

Review of F.J. Ragep; *Naṣīr al-Dīn al-Ṭūsī's Memoire on Astronomy*,
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In spite of the fact that Naṣīr al-Dīn al-Ṭūsī (A.D. 1201 to 1274) is one of the most distinguished scientists in the Islamic world, and that no modern books on the history of Medieval astronomy have missed his name, his major work on astronomy has never been critically edited nor has been translated into modern language. This is partly because few modern scholars were equipped with the both of two different aspects of learning, i.e. reading Arabic texts and understanding the technical details of mathematical astronomy. Now we are fortunate to find in Ragep's critical edition and English translation of Ṭūsī's *Tadhkira*, a full mastery of these disciplines with which he filled the gap of exactly one hundred years since Ṭūsī's astronomy first interested European scholars.

Ragep's work consists of six parts in two volumes. Vol. 1 contains Part I (General Introduction), Part II (Edition and English Translation), and Part III (Commentary Figures). In Vol. 2 are Part IV (Commentary), Part V (Critical Apparatus), and Part VI (Appendices).

In Part I Ragep describes Ṭūsī's life, his works, the historical significance of the *Tadhkira* as a book as well as a genre, its physical principles and modelings in historical perspective, the sources which are explicitly referred to in it, its influence, including that on Copernicus, its commentaries, and the evolution of the text.

The mere account of Ṭūsī's life is impressive and dramatic: the young days as a student of the Shī'ite descent, the most productive years under the patronage of the so-called Ismā'īlī 'assasins', and the last stage of life as an established scholar who directed the building of the famous Marāgha observatory under the Mongolian ruler Hülegü who put an end to the Ismā'īlīs and the Abbasid Caliphate.

Even more stimulating is Ragep's presentation of Ṭūsī as an independent thinker. What characterizes Ṭūsī is his 'rapprochement of Hellenistic and Islamic disciplines', and he 'would seem to have been at least partially successful in transcending the religious disputes that had disturbed him so much as a youth.' Thus it is natural for Ragep to give a negative answer to the interesting question whether Ṭūsī's scientific and, in particular, astronomical views were influenced by the changes of his religious and political stance.

As for the historical significance of the *Tadhkira*, Ragep begins with the question, 'Why was it that someone in the 13th c. came to feel that the *Almagest* should be summarized from the point of view of physical bodies?', and he answers this question by trekking the two streams of history of astronomy, mathematical vs physical, from Eudoxus vs Aristotle, Ptolemy's *Almagest* vs his *Planetary Hypothesis*, down to Ibn al-Haytham's attempt of rapprochement. This is, no doubt, one of the most interesting topics in the history of ancient and Medieval astronomy.

Ragep's account of the evolution of the texts from the *Risālah-i Mu'īnīya* (A.D. 1235) and the *Hall-i mushkilāt-i Mu'īnīya*, both in Persian, to the Arabic texts of the Marāgha version (A.D. 1261) and the final Baghdād version (A.D.1274) of the *Tadhkira* is also quite useful in understanding how Ṭūsī formed the ingenious device which is known today as *Ṭūsī couple*.

The main contribution, and probably most painstaking work, of Ragep is no doubt the establishment of the critical edition of the Arabic text. In the beginning Ragep collected some twenty kinds of manuscripts, out of which eleven were carefully examined. But as the work proceeded he found that only six manuscripts were important enough to put in the critical apparatus. These six showed clearly the stages of repeated revisions of the text. They are classified as (1) original version: D T (made in Marāgha, grouped as α), (2) intermediate version: M, and (3) final revision: G F L (made in Baghdād, grouped as β). Even a layman of philological approach might be excited to know that there is a case 'where a phrase that was added in the margins of M T, and into the text of G, is marked for deletion in F and is missing entirely in L.'(page 75)

Ragep's edition is based on the final version, and whatever were added in it are put within the slashes, while the deleted parts and different readings in the original or intermediate versions are put in the footnote. Thus we can read all the three versions in a single text! Due to the lack of space Ragep has put all the variants (which are numerous) in Part V.

The English translation is exactly facing the Arabic text, with almost all the words at the top of the first line of the each couple of pages corresponding to each other. The paragraph breaks (with numbering) and punctuation marks, which were introduced by the editor, also help readers to check the original wording. Ṭūsī's accurate and scientific Arabic, as I found, is so well reflected in the translation that the readers without any knowledge of Arabic language might be able to get very close to Ṭūsī's mind. Even the mistakes made by Ṭūsī and the ambiguity of the Arabic expression, some of which reveal the process of revision, were retained in the translation. This bilingual text surely helps those readers who want to learn scientific Arabic. One thing I wish Ragep should have specified is the use of round brackets in the translation. What is enclosed there is neither addition nor explanation by the translator, nor something to do with the difference of versions.

Commentary is indispensable for the better understanding of the text of this nature. Since Ṭūsī's aim was to improve Ptolemy's mathematical model by his physical model, knowledge of the *Almagest* is prerequisite. Ragep saved much space by referring the readers to the recent works on the *Almagest*, especially those by O. Neugebauer, O. Pedersen, and G. Toomer and thus he could devote much space to the clarification of the text, the origins of Ṭūsī's new ideas, different opinions among the commentators, and those parameters which are different from Ptolemy's.

The same figures are used in the text and translation, the only difference being symbols and explanatory words. They are neatly drawn by computer graph-

ics. Some curious readers might be interested in the original figures, but no photographs are offered. Separate apparatus is given for figures in the manuscripts. Explanations about variant readings and figures are given in Arabic, which is not convenient to those who are not so at home in Arabic as Ragep is. Some figures are added by Ragep to help the readers to understand his commentary. Among them Fig. C15 seems to be misleading, because the 'large sphere equator' and the 'small sphere' do not necessarily cross at the endpoints of the epicycle diameter, as is evident from the corresponding figure (T13) in the text.

Since the whole text was printed from the camera-ready copy prepared by the author, there were no room for printing errors creeping in. All the few mistakes which did not escape my attention are too trivial to list here.