4.8 BIBLIOGRAPHICAL NOTES ON ISLAMIC ASTRONOMY, THE RESULTS OF A STUDY OF THE EXACT SCIENCES AMONG THE JEWS OF YEMEN

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Introduction

The people of Yemen as a whole, and the Jews of that country in particular, possess a very rich cultural heritage, including achievements in the field of astronomy. The medieval astronomical sources were the subject of an exhaustive study by David A. King (Mathematical Astronomy in Medieval Yemen, Malibu 1983). Some material concerning Jewish interest in the subject was collected by Bernard R. Goldstein (The Survival of Arabic Astronomy in Hebrew, J. for the Hist. of Arabic Science 3, 1979,31-39, note 2c.) The author of this paper has recently completed a monograph on the exact sciences among the Jews of Yemen. In this paper we present some discrete items of mainly bibliographic interest which emerged from that study. Note that our sources are all Arabic manuscripts, written in Hebrew characters.

1 The Zījes of al-Fārisī

Both King (p. 25, no.6.3) and E.S.Kennedy (Survey of Islamic Astronomical Tables, no. 54) report one zīj from Abū ᶜAbd Allāh Muḥammad ibn Abī Bakr al-Fārisī, known by three titles: al-Khaẓāᵓinī, al-Muẓaffarī, and al-Fārisī. On the basis of certain remarks of Aluᵓel ben Yeshaᶜ, a Jewish astronomer working at the very end of the 15th century, we learn that, in fact, the Khaẓāᵓinī zīj and the Muẓaffarī zīj are distinct from one another and different in their makeup. It also appears that al-zīj al-Fārisī is a general term which may be applied to either.

In a discussion of the "second correction" for the five planets, i.e. for the epicyclic diameter at mean distance, Aluᵓel writes: "the explanation of this in the Maᶜārij and in the tables of the Khaẓāᵓinī zīj is clearer than that of the Muẓaffarī zīj." (Ms. Heb 28^{O} 6055, Jewish National and University Library, Jerusalem, f58a). The Maᶜārij is another work of al-Fārisī, Maᶜārij al-Fikr al-Waḥīj fī ḥall mushkilāt al-zīj (King, no.6.24).

More details as to the differences between the two zījes emerge from the discussion on the equation of time. Aluᵓel writes (30a): "It is clear from the al-Fārisī zīj that the extremum of this correction is approximately 30 minutes--so it is in the Muẓaffarī. In the Khaẓāᵓinī it is half of this, and different as well. Up to the present we do not know the reason for this difference."

From this passage we infer that the al-Fārisī zīj may have been a collective title for all the tables of al-Fārisi. (In his commentary to Maimonides' Sanctification of the New Moon, however, Aluᵓel speaks of al-zīj al-Fārisī

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al-Muẓaffarī). More importantly, we learn that the values for the equation of time tabulated in the Muẓaffarī zīj were approximately double those of the Khazā'inī. Now this raises several problems. First, we note that in his commentary to Maimonides, Alu'el notes that the lunar corrections found in the Muẓaffarī zīj are double those of the standard zījes. Regarding the second lunar correction, whose maximum is usually about 5^{o}, Alu'el writes (21a): "The author of the Muẓaffarī zīj doubled it, making it approximately 10^{o}, in the same manner that he doubled the first correction." Alu'el goes on to say: "Even now we do not know the truth regarding some of the matters included in this zīj, because in it are things not found in the [standard] tables." In fact, however, this doubling of the values is readily understandable, and the suitable explanation was given in an anonymous note to the copy of the Muẓaffarī zīj found in the collection of Rabbi Yosef Kafaḥ of Jerusalem. Speaking of the first lunar correction, whose maximum is about $\pm 13^{o}$, the commentator notes that al-Fārisī subtracted about 13^{o} from all the mean anomalies and doubled the correction, such that the correction would be always positive, and computation simpler.

However, in the case of the equation of time, it is the Muẓaffarī zīj which has the standard values (maximum 30'; cf. O. Neugebauer, A History of Ancient Mathematical Astronomy, 985, 1406), while the Khazā'inī presents roughly half these values. Moreover, I take the phrase of Alu'el, "and different as well" (wa-mukhtalifun ayḍan) to mean that the values in the Khazā'inī zīj are not consistently half those of the Muẓaffarī, i.e. they may have been calculated in an independent fashion. Finally, we note that Alu'el has not simply mixed up the two zījes: the same Muẓaffarī zīj which has doubled the lunar corrections has also the normal values for the equation of time (e.g. the copy found in BL Or. 4104).

2 Quṭb al-Dīn al-Shīrāzī (?)

Did the writings of the "Marāgha school", with their tremendous innovations, reach Yemen? There is strong, and, to my mind, convincing evidence in the commentaries of Alu'el that one such work, the Nihāyat al-Idrāk of Quṭb al-Dīn al-Shīrāzī, was in fact known to Yemeni astronomers. Alu'el refers some seven times to an astronomer by the name of al-Shirwānī. Three important points of detail argue for the identification of al-Shirwānī with al-Shīrāzī, and this despite the fact that the name al-Shirwānī is known in the history of Arabic astronomy, and, in particular, it was also the name of al-Faḥḥād who, in turn, was an important source for al-Fārisī. The three points are the following:

1) The full name of the astronomer. In an interesting passage Alu'el writes (71a): "It has been said that al-Shirwānī is the author of the Tabṣirah, but it is most likely that this is incorrect ... the name of the author of the Tabṣirah ... is ʿAbd al-Jabbār al-Kharaqī, but the name of al-Shirwānī is Maḥmūd bin Masʿūd." Now Maḥmūd bin Masʿūd is part of the full name of al-Shīrāzī. Moreover, we learn from this passage that there was some confusion regarding al-Shirwānī, a fact which may help explain what is, in our opinion, the corruption of the name al-Shīrāzī.

2) The title of the work: In his commentary to Maimonides, Alu'el gives the full title of "the book of al-Shirwānī" as Nihāyat al-Idrāk fī ʿilm al-Aflāk. (20b)

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There is no such work ascribed to al-Fahhād. However, the book of al-Shīrāzī is called Nihāyat al-Idrāk fī Dirāyat al-Aflāk.

3) The theory. In the passage cited above, where Alu°el shows that al-Shirwānī is not the author of the Tabṣirah, we read: "Moreover, al-Shirwānī holds that the sun has an epicycle, but the author of the Tabṣirah is not of that opinion." In another comment (33b), Alu°el notes that al-Shirwānī assumes two epicycles in the theories of Venus and Mercury. Both of these details are appropriate to the "Marāgha school."

(Note: I do not have a copy of al-Shīrāzī's work. I sent a passage quoted by Alu°el from al-Shirwānī to Dr. George Saliba. Dr. Saliba could not find that exact passage in al-Shīrāzī, but neither he nor I regard this as conclusive).

3 Others

In the private collection of Mr. Yehudah Levi Nahum (Ḥolon, Israel), which will surely prove to be of great value once the very numerous fragments have been identified and/or catalogued, are four pages belonging to the astronomical treatise of Qāsim bin Muṭarraf, composed 319 H. in Cordova. The identification is secured by the title of chapter 12 which is preserved in the fragment and matches that given by Sezgin, vol. 6, 158. The city of Cordova is mentioned as well, and the fragment breaks off "in the year 300 of ... ". The Istanbul manuscript, from which Sezgin (by way of an article by F. Rosenthal) learned of the treatise, contains the unique copy of Qāsim's treatise. It is interesting that such an early Andalusian treatise reached Yemen.

The opening page of a treatise on twilight is found in one of the manuscripts in the collection of Rabbi Kafah. Unfortunately, the page is damaged, and it is impossible to make out either the name of the author or the title of the treatise. Reference is made to works on the same subject by Ibn Mu°ādh (published by B. R. Goldstein in Archive for History of Exact Sciences, 1977) and by another jurist, °Abd al-Raḥmān bin Ṭāhir.

A copy of the Zīj al-Jāmi° purports, according to a somewhat unclear note, to have been copied from Kushyār's autograph, which also contained autograph criticisms and corrections on the part of Bahrām ibn Binyāmin. However, this copy is missing part III of Kushyār's zīj.

Several short quotations from Abū-l-°Uqūl are found in a manuscript of Rabbi Kafah, but I do not know if these are taken from any of the works listed by King (pp.25ff.). They deal with the (1) size and distance of the sun and the moon, (2) lunar eclipses, (3) musical ratios of the orbs, and (4) circumference of the earth.

Also worth mentioning are (1) a short fragment from Ibn Yunus' Zīj al-Ḥākimī on the elevation of the pole of the ecliptic and (2) a table from the zīj of Yaḥya ibn Abī Manṣūr.

DISCUSSION

S.M.R.Ansari : Did you find any work on Instruments in Yemen ? If I understand correctly there is extent Zīj-i-Safiha of Al-Khazīnī in Yemen.

Y.Tzvi Langerman : There is some mention of instruments but nothing special.
Sorry - I am referring to the Zīj with the title of al-Khaza'inī by the astronomer Abū Bakr al-Fārisī.

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