thorough understanding of the underlying astronomical theory) and a very complete set of indices. Tables are classified (I, 18-20) into 7 different kinds corresponding to: A, chronology; B, trigonometry and spherical astronomy; C, mean motions of Sun, Moon, node and planets; D, apogees, nodes, daily mean arguments; E, equations of sun, moon and planets; F, planetary latitudes; G, mean syzygies; H, parallax; J, eclipses; K, visibility of the lunar crescent; L, fixed stars; M, geographical; N, projections of rays; O, planetary visibility and retrogradation; P, eighth sphere; Q, revolution of years; R, astrology; S, almanacs and ephemerides; T, calendars and computus; U, varius auxiliary tables. In relation to category S, it came as a surprise for me to discover that the term *almanac* is not always applied to a perpetual almanach such as Azarchel's, but also to a set of ephemerides calculated for a lunar or a solar year (II, 542-6).

Toomer's analysis of 1968 had made an accurate study of the sources used for the compilation of the *Toledan Tables* and established that only the mean planetary motions could be considered original, while the rest of the materials were the result of hasty adaptations of the corresponding tables in the *zīj*es of al-Khwārizmī and al-Battānī. This general idea is fully confirmed by Pedersen (III, 1139 ff.) who states that the *Toledan Tables*, in a strict sense, comprise the planetary mean motions and the syzygy tables (I, 16-17). Although Theon's *Handy Tables* ("Zaiun Alexandrinum", II, 521) are mentioned, their influence (quite obvious in the planetary equation tables) was indirect and took place through al-Battānī's *zīj* (I,47). Pedersen also confirms Mercier's discovery (see for example his paper in *From Baghdad to Barcelona*, 1996) that only the solar mean motion can be considered original in the *Toledan Tables*, for "the differences between the tropical longitudes of the Sun and planets in the *zīj* of al-Battānī are respectively equal to the difference between the sidereal longitudes of the Sun and planets in the *Toledan Tables*" (Mercier, 1996, p. 300). According to Pedersen's computations (III, 1140-1) the value of precession subtracted from al-Battānī's tropical parameters to obtain the corresponding Toledan sidereal one is between, approximately, 0;0,0,9,18,27° and 0;0,0,9,18,35°/day. On the origin of this parameter I can give a hypothetical explanation: it could have been obtained by comparing Ptolemy's longitude of *Qalb al-Asad*/ Regulus for year 139 AD (122;30°) and Maslama's observation of the same star in 367 H/968 AD, mentioned by Azarchel in his treatise on the motion of the fixed stars (135;40°). Since the difference is 13;10° in a period of time which amounts to, approximately, 839 Julian years, it is easy to check that

$$13;10^\circ / (839 \times 365.25) = 0;0,0,9,16,50,16^\circ$$

The radices for Hijra are more difficult to justify. They are comprised between -0;24,13° and -0;24,18° in relation to those of al-Battānī. This value is in agreement with what one would expect in an Andalusī-Maghribī tradition in which precession reaches 0° some time before the Hijra. This is confirmed by a set of *tropical* mean motion tables for Toulouse (II, 1205), in which the collected-year values for A.D. 600 are about the same as those of the normal Toulouse sidereal ones, "so no doubt a year about 600, perhaps the Hijra, has been dated as the origin for precession". In spite of this, I have not been able to obtain 0;24° for the beginning of Hijra with the trepidation tables extant in the Toledan collection (IV, 1545) - considered by Pedersen to be probably the result of the work of the Toledan team - with which the calculated value amounts to 0;17,31°. Other attempts, made with al-Istijjī's parameters (see Comes in *Suhayl*, 2001, pp. 318-322) and with the different models described by Ibn al-Zarqālluh in his treatise on the motion of the fixed stars, have also been unsuccessful.

Trepidation, solar mean motion and tables adapted to the coordinates of Toledo are the topics one has to check when searching for original materials in Pedersen's edition of the *Toledan Tables*. As regards trepidation, it is interesting to note that canons *Ca* contain no allusion to precession/trepidation except in I, 232-233, where we find a canon on solar declination: "intra cum loco solis aequato, cuius initium est a capite arietis". If one takes this expression seriously, it implies the declination which corresponds to a sidereal longitude of the Sun, measured from the [movable] Head of Aries. Pedersen is obviously not happy with this interpretation for he translates (p. 233 n.2): "from the vernal point (= head of Aries)". Trepidation is dealt with in canons *Cb* and *Cc* (II, 478-79 and 686-87). In the former we find a peculiar expression which seems to show the influence of Andalusī astronomical terminology: in II, 436-437, at the end of the computation of the solar longitude, we read "et tunc habebis locum solis certissime cuius initium erit a initio arietis [in 8'a sphaera]". In this context *certissime* makes me think of an Arabic *dhātiyya* [= sidereal]. It is also interesting to remark that canons *Cb* (II, 533) refer to a tropical ascendent ("ascendens cum motu 8'vi circuli"), a practice that does not conform to the standard tradition of Andalusī -Maghribī astrology which tends to use sidereal ascendents.

Trepidation may also be connected with the precessional increments of star longitudes. Pedersen (IV, 1489-1508) edits several sets of star tables which seem to correspond to Toledan (or derived) early material. In them two different increments on Ptolemaic longitudes are used:

1) 14;7° in table LA11, of which a close Arabic cognate was published by Kunitzsch (1980), the latter being dated in 459/1066-67. This date makes sense, for it is confirmed by the "corrected" longitudes of Qalb al-Asad used by Azarchel, in his treatise on the motion of the fixed stars, to establish the accurate values of precession (Samsó, Variorum, 1994, VIII, pp. 7-10), which are 122;26° for the time of Ptolemy (139) and 136;35° for his own time (1075), the difference being 14;9°.

2) 14;55° in tables LA12, LA13 and LA13a, although LA12 also has 15;7° in 12 cases out of 35. One of the manuscripts containing LA12 gives 577H/1181-1182 as a date, while table 13a is dated in 1422 Alexander/1110-11 (Table 13A). Pedersen, following a suggestion by Kunitzsch, proposes that 1110-11 is the date to which an increase on Ptolemaic longitudes of 14;55° corresponds, while 577H could be corrected to 527/1132-33, a date to which an increase of 15;7° could be assigned. It is strange that table LA13 includes columns showing the maximum altitude of the star and its half daily arc, implying a latitude of 39;54° (Toledo). This latitude is peculiar when related to a date ca. 1110 (later than 1085, the year in which Toledo was conquered by Alfonso VI). The suggested dates (1110-11 and 1132-33) would however fit Ibn al-Kammād, who was probably Azarchel's disciple and who, as shown by A. Mestres (in *From Baghdad to Barcelona*, 1996), was active in Cordova in 1116-17. He might have corrected the star longitudes in a Toledan table without bothering to do the same with the maximum altitude of stars or their half daily arcs.

My impression is, however, that the increment of 14;55° may correspond to 527H/1132-33. The longitude of Qalb al-Asad in table 13A is Leo 17;25° (Ptolemy, Leo 2;30°: dif. 14;55°). The longitude of this star in Western Islamic tables for precession

0° is Leo 9;8° or 9;18° (see M. Díaz, *La teoría de la trepidación en un astrónomo marroquí del siglo XV*, Barcelona, 2001, p. 56). The absolute value of precession implied is, therefore, 8;17° or 8;7°. For the beginning of year 527 H I obtain, using Azarchel's tables based on his third model of trepidation a value of 8;4,4°, not far from 8;7°.

3) There is, finally, a star table (LA14) in which the star longitudes do not seem to be related to the Ptolemaic ones by adding a constant of precession. Some of them (Qalb al-Asad, for example, the longitude of which is Leo 9;10°) seem to derive from a table which computed star longitudes for precession 0°. A column includes values of the half daily arc for each star for a latitude between 33;30° and 34° (Fez?).

Solar mean motion is obviously related to the values of the *revolutio anni*: canons *Cb* (II, 484-7) mention an amount of 2481/9600, corresponding to 6;12,9^{h} and to 93;2,15° in *Cc* (II, 662-3). Other values are given in IV, 1567, although only one seems to be related to the tradition of the *Toledan Tables*: CG11 which gives 92;20,55...°, equivalent to 6;9,23,43...^{h} or 0;15,23,29,17...^{d}. This value corresponds to the solar mean motion implicit in canons *Ca*01 (0;59,8,11,28,27,29,49°). Ibn al-Kammād ascribes to Azarchel a *revolutio anni* of 92;24°. It is interesting to remark that similar values can be found in a set of tables ascribed to Ibn al-Hā'im in the Hyderabad MS of the *zīj* of Ibn Isḥāq (Abdurahman, in *From Baghdad to Barcelona*, 1996, pp. 372-375): here the *revolutio anni* is 92;20,56,40,12°, 6;9,23,46,40,48^{h}, or 0;15,23,29,26,42^{d}. This is not the only value quoted by Ibn al-Hā'im who, in the text of his canons, says that the length of the solar year for the beginning of the 7th/13th c. (Abdurahman, 1996, pp. 370-371) was 365;15,23,37,30^{d} (which fits the values of the *revolutio anni* extant in the same text, 92;21,45° and 6;9,27^{h}), very near to the value ascribed to Azarchel (365;15,24^{d}, see Samsó, *Ciencias de los Antiguos*, Madrid 1992, p. 213). Finally, in Pedersen IV, 1586-89, we find a set of tables of the *revolutio mensium*, which are the result of the division of a tropical year of 365^{d} 5;47,30° into 12 equal "months". Similar tables (though related to a sidereal year) appear in the Hyderabad MS of the *zīj* of Ibn Isḥāq ascribed to Ibn al-Hā'im (see Abdurahman, 1996, pp. 376-377).

Another solar parameter is the obliquity of the ecliptic and, in this respect, the values found in the *Toledan Tables* are remarkably homogeneous: 23;33° (I, 69) and 23;33,30° (I, 67 and 69; II, 508; III, 961-64) are ascribed to Yaḥyā b. Abī Manṣūr and/or to Azarchel and canons *Cb* (II, 410-11) and *Cc* (II, 612-13) add the remark "quae [i.e. Yaḥyā's value] apud nos ducitur verior, quia primam novimus rumore, et hanc didicimus per considerationem" ("and among us this is considered truer, since we know the former from hearsay but have learnt the latter from observation"). In this relation we find (in III, 765, 967) a declination table with a maximum 23;33,8° a parameter which, until recently, was only known through another declination table ascribed to Abraham ben ᶜEzra: the situation changed radically with the publication of a paper by George Saliba (*Al-Qanṭara*, 1999, p. 11) on the critiques of Ptolemy made by an anonymous Toledan astronomer who was a contemporary of Azarchel to whom he ascribes an obliquity of the ecliptic of 23;33,8°, obtained, probably, through observation.

The coordinates of Toledo are another set of values which can safely be considered original. It is interesting to see that MA11 (the principal version of the list of geographical coordinates of cities) gives a longitude for Toledo of 11° and a latitude of 40° (IV, 1516). A later set has a longitude of 28;30°, and a latitude of 39;51° (occasionally 39;54°). The longitude of 28;30° implies the use of the water meridian, commonly related to the Toledan tradition (see Comes, 1994) and it fits a longitude for Cordova of 27°, documented in al-Andalus since ca. 940 (Samsó 1992, p. 90). 28;30° for Toledo also fits the time difference with Arin of 4 1/10 hours (= 61;30°) found in canons *Ca* (I, 250-

1) and *Cb* (II, 430-1), as well as in a set of mean motion tables (III, 1211). In the fourteenth century Isaac Israeli (III, 754) ascribes to Abraham Zarkil a longitude for Toledo of 62° (= 28°) from Arin, a value which corresponds to the $4;8^h$ used by tables CB^* (see III, 1191 ff). In another passage the same source states that Toledo is 4^h + 162/1080 ($4;9^h$, equivalent to 27;45° from the water meridian). As for the latitude of Toledo, the most common value seems to be 39;54° which appears both in tables (see III, 997-1003, 1125-1127, and in canons Cb (II, 431) and in a variant of Cc (II, 730).

This is about all I have to say on the masterly work of Fritz Pedersen. Other scholars will be interested in various other aspects of this edition which opens many doors to the study of an important medieval European tradition. For my part I was mainly interested in exploring the information it contains about the astronomical work of what Ibn al-Hā'im (fl. ca. 1200) calls *al-jamāᶜa al-ṭulayṭuliyya* ("the Toledan community").

Julio Samsó

Ahmad Jabbār and Mūḥammad Aballāgh, *Ḥayāt wa-mu'allafāt Ibn al-Bannā al-Murrākushī* [sic] *maᶜa nuṣūṣ ghayr manshūra*. Manshūrāt Kulliyyat al-Adāb wa l-ᶜUlūm al-Insāniyya bi l-Ribāṭ. Silsilat Buḥūth wa-Dirāsāt, raqm 29. Rabat, 2001. 238 pp.

This is an important attempt to write a biobibliographical survey of the Moroccan mathematician and astronomer Abū 'l-ᶜAbbās Aḥmad b. Muḥammad b. ᶜUthmān al-Azdī, known as Ibn al-Bannā' al-Marrākushī. The authors have used all available published and unpublished primary sources, among which they emphasize the importance of the biobibliographical notes by two fourteenth century Maghribī mathematicians who wrote commentaries on the *Talkhīṣ aᶜmāl al-ḥisāb* of Ibn al-Bannā': Ibn Haydūr al-Tādilī (d. 816/1413) - in his *al-Tamḥīṣ fī sharḥ al-Talkhīṣ* - and Ibn Qunfudh al-Qusanṭīnī (d. 810/1407) - in the *Ḥaṭṭ al-niqāb ᶜan wujūh aᶜmāl al-ḥisāb*. Working editions of these two notes are published here as two appendices (pp. 193-205): Ibn Qunfudh's text had been previously edited by Yūsuf Gargūr in his Ph.D. thesis (Algiers, 1990) but Ibn Haydūr's note was unpublished and it appears here for the first time: the MSS used to prepare this edition are mentioned on p. 91.

As a result of their efforts Djebbar (= Jabbār) and Aballāgh confirm the precise dates of birth (9th or 10th Dhū 'l-Ḥijja 654/29th or 30th December 1256) and death (5th Rajab 721/31st July 1321) (pp. 20-23) and reject (pp. 24-26) the legend that he was born in Granada as a myth created by Casiri. Ibn al-Bannā' was born in Marrākush where he studied with several masters (the authors name 17 on pp. 29-45) the *Qur'ān*, Qur'ānic readings, Arabic language, Arithmetic (*ḥisāb*) and other branches of Mathematics, Partition of Inheritances (*Farā'iḍ*), Logic, *Uṣūl al-Fiqh*, Astronomy and Astrology. All of these disciplines appear represented in the list of Ibn al-Bannā's own works. Djebbar and Aballāgh consider doubtful that Ibn al-Bannā' ever studied in Fez, a city which he seems to have visited only at a later stage of his life (pp. 27-29).

The authors discuss carefully (pp. 40-45) the very interesting problem of the relations between the Moroccan mathematician and the *Zāwiya Hazmīriyya* of Aghmāt and with its two founders the brothers Abū ᶜAbd Allāh (d. 678/1279) and Abū Zayd al-Hazmīrī (d. 706/1306). This topic is connected with Ibn al-Bannā's reputation as a *ṣūfī*, which the authors consider another myth created by popular imagination to justify the success of certain predictions he made. In fact Ibn Haydūr himself gives a serious base for this belief because he states that Ibn al-Bannā' served (*khadama*) Abū ᶜAbd Allāh al-Hazmīrī and entered his *ṭarīqa* together with the other poor (*fuqarā'*) who were his disciples. There, Ibn al-Bannā' remained in isolation (*khalwa*) for a whole year and one night he had the vision of a whole circle of