A Comparative Study of Quṭb al-Dīn Shīrāzī's Texts and Models

on the Configuration of the Heavens

Kaveh Farzad Niazi

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This dissertation analyzes the astronomical writings of Quṭb al-Dīn Shīrāzī, a well-known Persian scholar of the Ilkhanid era (i.e., the second half of the thirteenth century to the early decades of the fourteenth century C. E.). The sustained attempts, by scientists of the Islamic world to rid Ptolemaic astronomy from what they considered its many non-physical characteristics was the driving force of the particularly productive genre of hay'a or the science of the configuration of the universe. All three of Shīrāzī's works that are studied in this thesis belong to this genre of astronomical writing. These works are the Nihāyat al-īdrāk fī dirāyat al-aflāk (1281 C. E.), al-Tuhfa al-shāhīya fī 'ilm al-hay'a (1285 C. E.), and the Ikhtīyārāt-i Muẓaffarī. This thesis highlights Shīrāzī's models for the upper planets, and their evolution over the period 1281 to 1285 C. E. A careful look at the models for the upper planets allows for a clearer view of the distinctions between these three substantial works and their relations to one another. In particular this study allows us to date the Ikhtīyārāt-i Muẓaffarī to the same period as the Nihāyat al-īdrāk fī dirāyat al-aflāk, i.e., c. 1281 C. E. In the thesis I discuss, as well, the reasons for Shīrāzī's choice of language for the Ikhtīyārāt-i Muẓaffarī, which was written in Persian (unlike the other two that were written in the lingua franca of Islamic science and scholarship, Arabic). This thesis demonstrates, as well, that the Ikhtīyārāt-i Muẓaffarī was a scientific work of the same technical sophistication as the other two works listed.
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for their loving support,

for instilling in us

a thirst for knowledge,

and for bestowing on us an abiding love for the culture and history of Iran.
Chapter I. Purpose and Background of Study

It is not natural that the stars should either move themselves ... or that they should be carried along certain circles. But there must exist spheres, made of the fifth essence, situated in the depth of the universe and moving there, some higher up, some arranged below them, some larger, some smaller, some hollow and some massive within the hollow ones, to which the planets are fastened in the manner of the fixed stars.

Theon of Smyrna, c. 120 C. E.

The great Plato, my friend, expects the true philosopher to take his mind from the perceptible and the totality of changing matter and to transfer astronomy beyond the heavens, to behold there absolute slowness and absolute speed with their true values. From these marvelous sights you seem to lead us down to those orbits in the heaven and to the observations of those practical people, the astronomers, and to those hypotheses which they have artificially devised on the grounds of their observations and which people like Aristarchus, Hipparchus, Ptolemy and others of their calibre used to din into our ears.

Proclus Diadochus, 410-485 C. E.

And it is necessary that motions that appear non-uniform rest upon that which entails their uniformity. And [thus for] each motion that is non-uniform, its [corresponding] angles or arcs in a given time period are compounds. So, if these principles are required, it is imperative at the same time for each planet to have several orbs due to the [non-uniform] motion it exhibits.

Quṭb al-Dīn Shīrāzī, 1235-1311 C. E. (634 – 710 A. H.)
A. Introduction

The goal of this study is a better understanding of the developments in astronomy in Persia in the late thirteenth and fourteenth-century, through a study of the astronomical works of the polymath Quṭb al-Dīn Shīrāzī. Quṭb al-Dīn's books on astronomy include works in Arabic, the lingua franca of science in the Islamic world, as well as in his native language, Persian. Though in Shīrāzī's day, the era of the Ilkhanid dynasty, Persian had long come into its own as a sophisticated and supple vehicle for the production of literary and historical works, its use in scientific texts was considerably less common. Three of Shīrāzī's major works on astronomy – two in Arabic, one in Persian, written in the same stage of the author's life – provide, therefore, a rare opportunity to study the cultural interplay between the choice of language and the content of scientific works during this period. The works in question form the primary texts for this study, and all had, as their principal concern, the configuration of the celestial orbs, or *hay’at al-aflāk* in Arabic.

In Arabic the term *hay’a* denotes form or configuration, and the genre of astronomical writing to which it was applied aimed at a physically coherent description of the configuration of the universe as a set of nested spheres of specified dimensions subject to the laws of natural philosophy. This genre, which appeared at least as early as the eleventh century of the common era, does not have a precise analogue in the Greek tradition. Rather, *hay’a* grew out of Greek astronomy and the long-standing debate within it with regard to the epistemological truths of astronomical knowledge.1 How did the mathematical models that were used to predict the

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position of the celestial bodies correspond to reality? What was the nature of the celestial orbs, with which so many celestial observations could be described phenomenologically? How did these orbs interact with each other and with the heavenly bodies which appeared to be affixed to them? Given their success in describing the motion of the planets (even if, at times, this description was merely qualitative – as in providing a conceptual framework for the treatment of the retrograde motion of planets), how closely did the mathematical models of the astronomers correspond to the laws of natural philosophy? The impetus for *hay’a* research was the encounter of the scientists of the Islamic world with this Greek astronomical tradition, and the desire to combine a descriptive or geometrical astronomy, that was focused on the accurate prediction of the location of the celestial bodies, with a physics that aimed to describe the nature of the celestial bodies and their behavior.

The first concern, the development of precise predictive models, is exemplified by Ptolemy's monumental work on Astronomy, the *Almagest*. After its publication in the second century of the common era, this book was to serve as the main reference for astronomers in both the Hellenistic and Islamic traditions for the subsequent fourteen centuries. Though resting on the Greek tradition of cosmology, as exemplified by Aristotle's *Metaphysics* and *De caelo*, Ptolemy's focus in much of the work is on the development of detailed mathematical models for the motions of the planets.² Though the mathematical models in the *Almagest* are informed by the cosmology of the celestial entities under consideration, the physical or cosmological

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considerations remain in the background. For instance, while serving as the epistemic
underpinnings of Ptolemy's astronomical theory, the spherical orbs – which are the purported
movers of the planets – are barely mentioned in the *Almagest* at all.³

The second tradition of Hellenistic astronomy that was a source of the subsequent *hay’a*
literature in the medieval period is represented by Ptolemy's *Planetary Hypotheses*, which was
written after the *Almagest* and is considerably shorter. In the *Planetary Hypotheses* Ptolemy
states that his aim is to treat the celestial motions in a more general way than he has in the
*Almagest*, and in a manner, in his words, which “appeals more to the imagination.”⁴ Ptolemy's
usage of the term “hypothesis” in the title of this work is distinct from the modern usage, and is a
cue to his conceptualization of the book. Today a hypothesis means something akin to an
untested theory, whereas Ptolemy used this word to mean a “system of explanation” or model.⁵
In both the *Almagest* and the *Planetary Hypotheses* this term refers to mathematical as well as
physical models akin to equatoria, i.e., devices constructed of wood or metal, used to depict the
motion of the planets.⁶ Ptolemy's focus in the *Planetary Hypotheses* is on providing a coherent
depiction of the planets and the planetary orbs as physical objects. Thus, the challenges that
faced him in the composition of the *Almagest* (namely, the need to carry out his theoretical work
within the framework of Aristotelian cosmology) would have been present to an even greater
extent during the composition of the *Planetary Hypotheses* once the physical nature of the

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As far as his equatoria and the issues facing them were concerned, Ptolemy introduces a discussion of their limitations even in the *Alamgest*. Invoking the perfection of the celestial realm vis-a-vis the imperfection of his equatoria Ptolemy states:

Now let no one, considering the complicated nature of our devices, judge such hypotheses to be over-elaborated. For it is not appropriate to compare human [constructions] with divine, nor to form ones beliefs about such great things on the basis of very dissimilar analogies... Rather, one should try, as far as possible, to fit the simpler hypothesis to the heavenly motions, but if this does not succeed [one should apply hypotheses] which do fit. For provided that each of the phenomena is duly saved by the hypotheses, why should anyone think it strange that such complications can characterize the motions of the heavens when their nature is such as to afford no hindrance, but of a kind to yield and give way to the natural motions of each part.\(^8\)

The desire to provide theoretical formulations of the motion of the planets that would describe the observable phenomena and yet be free of the sort of complications that Ptolemy alludes to was one of the primary driving forces of *hay’a* research.\(^9\)

Aristotle, who provided the basis of the cosmological systems within which Ptolemy was to carry out his work, was not concerned with producing a detailed models of planetary motion.\(^10\) Where he does describe the intricacies of the celestial models under consideration his remarks are qualitative. In the *Metaphysics* he writes:

Eudoxus held that the motion of the Sun or of the Moon involves, in either case, three spheres, of which the outermost is the sphere of the fixed stars, and the second revolves in the circle which

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\(^8\) Ptolemy, *The Almagest*, 600.


bisects the zodiac, and the third in the circle which is inclined across the breath of the zodiac...and he held that the motion of the planets involves, in each case, four spheres, and of these also the first and second are the same as before... the third sphere of all planets has its poles in the circle which bisects the zodiac, and the fourth sphere moves in the circle inclined to the equator of the third...and the number of all the spheres -- those which move the planets and those which counteract these -- will be fifty-five.\textsuperscript{11}

Ragep discusses how the cumbersome system of counter-rolling spheres described in this fragment suggests a concern on Aristotle's part with the physical nature of the spheres in question.\textsuperscript{12} It is important to note that the discussion here, as elsewhere in the cosmological sections of *De Caelo* and the *Metaphysics*, is vague and lacks precision. Instead, it fell on Ptolemy to propose his detailed mathematical models of the universe, while remaining within the constraints of Aristotelian cosmology. This cosmology imposed a strict set of requirements on celestial motion – the requirement of uniform circular motion that was concentric with the earth, being a primary example.\textsuperscript{13} That a coherent cosmology based on a scheme of nested celestial spheres would involve spheres tasked with counteracting the rotation of other spheres (thus keeping the planetary motions generally independent of each other) is the type of physical consideration that Ptolemy would have had to have made in his conceptual framework while worrying, as well, about providing accurate mathematical and physical models.

In the *Planetary Hypotheses*, Ptolemy not only lists the distances and sizes of the planets, but he includes, as well, a description of what was to become the basic conceptual framework for *hay‘a*, \textit{i.e.}, a scheme in which the spheres of adjacent planets are nested so that the greatest distance of a given planet relative to the center of the world is equal to the least distance of the

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next planet farther from the center of the world, and so on, all the way to the sphere of the fixed stars.\textsuperscript{14}

Given the fact that the purported orbits of the heavenly bodies were, according to the universally-held Aristotelian belief system, circular and geocentric (rather than elliptical and heliocentric as we know them today to be), it was necessary for Ptolemy to devise ingenious mathematical formulations that were physically unrealizable, in order to account for the variable velocity of the planets in their orbits. In the \textit{Almagest} the spheres or spherical sections for the Moon and the planets, for instance, are formulated to "rotate" about a point that is not coincident with their axes. While admissible as a mathematical feature of the theory when treating the orbs of the planets in an abstract and mathematical sense, this element of Ptolemy's theory was physically untenable as far as the authors of the \textit{hay'a} tradition were concerned. The issue, the so-called “equant problem,” is not raised by Ptolemy in this work but was one of the main driving forces for the theoretical work of the \textit{hay'a} authors.\textsuperscript{15}

At its roots the problem of the equant is the problem of reconciling detailed and descriptive mathematical models of the motion of the celestial bodies with a coherent physical picture. Though, as we have seen, this was already a preoccupation of the astronomers of the Hellenistic period, the attempt to bring these two conceptions of astronomy into agreement proved especially productive for the scientists of the Islamic world during the medieval era.\textsuperscript{16}

The desire to arrive at an astronomical formulation that was in accord with physics, can be seen, for example in two early \textit{hay'a} works by Ibn al-Haytham, known to the Latin west as

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\textsuperscript{15} Ptolemy, \textit{The Almagest}, 422; Swerdlow, \textit{Mathematical Astronomy in Copernicus’s De Revolutionibus}, 40.
\end{flushright}
the Configuration of the Universe), and al-Shukūk ‘alā Baṭlamyūs, (or Doubts Concerning Ptolemy). Henceforth these two works will be referred to as *Maqāla/Treatise* and *Shukūk/Doubts*, respectively. In his earlier work, the *Maqāla/Treatise*, one of Ibn al-Haytham's goals appears to have been a re-rendering of the Ptolemaic system with an emphasis on the spherical orbs of the heavens as three-dimensional bodies. This is made clear with a statement regarding the limitations of the mathematical formulations within the Ptolemaic tradition:

> Since those theories, that is, those which point to the form of the figure and the laws of the motions by means of proper observation and correct proofs are, however, based upon the motions of imaginary points on the circumferences of intellected circles according to what is demonstrated in those books of theirs which we have; and, likewise, [those points] are assigned by indication on their part, but not explicitly, to the surfaces of solid spheres which, in fact, are the things which have those motions on those points, it turned out that their theory insofar as they explained it was limited to those circles and points only.

If the orbs in which the planets are embedded are said to be three dimensional objects, Ibn al-Haytham appears to be saying, then a proper treatment of the motion of the planets must include the reality of these spheres in its derivations (and not limit itself, as Ptolemy had done in the *Almagest*, to treating cross-sections of spheres as figures on a planar surface). Ibn al-Haytham continues in the *Maqāla/Treatise*: “Since our doctrine is in accordance with what he [Ptolemy] explained and arranged, and he avoided the use of any bodies, we investigated each of the motions … in such a manner that that motion may appear to be the result of a spherical body that is moving with a simple, continuous, and unceasing motion.” This declaration provides a

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statement of purpose for the composition of the Maqāla/Treatise while acknowledging its debt to Ptolemy, as well. Interestingly, in Ibn al-Haytham's later work on hay‘a, Shukūk /Doubts, such accord with Ptolemaic theory appears no longer to have been tenable for the author. As the title suggests this work is a critique of the physical inconsistencies of Ptolemaic theory as they appear in both the Almagest and the Planetary Hypotheses. These physical inconsistencies were caused by the fact that the celestial orbs were constrained by prevailing notions of how the universe worked to move with a uniform angular velocity, as we saw before. Using this as a criterion, the list of non-physical elements in Ptolemy's theory that Ibn al-Haytham identified includes the irregular rotation of spheres (as in the case of the motion of the deferent sphere for the planets and its posited “uniformity” about a point distinct from the center of the sphere), back-and-forth (i.e., non-circular) motions of the lunar epicycle, and oscillations of orbital planes to account for the latitudes of the planets. It was precisely these features of Ptolemaic astronomy that was to preoccupy the scientists of the hay‘a tradition of the ensuing centuries.

Writing in the 13th century – in what was a period of efflorescence for hay‘a research – renowned and savant Naṣīr al-Dīn Ṭūsī (1201 – 1274 C. E., 597 – 672 A. H.) includes sixteen objections to Ptolemy in his hay‘a work al-Tadhkira fi ‘ilm al-hay‘a, or Memoir on Astronomy (henceforth referred to as the Tadkhira/Memoir). Ṭūsī’s objections are at their root the same as Ibn al-Haytham's and include: the irregular motion of the deferents of the Moon, Mercury, Venus, Mars, Jupiter and Saturn; latitudinal deviation and latitudinal slant for Venus and Mercury; the oscillation of the equators of the deferent orbs for Venus and Mercury; and the

20 Ibid.
21 Saliba, Islamic Science and the Making of the European Renaissance, 97-106.
22 In Ptolemy's scheme the lunar epicycle was the orb which carried the moon, and which in turn was carried by the deferent orb.
back and forth oscillation of the Lunar epicycle.  Ṭūsī himself provides a solution to the first set of issues, i.e., the equant or the irregular motion for all the planets (save the Sun and Mercury) by relying on a mathematical formulation now referred to as the Tusi Couple.  Mu’ayyid al-Dīn al-‘Urḍī (d. 1266 C. E.), perhaps the most innovative astronomer of his era, was to provide another original solution to the problem of the equant, one that relied on a mathematical theorem now referred to as ‘Urḍī’s Lemma.  As Ṭūsī’s student Quṭb al-Dīn Shīrāzī, who is the subject of the present study, was able to rely on the works of his predecessors Ṭūsī and al-‘Urḍī, and, by incorporating the Ṭūsī couple and ‘Urḍī’s Lemma, to propose additional planetary models of increasing complexity. Both of these mathematical artifacts appear as well in the works of Copernicus, thus linking the astronomy of the Early Modern Period in Europe to the research of al-‘Urḍī, Ṭūsī, and their fellow astronomers in the Islamic world.

B. Shīrāzī and His Era.

1. The Marāgha School

The term Marāgha School was first coined by Kennedy, and is used in a 1966 article in reference to the group of astronomers mentioned above, i.e., al-‘Urḍī, Ṭūsī, Shīrāzī, and others who were active in thirteenth-century Ilkhanid Iran.  Also included in the grouping were scientists such as the Damascene astronomer Ibn al-Shāṭir (1304 – 1375 C. E., 704 – 777 A. H.)

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23 Ṭūsī, Naṣīr al-Dīn al-Ṭūsī’s Memoir, 50.
24 Saliba, Islamic Science and the Making of the European Renaissance, 155.
25 Ibid., 151.
26 Swerdlow, Mathematical Astronomy in Copernicus’s De Revolutionibus, 47.
whose theoretical work can be viewed as a continuation of that of the aforementioned scientists. The term Marāgha refers to the site of the great observatory commissioned by the grandson of Chingiz Khan, Hülegü (or Hulāgū, as he is referred to in the Islamic world), who appears to have settled in the city in 1258 C. E. after the fall of Baghdad. At roughly the same time Ṭūsī selected a site near the city for the construction of said observatory. Though the term Marāgha school is perhaps useful in identifying a commonality of approach in addressing the issues facing Ptolemaic astronomy, it can also be misleading due to its lack of precision. As we have seen, for example, not all astronomers grouped in the Marāgha school actually had the opportunity to live there. For this reason, the use of this term will be avoided here.

Funded by religious endowments, or awqāf, the Marāgha observatory, was to continue its operation for more than fifty years. The first director of the observatory, was Naṣīr al-Dīn Ṭūsī himself, who staffed the observatory with astronomers from as far afield as China. al-ʻUrḍī’s name has been preserved as the builder of the scientific instrumentation at the observatory. Though there is no documented evidence that Shīrāzī worked at the observatory, his tutelage

30 Swerdlow, Mathematical Astronomy in Copernicus’s De Revolutionibus, 295; George Saliba, “The First Non-Ptolemaic Astronomy at the Maragah School,” Isis 70, no. 4 (December 1979): 571-576; The same is true for Ṭūsī’s theoretical work on the motion of the planets; Ṭūsī, Naṣīr al-Dīn al-Ṭūsī’s Memoir, 14.
33 ʻUrḍī, Kitāb al-hay’a, 30.
under Ṭūsī and his close association with him together with the fact of his residence at Marāgha during Ṭūsī's directorship, make an association with the observatory, in some form, all but certain.  

The transmission of the intellectual tradition of the Marāgha school to Early Modern Europe has been an area of active research. A considerable amount of evidence confirms that this transmission did indeed occur. The list of models within Copernicus's *De revolutionibus* and *Commentariolus* that can be traced to the aforementioned astronomers includes those devised by Ṭūsī, al-'Urdī, and Ibn al-Shāṭir.  

In addition there is conclusive evidence for knowledge of the planetary theory of Ṭūsī in Italy in the early 16th century. Though the precise path for the transmission of this information to Copernicus has yet to be determined, it is likely that he learned of it himself during his stay in Padua during the years 1501-1503 C. E.; perhaps through a work, similar to Shīrāzī's, that included references to a collection of techniques devised by Ṭūsī, al-'Urdī and their colleagues.

2. Shīrāzī: Preliminary Remarks

Described as “one of the greatest Persian scientists of all times,” and “one of the foremost thinkers and scholars of Islam,” Ḥujjat al-Dīn Shīrāzī (1235-1310 C. E., 634 – 710 A. H.) was, much like his teacher Ṭūsī, a polymath who wrote on astronomy, philosophy, theology,

and medicine. He is best remembered today for his commentary on the *Philosophy of Illumination* by the Persian illuminationist philosopher Suhrawardī. A large encyclopedic work of his, *Durrat al-tāj li-ghurrat al-Dabāj* or the *Pearl in the Crown for the Brow of al-Dabāj* (henceforth *Durra/Pearl*) is well known, though today it is studied primarily as a work of Persian literature. The dearth of published works by Shīrāzī, noted by Nasr in 1976, is strangely at odds with Shīrāzī's reputation and has not improved substantially since then.

Three of Shīrāzī’s texts on astronomy will be examined in some detail in Chapter 4 of this thesis. These are 1. *Nihāyat al-idrāk fī dirāyat al-aflāk* (“The Limits of Attainment in the Understanding of the Heavens,” henceforth the *Nihāya/Limit*) which is the earliest of Shīrāzī’s major works on *hay’a*, 2. *al-Tuhfa al-shāhīya fī ‘ilm al-hay’a* (“The Royal Offering Regarding the Knowledge of the Configuration of the Heavens,” henceforth the *Tuhfa/Offering*) a shorter work written less than four years later, and 3. *Ikhtīyārāt-i Muẓaffarī*, a *hay’a* text in Persian. The title of *Ikhtīyārāt-i Muẓaffarī* indicates that it is an astrological work dedicated to Shīrāzī’s patron, Muẓaffar al-Dīn, and this will be referred to as the *Ikhtīyārāt/Selections*. With one exception (namely a chapter in the *Tuhfa/Offering*) none of these works has been subjected to in-depth studies. Furthermore while portions of the *Nihāya/Limit* and the *Tuhfa/Offering* have been the subject of articles by historians of science, including Kennedy, Saliba, and others, none

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42 The word *Ikhtīyārāt* means choices or selections in Persian. It refers to an astrological genre which was focused on determining the auspiciousness of a given day for a given action. Ṭūsī appears to have contributed to this genre, as well; David Pingree, “EKṬĪRĀT,” *Encyclopaedia Iranica*, December 15, 1998, http://wwwiranica.com/articles/ektiarat.
of these works has been edited or extensively translated. The goal of this thesis is to contribute, in some measure, to the scholarship concerning an overlooked medieval scientist, by further exploring the development Shīrāzī's thoughts on astronomy as exhibited in these three closely-related works, and by an examination of the social and cultural influences on Shīrāzī as they are manifested by his choice of language.


One of the earliest extended discussions of Shīrāzī’s relevance to the history of astronomy appears in Kennedy's 1966 article referred to above. In this article a mathematical formulation known as the principle (or the hypothesis) of the “maintainer and the director” (aṣl al-hafīza wa al-mudīr) is ascribed to Shīrāzī. In the same article, however, Kennedy notes textual clues within the Nihāya/Limit, such as Shīrāzī's allusion to the “master of this method” as “one of the formost [practitioners] of this science,” that indicate that the formulation may have originated with someone else. Indeed, as we shall see, there are several other references within Shīrāzī's works to the “master of the principle of the maintainer and the director.” In a series of articles published in the late 70's Saliba demonstrated that the astronomer Shīrāzī is referring to as “the master of this method” is none other than al-'Urḍī himself. Shīrāzī's reluctance in identifying those of his immediate predecessors such as al-'Urḍī and Ṭūsī upon whose work he relies heavily for his astronomical works is rather puzzling. It is worth noting here, however,

43 Other references to this formulation translate the Arabic expression as the “maintainer and the dirigent,” as well as the “protector and the dirigent.” The significance of this formulation will be examined in Chapter 4.
44 Quṭb al-Dīn Shīrāzī, Nihāyat al-irdāk fi dirāyat al-aflāk, Köprülü MS 957, 82r.
45 These references will be discussed in Chapter 4.
that in the *Durra/Pearl* Shīrāzī praises al-‘Urḍī explicitly in a passage on planetary motions:

> And the science that specializes in [the motion of the planets] is *hay’a*, of great number and many-branched are its various subjects, and it is of those excellent sciences that offer proof as to the grandeur of the Creator, may He be glorified. And the knowledgeable savant Mu’ayyid al-Dīn al-‘Urḍī has studied it in a manner [such] that no one else has exceeded him in it.⁴⁷

In addition to the research carried out on Shīrāzī's work by Kennedy and Saliba, one of the chapters of the *Tuhfa/Offering* has been edited and translated by Morrison.⁴⁸ This chapter includes a systematic presentation of various mathematical formulations such as the Ṭūsī couple and ‘Urḍī's Lemma, as well as others. We will have the opportunity to refer to this paper in Chapter Four of this thesis.

### 4. Methodology and Approach

The methodology for the study is suggested by Shīrāzī's works themselves. A textual comparison of the three works should help answer the following set of questions in regard to the works themselves: How are the three works related? Why did Shīrāzī choose to write three books in two different languages covering essentially the same ground? What were Shīrāzī's criteria for including or omitting material in his books on *hay’a*? What does a comparison of these three works tell us about Shīrāzī's approach to his astronomical research and his models for the planetary motions?

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Another set of questions is suggested by the view of Shīrāzī as a scientist embedded in the society of late thirteenth-century Persia. Given the fact, for example, that the authorship for the model that Shīrāzī proposes for the upper planets belongs to al-‘Urḍī, how did Shīrāzī choose to incorporate the material of his predecessors in his work? What is the reason for his reticence in acknowledging some of his immediate predecessors? How did issues of patronage affect the content of the works in question?

As is well known, Arabic has been the language of science par excellence in the Islamic world. A final set of questions, then, revolves around Shīrāzī's choice of language. Why did he write one of his major books on astronomy in Persian? How did this choice of language affect the content of these books? Does the *Ikhtīyārāt/Selections* represent, as has been suggested, a popularized or abridged version of the Arabic works?

The choice of the chapter on the upper planets was determined by the central role of this chapter in highlighting both Shīrāzī's technical capacities as a scientist and his relationship with his predecessors, upon whose work he solidly rests his. The technical nature of this chapter should allow, as well, for a careful examination of the rather uncommon use of Persian in a scientific treatise. It should be noted, however, that this study represents a mere beginning. It is to be hoped that the study of Shīrāzī's works on *hay’a* and on other topics will continue, culminating with edited translations of the works of this important 13th century C.E. figure.

5. **Outline of the Present Study**

In the remainder this introductory chapter (Chapter One, Section C) I present the list of sources for this thesis. In Chapters 2 I sketch the historical backdrop to the era in which Shīrāzī
lived, and in Chapter 3 present what has reached us in regard to Shīrāzī's life. Chapter 4 consists of a comparison of the chapters on the upper planets as they appear in each of Shīrāzī's *hay'ɑ*
books mentioned above. As Appendix 4-B indicates, each of these books is organized in a nearly identical manner by being divided into four large sections. The section of primary interest for our study is the second section, which includes the planetary models for the Sun, Moon, upper and lower Planets. In this same section Shīrāzī includes a chapter on the mathematical “hypotheses” or principles (such as the Ṭūsī couple) upon which he relies in his subsequent work. This chapter yields a considerable amount of material pertinent to our discussion, and will be presented prior to our discussion of the upper planets. Once the stage has been set for our discussion of the upper planets, these texts will be used to illustrate the development of Shīrāzī's thought on the configuration of the planetary orbs, his use of language, his choice of presentation, and his attitudes towards his audience, both Persian and Arabic speaking. Chapter 5 will include a discussion of how the choice of language in these works is manifested in the content of each work. Chapter 6 will provide a summary of our findings together with some concluding remarks.

C. The Sources.

1. Astronomical.

   a. Shīrāzī's books on Astronomy. The three books of Shīrāzī on astronomy that form the critical primary sources for this study were listed in section B.3 of this chapter. They are the *Nihāya/Limit*, and the *Tuhfa/Offering* in Arabic, and the *Ikhtiyārāt/Selections* in Persian. The manuscripts that have reached us generally consist of 200 or more folios, and as noted none
of these works has been edited. The manuscript copies of these books that were used for this study will be described in Chapter 4.

b. The *Tadhkira/Memoir* by Ṭūsī. This book is in Arabic and has been translated and edited by Ragep who was able to identify two versions of the *Tadhkira/Memoir*: what he called a Marāgha, and, a later, Baghdad version. Interestingly some of the changes in the Baghdad version of the *Tadhkira/Memoir* may have been due to Shīrāzī. In addition Shīrāzī appears to have had his own personal copy of this work.

Others of Ṭūsī's works on *hay'a* that have been published include *Zubdat al-idrāk fī hay’at al-aflāk*, or the Essential Understanding of the Configuration of the Orbs, and *al-Risāla al-Muʿīnya*, or the *Muʿīnya Epistle*, and *Ḥall-i mushkīlāt-i Muʿīnya*, or a Solution of the Difficulties of the *Muʿīnya*. The first book is in Arabic, and the latter two are in Persian. With respect to these works Ragep states that the *Zubdat al-idrāk fī hay’at al-aflāk* appears to be a simplified work, and the latter two works (both in Persian) appear to have been superseded by the *Tadhkira/Memoir*.

c. ʿUrḍī's *Kitāb al-hay’a*.

*Kitāb al-hay’a* or the Book of *Hay’a* by al-ʿUrḍī was written before 1259 C. E. In it ʿUrḍī presents the celebrated lemma that allowed him to deal with important contradictions in 

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49 A fourth work of Shīrāzī's on astronomy, *Fa'altu fa lā talum*, is a polemical work of a later date and is not part of the present study.
51 Ibid., 73-75.
52 Ibid., 78.
the Greek astronomical tradition (namely, those concerning the aforementioned equant problem). This work has been edited and published by Saliba.\(^56\) A translation into English that has also been prepared by Saliba awaits publication. Only three manuscript copies of this work are extant.\(^57\) That Shīrāzī knew ‘Urḍī's work is clear from the fact that he relies on ‘Urḍī's models in his own work.\(^58\) Furthermore that Shīrāzī knew ‘Urḍī's Kitāb al-hay’a itself is suggested by the presence in the Nihāya/Limit of an extended section, several paragraphs long, that intersperses direct quotes from ‘Urḍī's work with paraphrased fragments.\(^59\)

**d. Ibn al-Haytham on hay’a.** Ibn al-Haytham, the great 11th century scientist and pioneering figure in the hay’a is mentioned several times by Shīrāzī. In the chapter on the principles in the Ikhtiyārāt/Selections Shīrāzī writes the following:

> So [based] upon the group of moderns like Abū Alī ibn al-Haytham who was a renowned mathematician, and whose words … have greatly benefited the corporeal conception of the configuration of the heavens and others like him who have expounded on the corporeality of the orbs and the conception of the principles for the motions that they have found through observations, [and who] have determined that each motion necessitates an orb that is the cause of that motion, it is necessary to [arrange] the orbs in such a manner so that that which is desired is achieved from it, meaning so that that which is observed is obtained by it, while at the same time [the configuration] being in accord with principles, and should it add or subtract from the number of orbs it should not be considered [at fault], but if it [is inconsistent with observation] or if it does not [follow a number of the principles and basic premises] it will have missed the mark.\(^60\)

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56 Urḍī, Kitāb al-hay’a.
57 Ibid., 8.
59 This occurs in the discussion immediately prior to the geometrical illustration of ‘Urḍī's Lemma. The related figure in Shīrāzī's book generally follows the lettering scheme of al-‘Urḍī's, as well. Quṭb al-Dīn Shīrāzī, *Nihāyat al-idrāk fī dirāyat al-aflāk*, Köprülü MS 957, 73v., and the Kitāb al-hay’a, Marsh 621, 158v., as presented in Saliba, *A History of Arabic Astronomy*, 131 and Urḍī, Kitāb al-hay’a, 222.
In addition, in the chapter on the planetary latitudes in the Nihāya/Limit Shīrāzī refers to one of Ibn al-Haytham's books on the “inclination of the apogees.” The Maqāla/Treatise has been edited and exists in an English translation. The Shukūk /Doubts, in which Ibn al-Haytham expresses his criticisms of Ptolemy's planetary models was published in Arabic in Cairo. It has also been translated into English in its entirety as a Ph. D. thesis.

2. Biographical.

a. Shīrāzī's autobiographical note.

Shīrāzī himself wrote an autobiography in the introduction to his commentary on Avicenna's Canon, al-Tuḥfa al-sādiya fī al-tibb: This autobiography covers in some detail, Shīrāzī's early training as a physician and some other events of Shīrāzī's life up to the year 1282.

This characterization of Ibn al-Haytham is quoted directly from Ṭūsī. See note 6, Chapter Six.

61 Quṭb al-Dīn Shīrāzī, Nihāyat al-idrāk fī dirāyat al-aflāk, Köprülü MS 957, 90r. “And as for the cause of the inclination of the apogees, Ibn al-Haytham has written a treatise mentioning therein the bodies that cause these motions, so that he added for every epicycle of the five [wandering planets] two orbs for the sake of the inclination and in the lower two he added to additional two orbs for the sake of obliquity.”


65 Walbridge, The Science of Mystic Lights, 186.
C. E., when the first version of his commentary was completed. In his autobiography Shīrāzī describes in some detail his upbringing in a medical family and the hardships endured in authoring his commentary on Avicenna's seminal work, the *Canon*. Though Shīrāzī's commentary on Avicenna's work has not been translated or studied in detail, it is, in what is perhaps a measure of the importance the author attached to it, his only known work that includes such autobiographical material. This biographical note has been reproduced nearly in its entirety in the edition of the *Durra/Pearl* that was edited by Mishkat.

b. Biographical Dictionaries.

A monumental work by Ibn al-Fuwatī (1244-1323 C. E. / 642 – 723 A. H.) who was a librarian at Marāgha (and who appears to have known Shīrāzī personally), the *Majma‘ al-ādāb fī mu‘jam al-alqāb*, has only survived in an abridged form. The biography of Shīrāzī that appears in the surviving work is not extensive, even though it is likely that information from the original work has found its way into other biographies. *Tārīkh ‘ulamā‘ Baghdaḏ, al-musammā muntakhab al-mukhtar*, a fourteenth century history by Muḥammad ibn Rāfi‘ al-Sallāmī (d. 1372 C. E. / 774 A. H.) has a fairly lengthy biography of Shīrāzī. Ibn Ḥajar al-‘Asqalānī (1372-1449 C. E. / 773 – 852 A. H.) also includes a substantial entry on Shīrāzī in his *al-Durar al-kāmina* with some material that is not found in either the abridged dictionary of Ibn al-Fuwatī or in the work of al-Sallāmī. Other early sources of biographical information for Shīrāzī

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66 Ibid.
include ْتَباَقَّاتُ الْشَّافِئِيْةُ الْكُبْرَةُ, by Tâj al-Dîn al-Subkî (d. 771 A. H.), 72 and ْتَباَقَّاتُ الْشَّافِئِيْةُ, by Jamal al-Dîn ʿAbd al-Rahîm al-Isnawî (d. 1332 C. E. / 772 A. H.). 73

The biographical information on Shîrâzî found in Ibn al-Fuwaṭî, al-Sallâmî, and al-ʿAsqalânî also appears in later encyclopedic works such as Kashf al-żunûn by Kâtîp Çelebi (Hajjî Khalîfa, 1609 – 1657 C. E. / 1017- 1067 A. H.), 74 al-Badr al-Ţalîʿ, by al-Shawkânî (1760 - 1834 C. E. / 1173 - 1250 A. H.), 75 and Rawdât al-jannât, by Muḥammad Bâqîr Khwânsârî (1811-1895 C. E. / 1226 – 1313 A. H.). 76

c. Historical Annals.

Arranged chronologically, historical annals were records of the major political and social events of the year, and often included the passing away of significant individuals. 77 Annalistic works that mention Shîrâzî's name include: Mukhtasar fî akhbâr al-bashar, by Ismâʿîl Abî al-Fidâʾ (1273 – 1331 C. E. / 672 - 732 A. H.), 78 Mirʿât al-janân wa-ʿibrat al-yaqţân fî maʿrifat

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72 Tâj al-Dîn ʿAbd al-Wahhab ibn ʿAlî Subkî, ْتَباَقَّاتُ الْشَّافِئِيْةُ الْكُبْرَةُ (Baghdad: Riāsat diwān al-awqâf, 1971), 20.
75 Muḥammad ibn ʿAlî Shawkânî, ّبَلْدِرُ الْكَجِلِّيْبِ ِصَلَالِهِ ْبَالْقُرْنِ اللَاكْبِرِ (Bayrût, Lubnân: Dâr al-Maʿrîfah, 1978).
The entries in these works are generally short, giving the name, the occupation, and the date of Shīrāzī's death. However, the monumental Tārīkh al-Islām, by Shams al-Dīn Abū ʿAbd Allāh Muḥammad al-Dhahabi (1274 – 1348 C. E. / 673 – 748 A. H.) includes a substantial entry for Shīrāzī.

**d. Historical Sources on the Mongols in Iran and the Seljuks of Anatolia.**

Shīrāzī makes very few appearances in the sources that deal specifically with the history of the Mongols. These sources are important, however, in providing information on the social and political conditions of the world in which Shīrāzī lived. As we will see in the subsequent section of the chapter (Section E) Mamluk historians have been increasingly recognized for their importance in Mongol studies. The standard works for the study of the Mongols in the

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Middle East, however, are in Persian. The accounts of the campaigns of Chingiz Khan have been preserved in ‘Alā’ al-Dīn ‘Atā’ Malik b. Muḥammad Juwaynī’s celebrated history, *Tarīkh-i jahān gushāy*, or *History of the World Conqueror*. This book contains valuable information about the subsequent history of Persia up to the period immediately prior to the fall of Baghdad to the Mongols, in 1258 C. E.

Another centrally important work on the history of the Mongols for the period of interest is Rashīd al-Dīn Faḍl Allah’s *Jāmiʿ al Tawārīkh* or *Collection of Histories*. This work is the primary historical source for the Ilkhanid dynasty as well as the events of Shīrāzī’s life, and it was completed in 1310 C. E. /710 A. H. A physician, and a convert from Judaism to Islam, this renowned Ṣāḥib Dīwān (or chief financial administrator) is also known as Rashīd al-Dīn Ṭabarī, in reference to his career as a physician prior to his entrance into the govermental bureaucracy. If the authenticity of a surviving collection of letters attributed to him is accepted it appears as though he, too, knew Shīrāzī personally.

The geographer/historian Ḥamd Allāh Mustaufī Qazwīnī (d. after 1339-40 C. E./ 740 A. H.), who was a younger contemporary of Rashīd al-Dīn Ṭabarī, and who was appointed by him to work as a financial director in Qazwīn (modern Qazvin), also wrote a historical work encompassing the Ilkhanid period: the *Tārīkh-i Guzīda*. Qazwīnī completed this work in 1330 C. E./ 730 A. H. dedicated it to one of Rashīd al-Dīn's sons.

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84 See section F, below.
85 Ḥamd Allāh Mustaufī Qazvīnī, *Tārīkh-i Guzīda*, Nawa‘i, A., Ed. (Tehran: Amir Kabir, 1960). A short biography of Shīrāzī appears on p. 701. The Qūṭb al-Dīn Shīrāzī that is listed as having been executed by Ghāzān Khān in the year 700 A. H. (see p. 605) is clearly different from our Qūṭb al-Dīn and highlights the pitfalls of dealing with medieval histories such as we have listed.
A list of historical works concerned with the Seljuks of Anatolia appears in The Seljuks of Anatolia, by Köprülü. These works are also exclusively in Persian, and with the notable exception of al-Ḥusayn b. Muḥammad al-Munshiʾ al-Jaʿfarī's al-Awāmir al-ʿalāʾīya – commonly referred to as the Saljūqnāme – and the Tadhkira-i Aqsārāī (see below) have only been partly published. al-Jaʿfarī is more well known by his pen-name Ibn Bībī and an abridged version of his history was published by Houtsma in 1902. Houtsma's edition has also been reproduced in its entirety in Akhbār-i salājeqe-i Rūm, a compendium of Seljuk histories by Mashkur.

Tadhkira-i Aqsārāī, the last section of a work entitled Musāmarat al-akhbār by Muḥammad Aqsārāī, contains a fair amount of information pertinent to Shīrāzī's life and career. It was completed in 1323 C. E. / 723 A. H. This work was published in 1983 in Tehran. (Portions of this work appear, as well, in Mashkur's work referred to previously.)

Cahen relies on these two works and others (including but not limited to a host of archival sources as well as the aforementioned works by Juwaynī and Rashīd al-Dīn Ṭabarī) to compose the chapters in his Pre-Ottoman Turkey that are relevant to our study. His historical narrative and the bibliography for the sections of his book dealing with the Seljuks and the Mongols are a rich source of information.

e. Mamluk Histories:

The importance of Mamluk historians and their works for the understanding of the

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87 Mehmet Fuat Köprülü, The Seljuks of Anatolia: Their History and Culture According to Local Muslim Sources (Salt Lake City, UT: University of Utah Press, 1992).
88 Ibid., 10.

f. Other Histories:

In his *Compendium of Dynastic Histories*, composed in Syriac and translated into Arabic with the title *Tārikh Mukhtaṣar al-Duwal* Ibn al-ʿibrī (or Bar Hebraeus, 1225 or 1226 – 1286 C. E. / 623 – 685 A. H.) mentions Shīrāzī in a short list of luminary scientists of Ṭūsī's era. This confirms the claims by Shīrāzī's biographers as to his fame and renown during his own lifetime. The interesting and in some cases unique accounts in Bar Hebraeus's history underline, as well, the importance of using non-Persian and non-Arabic sources when available, for the study of Islamic history.

g. Archival Material:


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Correspondences, in Persian). The collection of these letters has been judged by some as a Timur-era forgery in a paper published in 1999, though claims as to their authenticity persist.

h. Shírāzī’s Works in Print

Three of Shírāzī’s books have been printed in recent times: two on philosophy, and one on medicine. The first is of some relevance to our study. The other two are included here as corroboration of the earlier claim as to the unsatisfactory state of scholarship in regard to Shírāzī.

The texts are:

a. The Durra/Pearl (see Section B2): an encyclopedic philosophical work in Persian, dealing with logic, metaphysics, natural philosophy, mathematics, and theology.

b. Sharḥ ḥikmat al-ishrāq (or the “Commentary on the Philosophy of Illumination”), a commentary in Arabic on the great mystical philosopher Suhrawardī (1155-1191 C. E.). This is the best known commentary on Suhrawardī, and is the title most readily associated with Shírāzī.

c. Bayān al-ḥajah ‘ilā al-tibb wa al-aṭibbā’ wa ādābuhum wa waṣāyāhum (or the “Explication of the Need for Medicine and Physicians, Their etiquette and Testaments” a short tract, a modern edition of which was published in Beirut in 2003. 

i. Secondary Sources from the 19th and 20th centuries

Shírāzī is mentioned by a host of European historians of Islam and historians of science

writing in the 19th and 20th centuries. Information on him appears in Suter,\textsuperscript{102} Wüstenfeld,\textsuperscript{103} Brockelmann,\textsuperscript{104} and Wiedemann.\textsuperscript{105} He is also mentioned by Leclerc in an article that is based on the autobiographical note in the commentary to Avicenna's \textit{Canon}.\textsuperscript{106}

Shafrāzī has also been the topic of a Ph.D. Thesis. Walbridge examined his commentary on Suhrawardī in a Ph. D. thesis written in 1983 at Harvard University.\textsuperscript{107} Some of this material is re-examined in Walbridge's more recent book \textit{The Philosophy of Illumination}, published in 1992.\textsuperscript{108} Material on Shafrāzī can also be found in biographies devoted to his illustrious teacher, Ṭūsī.\textsuperscript{109} In addition, there are two extended biographies of Shafrāzī in Persian.\textsuperscript{110}

\begin{itemize}
  \item \textsuperscript{102} H. Suter, \textit{Die Mathematiker und Astronomen Der Araber und Ihre Werke} (Leipzig: B.G. Teubner, 1900), 159.
  \item \textsuperscript{103} Ferdinand Wüstenfeld, \textit{Geschichte Der Arabischen Aerzte und Naturforscher} (Göttingen: Vandenhoeck und Ruprecht, 1840), 148-149.
  \item \textsuperscript{104} Carl Brockelmann, \textit{Geschichte Der Arabischen Litteratur Von Prof. Dr. C. Brockelmann} (Leiden: Brill, 1937), vols. 2, 510.
  \item \textsuperscript{105} E. Wiedemann, \textit{Aufsätze zur Arabischen Wissenschaftsgeschichte} (Hildesheim: G. Olms, 1970).
  \item \textsuperscript{106} Lucien Leclerc, \textit{Histoire de la Médecine Arabe} (Paris: E. Leroux, 1876), 129-130.
  \item \textsuperscript{107} Walbridge, “The Philosophy of Qutb al-Din Shirazi; a study in the integration of Islamic philosophy.”
  \item \textsuperscript{108} Walbridge, \textit{The Science of Mystic Lights}.
  \item \textsuperscript{109} See, for example, Mudarris Razavī, \textit{Ahwāl wa Athār-i Muḥammad Ibn Muḥammad Ibn al-Ḥasan al-Ṭūsī}, 136-141.
\end{itemize}
Chapter 2. The Mongols in Iran (Historical Background)

Someone had fled Bukhara after the event and came to Khurāsān. They asked him of the circumstances of Bukhārā. He said: “They came, they gouged, they burnt, they slew, they pillaged, and they left.” The savvy crowd who heard this account agreed that a greater concision could not be achieved in the Persian language.¹

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Chormaqan-qorchi subdued the Baqtat people. Knowing that the land was said to be good and its possessions fine, Ögödei-qahan issued the following decree: “Chormaqan-qorchi shall remain there as garrison commander. Each year he shall make [the people] send [me] yellow gold, gild, [Gold brocade], ... and damasks, small pearls, large pearls, sleek Arab horses....”²

* * *

And those who remained in the towns had for the most part blocked their doors with masonry, or partially barricaded themselves and entered and exited through the roofs, fleeing the tax-collectors. And when the tax-collectors would go to the neighborhoods they would reveal a miscreant low-life who had knowledge of the houses, and by whose guidance they could drag the people out of the nooks, cellars, orchards, and ruins.... And as an example, the situation in Yazd was such that if one wandered its villages one could not see anyone at all to speak with or one from whom to ask directions. And the very few who had stayed behind had a designated lookout, who would signal as soon as he saw anyone at a distance, so that all could hide [underground in the water-channels, i.e., qanāts].³


³ Rashīd al-Dīn Ṭabībī, Jāmi’ al-tawārīḵh, 1028.
A. Introduction

The purpose of this chapter is to look at Mongol presence in Persia during the thirteenth century in order to better define the historical backdrop of Shīrāzī's life and career. While Shīrāzī was not yet born at the time of the initial conflict in the second and third decades of the century, the initial Mongol invasions were in many ways the defining events for the subsequent century and the trauma and disruption that they caused would likely have been felt not only by the immediate survivors but by subsequent generations, both in the affected areas and in neighboring regions. With the benefit of hindsight, historians often interpret the Mongol invasions and their aftermath as an attestation of the resilience of the subjugated cultures of those regions that were on the receiving end of the military ambitions of the Mongols. For the purpose of our study it is perhaps even more important to recognize that in this period the lives of many of those living in the lands of the abode of Islam, whether cosmopolitan elites or illiterate peasants, abounded with various contingencies and uncertainties (as well, at times, as opportunities) that stemmed from their existence as imperial subjects of the vast Mongol empire. As a well-known scientist and scholar Shīrāzī spent much of his life close to the centers of political power and thus would have been exposed to both the risks and rewards of the Ilkhanid court.

Viewing the era through his lens of a world-historian living in the twentieth century, Marshall Hodgson terms the campaigns of Chingiz Khan and his successors the “Mongol Catastrophe.” Yet, he concludes his discussion of the Mongol period on a positive note by emphasizing that, as traumatic as the Mongol invasions had been, their final result was the assimilation of the war-like nomads by the very cultures they had set out to conquer.4 Other

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4 Marshall G. S Hodgson, *The Venture of Islam: Conscience and History in a World Civilization* (Chicago:
historians have noted as well the productive nature of the encounter between the Mongols and their Persian-speaking subjects specifically with regard to the promotion of a pan-Asian trade network, the demand for luxury goods and the practice of relocating war prisoners (and the ensuing cultural cross-fertilization). It is important to not lose sight of appears to have been the singularly violent nature of the initial conquests and the onerous political and economic conditions in the subsequent decades. The hindsight of our modern day observations with respect to the indefatigability of the beleaguered cultures of the eastern lands of Islam – their ability to grow, their ability to permeate neighboring regions, their success in attracting new adherents – should not cloud our perceptions, in other words, with respect to the cataclysmic nature of the period in question as they were perceived by those experiencing the Mongol campaigns and their aftermath. Even though these campaigns created unprecedented opportunities for the diffusion of goods and of ideas across Eurasia (considerable portions of which were to be ruled by a coalition of Mongol-ruled polities in the subsequent decades) and even though the rapid diffusion and close proximity of previously isolated cultures would no doubt have created a remarkable setting for cultural, religious and intellectual ferment, one of their most singular features remains their intensity and violence, and – as far as Persia was concerned – the degree to which region was subjected (at least until the rule of Ghāzān, 1295 – 1304 C. E.) to ruinous economic policy and exploitation.

Rather than do justice to the history of the Mongols in western Asia with its multiplicity of facets and profusion of detail (for which the reader is referred to the studies that appear in the bibliography) this chapter has the considerably more modest aim of presenting the major
historical developments so as to provide a backdrop for our discussion of Shīrāzī's life. The primary goal remains, of course, to highlight especially those historical developments that would have been relevant to the life of Shīrāzī as an astronomer. For the purpose of our discussion the period of interest can be viewed as consisting of three phases: first, the period of the initial campaigns (1219 – 1226 C. E.); second, the period following the withdrawal of the main Mongol army with the installation of viceroys ruling in the name of the Great Khan in distant Mongolia (1226 – 1256 C. E., following Boyle's lead, I will refer to this period as the period of the viceroys); third, the period of Ilkhanid rule in Persia (1256 – 1335 C. E.). Though born during the period of the viceroys, Shīrāzī lived for essentially all of his adult life under Ilkhanid rule. Indeed, as we will see in Chapter Three his association with Ṭūsī and Hülegū appears to have been shortly after the arrival of Hülegū in Persia, i.e., at the commencement of the third phase, as defined above. Yet, insofar as the claims to legitimacy by Hülegū and his successors were in many ways rooted in the conquests of Chingiz Khan, and the sociopolitical conditions of Persia had evolved out of those earlier episodes it is necessary to begin our discussion with the appearance of the Mongols in western Asia in 1219 C. E.

B. The Arrival of the Mongols in Iran: Global and Local Perspectives

Referring to the period from 945 to c. 1250 C. E. as the “Early Middle Era of Islamicate History,” Hodgson characterizes it as one of prosperity and vigor. He notes that many of the practices and institutions that are today associated with Islam were devised or, in having originated in the preceding period of the Abbasid “High Caliphate,” came into their maturity

during this period. As examples of such practices and institutions Hodgson lists the establishment of the ‘ulamā’ as a social class, the spread of the sufi orders, the development of the iqtā’ system of land grants and of religious endowments or awqāf. Having spent the previous period in a process of transformation, says Hodgson, the practices and institutions of the “Perso-Islamic” world coalesced into a normative form that was capable of being exported from its heartland, i.e., the land “between the Nile and the Oxus,” to neighboring regions, e.g., Anatolia, North Africa, and across northern India, thus making this era one of expansion as well.

Not surprisingly, if we were to examine the chronicles of a more local nature written by those who were living during Hodgson's Early Middle period, we would encounter periods that were less characterized by growth and prosperity than by reversal and discord. Indeed, in the strife-ridden accounts of the fitna (i.e., riots/discord) which led to the establishment of Seljuk power in Persia (c. 1040 C. E.) and the predations of the Turkish Ghuzz tribes in eastern Persia (c. 1150) one comes upon the record of appalling atrocities that resulted in widespread destruction. The Ghuzz raiding campaigns in eastern Persia in 1179-1180 C. E., for example, are recorded in one of the local histories of Kirmān as follows:

And when the Ghuzz succeeded in their designs, they surged out of Bāghayn and descended in the vicinity of the stream of Māhān, and when they had straitened the situation of Bardsīr [to its limit] they

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8 For a discussion of the ‘ulamā’ as a social class, ibid. 153; for the spread of sufi orders, ibid. 201; for the iqtā’ system ibid. 50; for the awqāf system, ibid. 51.
9 Ibid., 255-292.
turned to Garmsîr and -- Woe to the poor citizens of Jîruft, oblivious and unknowing! -- [for] they swiftly descended upon
them and annihilated one hundred thousand souls with a diversity
of tortures, trials, and torments. [Then,] turning their attention to
the countryside, wherever there was a prosperous region or an
inhabited territory, they transformed it into [denuded and
abandoned ruins].

Clearly, then, the difference in the two pictures, one depicting advance and the other recession is
one of perspective: the first global and epochal, while the other local – both in the temporal and
spatial senses.

That taken as a whole Hodgson's Early Middle period could be considered as a period of
growth is especially remarkable, however, for the fact that this period was one in which the lands
of Islam experienced a calamity that was of a bona fide global nature. This calamity, which was
precipitated by the campaigns of the Mongol armies under their leader Chingiz Khan against
their sedentary neighbors, started with attacks against the Chin dynasty, in northern China in
1213. In western Asia the campaigns were slightly later with the attacks on the cities of
Transoxiana commencing in 1219 C. E. Though the parallels to the events surrounding the
ascent of the Seljuks and the incursions of the Ghuzz tribes are readily apparent, the Mongol
invasions (as recounted by the chroniclers of medieval Persia) dwarfed the scale of the earlier
episodes in terms of severity as well as the geographical extent of the conflicts. Indeed, even

11 Kermani, Badāyī‘ al-zamān fi waqāyī‘ Kirmān, 89.
12 H. Desmond Martin, The Rise of Chingis Khan and His Conquest of North China (Baltimore: Johns Hopkins
Press, 1950), 158. See Hugh Kennedy, Mongols, Huns and Vikings: Nomads at War (London: Cassell, 2002),
11, for a timetable of the Mongol conquests in China and Western Asia.
14 Encyclopaedic Ethnography of Middle-East and Central Asia, 1st ed. (New Delhi: Global Vision Publishing
from a global history perspective, these military campaigns appear to have been epoch-making, detrimentally affecting the prosperity of the subsequent two centuries – i.e., Hodgson's “Later Middle” period, 1250 to c. 1600 C. E.) across the entirety of the Eurasian continent.\textsuperscript{15}

That the historical chronicles of the period are replete with accounts of extensive devastation or total destruction is an indication of the traumatic nature of these encounters in the shared experience of the chroniclers. What is particularly noteworthy in regard to the Persian historiography of the Mongols, however, is that in addition to references to “uncountable slayings”\textsuperscript{16} and “the destruction of regions and the annihilation of the faithful”\textsuperscript{17} one also encounters statements depicting devastation of such magnitude as to represent a woeful rupture with an irrecoverable past. Less than a century after the termination of Hodgson's Early Middle period, Mustaufī Qazwīnī writes: “There is no doubt that the destruction which happened on the emergence of the Mongol state and the general massacre that occurred at that time will not be repaired in a thousand years, even if no other calamity occurs; and the world will not return to

\textsuperscript{15} Noting a dearth of modern historical studies on the region, Hodgson is reluctant to blame the period of economic retardation in his “Later Middle period,” i.e., subsequent to the Mongol campaigns, on a single cause. The discussion that appears under the rubric “the world-wide crisis” is suggestive but not conclusive: “For almost two centuries, there was something like a world depression reflected in the degree of urbanization, in the volume of trade, in the social resources available, even in sheer numbers of population. This may have been due partly to the after-effects of the Mongol devastations. These after-effects were both direct, in the lands that had themselves been devastated, and indirect, affecting the sources of world trade.” Hodgson, \textit{The Venture of Islam}, 2, 373. He also adds: “The economy of the age of Mongol rule was not expansive but, at least in some areas, contracting – though (to what degree is not clear) on an Oikoumenic scale the Mongols themselves may have been partly responsible for this.” Ibid. 386. The economy of the areas in Persia that were affected directly suffered catastrophically, however. See I. P. Petrushevsky, “The Socio-Economic Condition of Iran Under the Il-Khans,” in \textit{Cambridge History of Iran}, vol. 5.


the condition in which it was before that event.”

The most notable Persian work that chronicles this unprecedented set of encounters between the Mongols and the Persian-speaking cultures of western Asia is the *History of the World-Conquerer* by ʻAlā’ al-Dīn ʻAṭā Malik Juwaynī (1226 - 1283 C. E. / 623 – 681 A. H.).\(^{19}\) Juwaynī commenced on writing this work c. 1252 C. E. and completed it c. 1260 C. E.\(^{20}\) The book treats the history of the Mongols from shortly before Chingiz Khan's rise to power to the conquest of the Ismailis in Persia by Chingiz's grandson Hülegü. Juwaynī has been accused of servility to his Mongol patrons as well as of exaggerating the scale of the events he depicts. Though the accusations do not do justice to this remarkable historian and administrator,\(^{21}\) there is no reason to doubt that Juwaynī would have had to accomodate both his urge to report the

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\(^{18}\) Hamd Allāh Mustauffī Qazwīnī, *The Geographical Part of the Nuzhat-al-qulub Composed by Hamd-Allāh Mustauffī of Qazwīn in 740 (1340)* (Leyden: E.J. Brill, 1915), 2, 34. The original Persian can be seen in the first volume 1of the same work: Ibid. vol 1. 27.


\(^{21}\) See, D. O. Morgan, “Persian Historians and the Mongols,” in *Medieval Historical Writing in the Christian and Islamic Worlds*, D. O. Morgan, ed., (SOAS, London, 1982), 113-118. For the life of Juwaynī's first patron Möngke see Morgan, D.O. "Möngke." *Encyclopaedia of Islam, Second Edition.*, Edited by: P. Bearman, (Brill Online, 2010) <http://www.brillonline.nl/subscriber/entry?entry=islam_SIM-5260>. In reading Juwaynī's history one can't help wondering if there aren't instances in which he may have reduced the level of mayhem and carnage a bit. The account of the wretched woman from Tirmidh who, in an effort to buy time, admits to having swallowed some of her pearls, thus meeting an immediate and gruesome end, is one such example. The same account appears in the later historianWaṣṣāf. While it is true that Waṣṣāf's version is gorier and even more violent than Juwaynī, it is also more consistent with the level of mayhem in the rest of the account, and – given the tenor of the account – rings truer than Juwaynī's. It should also be noted that some of Juwaynī's astronomical figures may not have been too far off the mark. Jackson is one of the authors who disputes Juwaynī's figures for the number of descendants of Chingiz Khān, in his article “From Ulus to Khanate: The Making of the Mongol States c. 1220 – c. 1290,” *The Mongol Empire and its Legacy*, Amitzi-Preiss, R. and D. Morgan (Brill, Leiden, 1999), 12. Though Juwaynīs figures are implausibly high, modern genetic studies have in fact suggested a gargantuan number of offspring for the ruler (see Travis, J., “Genghis Khan's Legacy?,” *Science News* 163, no. 6 (February 8, 2003): 91).
sensational and violent campaigns as well as his desire to please his patrons and to protect his own personal well-being, while cognizant at all times of his position as a high-ranking bureaucrat in the Mongol government. These facts may help explain why, for example, he is meticulous in recording the cities that were spared ruination.\textsuperscript{22} That Juwaynī was interested, generally speaking, in the veracity of what he was relating can also be seen in the fact that occasionally – as in the episode of Khwārazm, he, too, encounters an unacceptably high figure for the dead and refuses to include it in his book.\textsuperscript{23} So, while the purported scale of the destruction often seems implausible (at Merv Juwaynī records 1,300,000 dead),\textsuperscript{24} there is little reason to suspect Juwaynī of willfully inflating his figures. At any rate, to fully appreciate these figures it is important to recognize the true significance of the reports, i.e., that to witness as well as chronicler, the events precipitated by the Mongol invasions were of a singular and unprecedented scale, and the implausible figures that were reported by witnesses or chroniclers were meant to convey the unimaginable scale of the destruction.\textsuperscript{25}

Juwaynī's loyalty to his employers as well as the recognition of his own place as a successful bureaucrat in the administration of the vast Mongol empire can perhaps best be discerned by the special emphasis that he places on the improved conditions since the original cataclysms (that had occurred roughly three decades before the time he was writing). This can be seen, for example, in his account of the sack of Bukhara (1220 A. D.). Here Juwaynī provides a detailed account of the original conquest of this important Central Asian city by

\begin{footnotesize}
\begin{enumerate}
\item Juwaynī, \textit{Genghis Khan}, 89; Juwaynī, \textit{The Ta’rikh-i Jahān-Gushā}, 69.
\item Ibn al-Athîr's figure is 700,000, \textit{al-Kāmil fi al-tārīkh}, 12, 393.
\end{enumerate}
\end{footnotesize}
relating the surrender of the townspeople, the resistance of the garrison stationed at the citadel, the use of the Bukharans as human shields in the siege of the citadel, the filling of the moat (for the citadel) with the “animate and inanimate” bodies of the levied Bukharans used as fodder, and the burning down of the entire town so that it came to resemble a “level plain.” Yet, he also concludes the same section of his work with a rather upbeat report of the subsequent revival of Bukhara at the time of the penning of his book.

There may be an additional significance to Juwaynī’s sanguine tone in regards to the revival of Bukhara, however, and this becomes apparent by regarding his preliminary comments on the Mongol conquest of Transoxiana (in which both Bukhara and Samarqand are located) as a whole:

Chingiz Khan came to these countries in person. The tide of calamity was surging up from the Tartar army, but he had not yet soothed his breast with vengeance nor caused a river of blood to flow [as was pre-ordained by Fate]. When, therefore, he took [Bukhara] and Samarqand, he contented himself with slaughtering and looting once only, and did not go to the extreme of a general massacre; and of those regions that were the dependencies and subsidiaries [i.e., of Bukhara and Samarqand], since the majority of these offered their allegiance, [the Mongols] defiled these regions even less, and subsequently they mollified what remained and were inclined to repair [these remains] so that presently [i.e., 1259/1260 C. E.] the prosperity and well-being of some of those domains equal what they were before, and for others they are approaching [their original condition].

27 Ibid., 84-85.
In a rather grim foreshadowing, however, Juwaynī continues:

It is otherwise with Khūrāsān and Iraq, which countries are afflicted with a hectic fever and a chronic ague: every town and every village has been several times subjected to pillage and massacre and has suffered this confusion for years, so that even though there be generation and increase until the Resurrection the population will not attain to a tenth part of what it was before. The history thereof may be ascertained from the records of ruins and midden-heaps declaring how Fate has painted her deeds upon palace walls.\(^{29}\)

Here we see repeated (at a considerably smaller divide from the events themselves) Qazwīnī’s sense of the unspeakable horrors suffered by Khūrāsān and Irāq (meaning here ‘Irāq-i ‘Ajam, or Persian “Iraq”),\(^{30}\) and the enormous losses, economic as well as cultural, incurred by the communities that were on the Mongol war-path.

It is reasonable to assume, then, that part of Juwaynī’s project (his role as prominent bureaucrat notwithstanding) is to capture within the grimness of the war campaigns, a hierarchy of destruction and violence. Since, by all accounts Khūrāsān – the initial conquest of which Chingiz entrusted to his son, Tulū – appears to have borne the brunt of many of the exceptionally violent events during the conquest, Juwaynī may have been taking pains to make sure that the violence this region suffered was emphasized against the texture of the general mayhem.\(^{31}\) In a short chapter entitled “A brief account of Toli’s Conquest of Khorasān,”

\(^{29}\) Juwaynī, Genghis Khan, 96; Juwaynī, The Ta’rikh-i Jahān-Gushā, 75.


Juwaynī writes:

With one stroke a world which billowed with fertility was laid desolate, and the regions thereof became a desert and the greater part of the living dead, and their skin and bones crumbling dust; and the mighty were humbled and immersed in the calamities of perdition. And though there were a man free from preoccupations, who could devote his whole life to study and research and his whole attention to the recording of events, yet he could not in a long period of time acquit himself of the account of one single district nor commit the same to writing. How much more is this beyond the powers of the present writer who, despite his inclinations thereto, has not a single moment for study, save when in the course of distant journeyings, he snatches an hour or so when the caravan halts and writes down these histories!\(^\text{32}\)

This passage, vis-a-vis Juwaynī's comments on the optimistic outcome at Bukhara, highlights the level of damage incurred by Khurāsān, while echoing as well Qazwīnī's sense of wonder and dismay at the wanton destruction.

The last of Chingiz Khan's battles in western Asia as they appear in Juwaynī's work was against Sultan Jalāl al-Dīn, the last of the Khwārazmshāh dynasty, a Turkish dynasty ruling Persia, on the banks of the Indus (this is dated to between the 21\(^\text{st}\) of August and the 19\(^\text{th}\) of September, 1221). This encounter was one from which Jalāl al-Dīn famously escaped with his life (in so doing eliciting the admiration and wonder of the Mongol ruler).\(^\text{33}\) Until his death in August 1231 C. E., Jalāl al-Dīn represented the only tangible resistance to the predations of the Mongols, but this resistance – though perhaps significant to the immediate survivors of the Mongol campaigns – appears to have had little influence on the subsequent history of Persia.\(^\text{34}\)

Shortly after his encounter with Jalāl al-Dīn, Chingiz turned his views homeward to


\(^{34}\) Ibid., 335.
distant Mongolia. According to the *Secret History of the Mongols*, Chingiz “left governors at the cities he had conquered” before returning home. Other historical sources state that in addition to the local governors (*basqāq* in Mongolian, *shahna/shihna* in Persian, from the Arabic *shihna*) various Mongol generals acted as viceroys administering and conducting military operations within Persian lands in the period subsequent to Chingiz's return to Mongolia. Judith Kolbas – whose research is focused on the numismatic evidence of the Mongol era – comments, however, on the absence of any evidence indicating a permanent Mongol presence south of the Oxus river, immediately subsequent to the first campaigns (i.e., the first phase). She suggests that the Mongol withdrawal, which may have in part been triggered by the Tangut uprising, changed at this point from a policy of “occupation” to “devastation.” Returning to their Mongol homeland that had been made suddenly vulnerable by challenges and uprisings, Kolbas argues, the Mongol armies were left with no choice but to finish off any of the surviving populations that could provide resistance in the future. If Kolbas is correct in her interpretation, then it is likely this scorched-earth policy with regard to the regions south of the Oxus river that is likely part of what survives in the chronicles as to the utter ruination of Khurāsān and ʻIrāq-i ʻAjam. Needless to say, the lack of a permanent Mongol presence in these regions would also help explain the accounts of the subsequent revival of Transoxiana, which as a permanent holding of the Mongols would likely have been subject to an official policy of repair and recovery. In this account, large portions of Persia to the south of the Oxus river – having been destroyed and heavily depopulated – may well have served primarily as a site for

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35 Ibid., 321.
36 Onon, *The Secret History of the Mongols*, 254. See also the quote reproduced at the beginning of the current chapter.
38 Kolbas, *The Mongols in Iran*, 60.
periodic looting raids or as grazing grounds for the large flocks of the pastoral Mongols. It is perhaps significant that in Rashīd al-Dīn's account, one of the only vassals listed as paying obeisance to Hülegū on the eve of his campaign in Persia were the Salghūrid ruler of Fars (i.e., the region in which Shīrāzī was born and spent his youth and which appears to have been spared from destruction).

That during the era of the viceroy was left in a state of desolation with the absence of any semblance of a central authority can also be seen in local histories such as that of Ḥusām al-Daula … conquered this region in the year 635 A. H. (1237 – 1238 C. E.), but since the [region] was, due to the decimation of the Mongols, empty of notables [i.e., figures of authority] he was unable to provide order, and merely attempted to repair the cities and to provide law and order to the best of his ability. And he struck an agreement with the Rustamdār rulers to move to Amul, since the passage of the Mongol army was in Sārī.”

It is also possible to discern from Mar‘ashī's words that, despite their vast scale, the Mongol campaigns in this period (i.e., during our first and second phases) were, characterized by some degree of unevenness, both with respect to extent of the destruction, as well as the degree of control exerted subsequently by the Mongols. As we noted earlier, Fars which was Quṭb al-Dīn's birthplace, for example, appears to have largely escaped destruction. Indeed, the Salghūrid rulers of Fars appear to have been successful in negotiating a workable relationship as vassals to

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40 Ibid.
the Mongols until the third quarter of the thirteenth century C. E.\textsuperscript{41}

It is not clear to what extent the survivors of the Chingiz Khan's military campaigns (all of whom were now theoretically the subjects of the great Khan in distant Karakorum) could draw comfort from the fact that ruination had not visited all of the commercial and cultural centers of Persia to the same extent, and that the Ruler of the Faithful still ruled from Baghdad. At any rate, the political situation of the region was to change again with accession of Chingiz's grandson Möngke to the position of great Khān in 1251.\textsuperscript{42} Seeking to consolidate the Mongol holdings in western Asia, he dispatched his brother Hülegū to the conquered lands in the west. Hülegū's campaign commenced in 1256 C. E. By 1258 the Ismaili polity in eastern and north-central Persia had been destroyed, Baghdad had been conquered and viciously sacked, the last caliph of the Abbasid line, executed. In addition all of modern-day Iran and much of present-day Iraq was incorporated into a newly formed Ilkhanid realm headed by Hülegū himself.\textsuperscript{43} It is not clear if the founding of the Ilkhan polity was part of the original understanding with Möngke, but when this fact was accomplished there appears to have been no dispute with Karakorum.\textsuperscript{44} Hülegū's descendants ruled Persia until their power disintegrated in the first half of the following century, nominally due to dynastic and succession issues, but no doubt, also due to practices and policies that ultimately proved unsustainable.

In the remainder of this chapter I will present a dynastic chronology of the Ilkhans, the dynasty under which -- with the exception of the years of his youth -- Shīrāzī was to spend all of his life and conclude with a review of the historical evidence of the observatory of Marāgha to discuss the role of the Ilkhans as patrons of the sciences and of astronomy in particular.

\textsuperscript{44} Boyle, “Dynastic and Political History of the Il-khāns,” 340.
C. A Chronology of the Ilkhans

1. The Occupation: Hülegü (1256 – 1265 C. E.)

A grandson of Chingiz by Tolui, Hülegü⁴⁵ left Mongolia in 1253 at the behest of his brother the great Khān Möngke, with a mission to subjugate the Nizārī Ismaili’s of Persia as well as subjugating the Abbasid caliph in the event that he refused to offer his allegiance.⁴⁶ He arrived at Samarqand in 1255 C. E., and received the homage of the minor rulers, amirs, and viceroys of Persia upon crossing the Oxus a short while later.⁴⁷ Among the rulers that paid homage were “the heir and successor of the Atabeg Muẓaffar al-Dīn of Fars [i.e., the Salghūrid ruler], and the rival Seljuk sultans from Rūm, ‘Izz al-Dīn and Rukn al-Dīn.”⁴⁸ Hülegü's address to the assembly of amirs and atabegs appears in Rashīd al-Dīn's history:

We have come to destroy the forts of the unbelievers by the Qa’an’s orders. If you have come of your will, with men and materielle, your land and home will remain yours, and your efforts will be appreciated. [If not], by God’s will, when we are through with them we will march against you, heedless of excuses, and to your land and your home the same will be done as will have been done to theirs.⁴⁹

The conquest of the Ismaili forts in Qustain and Daylam, in eastern and north-central of Iran, proceeded swiftly and the Ismaili polity was effectively brought to an end with the surrender of the Ismaili ruler Khūrshāh at the fort of Maymūndiz on Sunday 29 Shawwāl 654/19 November 1256.⁵⁰ ‘Alā’ al-Dīn Juwaynī was present and, acting as Hülegū's secretary, penned the yarlīgh granting safe conduct to Khūrshāh.⁵¹ Upon the surrender of the fort of Alamut some

⁴⁵ Hülegū is generally referred to as Hulākū or Hulāgū in the Persian sources, and as Hulāghū in Arabic sources.
⁴⁹ Rashīd al-Dīn Ṭabīb, Jāmi’ al-tawārīkh, 688.
⁵⁰ Rashīd al-Dīn Ṭabīb, Jāmi’ al-tawārīkh, 690; Juwaynī, Genghis Khan, 634; See also Daftary, The Ismā'īlīs, 426, and Kolbas, The Mongols in Iran, 155.
days later, Juwaynī was able to visit the famed library and to preserve some of the books and some of the astronomical instruments from destruction (while, at the same time, zealously consigning the Ismaili tracts that he found to the flames).\textsuperscript{52} It was Juwaynī, also, who penned the terms of the surrender for the Ismailis.\textsuperscript{53}

Naṣīr al-Dīn Ṭūsī was among the notables that surrendered at Maymūndiz.\textsuperscript{54} The fame of this scientist, then in his fifties, had reached Karakorum, and Hülegū had been entrusted by the Great Khan with sending him to the Mongol capital. Instead, Hülegū retained Ṭūsī as a member of his own retinue, where he became a trusted adviser and the administrator of the religious endowments (\textit{awqāf}) in the Ilkhanid realms. Ṭūsī served as well as the first director of the Marāgha observatory; the construction of which was funded, at least according to some historians, by the very \textit{awqāf} revenues for which Ṭūsī had been appointed as administrator.\textsuperscript{55} In his \textit{Zīj-ī Ilkhānī}, written during his tenure at Marāgha, Ṭūsī claims that he had been held by the Ismailis (whom he terms heretics) against his will, but this claim contradicts some of the other historical information from his life, including his own writings.\textsuperscript{56}

Upon the extermination of the Ismailis Ṭūsī's new master, Hülegū, was able to focus on his second task: the extermination of the Abbasid caliphate. On the ninth of Rabī‘ al-ākhar 655 A. H. (April 25, 1257 C. E.) he arrived at Dīnāvar and shortly thereafter at Hamadan where he sent a letter to the caliph:

\begin{quote}
On the tenth of Ramaḍān, with warnings and promises (\textit{bi tahdīd wa wa’id}) [stating] “At the time of the capturing of the forts of the infidels we asked for reinforcements from you; in response you claimed to be an ally, but did not send men.... Surely the word of men, common as well as exalted, has reached your ear as to what has befallen the world and its inhabitants at the hand of the Mongol
\end{quote}

\begin{thebibliography}{9}
\bibitem{52} Juwaynī, \textit{Genghis Khan}, 719.
\bibitem{54} Rashīd al-Dīn Ṭābib, \textit{Jāmi‘ al-tawārīkh}, 695; Juwaynī, \textit{Genghis Khan}, 635.
\bibitem{55} Muḥammad ibn Shākir Kutubī, \textit{Fawātī al-wafāyāt wa al-dhayl ‘alayhā} (Beirut: Dar al-Thaqafah, 1973), 3, 250; Sayılı, \textit{The Observatory in Islam and Its Place in the General History of the Observatory}, 207 - 211.
\bibitem{56} Ṭūsī, \textit{Naṣīr al-Dīn al-Ṭūsī's Memoir}, vol. 1, 10.
\end{thebibliography}
armies from the time of Chingiz to the present time, and what humiliations were made to visit upon the Khwārazmshāhs, and Seljuks and the kings of Daylam and the Atabegs and others who were possessed of glory and might, at the hand of the eternal and ancient God. The gates of Baghdad were not secure against any of these factions, [so that] they held court there. Thus, given our might and power, how can they be secure against us?\(^\text{57}\)

Given the fact that Rashīd al-Dīn lists concerns about both the (Ismaili) “unbelievers” as well as the “Caliph in Baghdad” as the reason for Hülegü's campaign, it is not clear how al-Musta’sam's cooperation would have changed the course of events.\(^\text{58}\) At any rate, Baghdad fell to the Mongol army on the 4\(^{\text{th}}\) of Safar, 656 A. H. (February 10\(^{\text{th}}\), 1258 C. E.), signaling the end of the storied and often powerful Abbasid dynasty that had served as the political and religious leaders of the Islamic umma for more than five centuries.\(^\text{59}\)

Many secondary sources report that Hülegü chose Marāgha as his capital shortly after the fall of Baghdad.\(^\text{60}\) The situation with primary sources is a bit different. Rashīd al-Dīn, the main

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57 Rashīd al-Dīn Ṭabīb, Jāmi’ al-tawārīkh, 699.
58 Rashīd al-Dīn Ṭabīb, Jāmi’ al-tawārīkh, 684.
59 Rashīd al-Dīn Ṭabīb, Jāmi’ al-tawārīkh, 714. In regard to the extermination of the Abbasid line Rashīd al-Dīn states: “At the end of Wednesday on the fourteenth of Safar of 656 they concluded the business of the caliph and his eldest son and five attendants who were with him, [at the village of waqaf?] and the following day, those of the others who had descended with him from the Kālwaḏīh gate, they martyred, and whomever of the Abassids they found, they did not leave alive, all except for the few whom they considered of no account. And Mubarakshāh the youngest son of the caliph they gave to Oljai Ḵhatun, and Oljai Ḵhatun sent him to Marāgha, to Ḵhwājah Naṣīr al-Dīn, and they gave him a Mongol wife and he had two sons with her, and on Friday the sixth of Safar they made the middle son of the caliph join his father and brother and the rule of the Abassid caliphs who had come to power after the Umayyads was thus extinguished, and the period of their caliphate was five hundred and twenty five years.” The caliph's death appears to have been in accordance with a Mongol practice that forbade the spilling of royal blood. This may be the source of the legend that the caliph died from hunger when he was imprisoned in a storeroom containing his treasure but no food. This account appears, for instance, in Waṣṣāf: ‘Abd Allāh ibn Fazl Allāh Waṣṣāf-i Ḵazrat, Geschichte Wassaf’s (Wien: Verlag der Österreichischen Akademie der Wissenschaften, 2010). A quote by the ruler of Miyāfāraqayn alludes to this, and also to what must have been a perception that al-Musta’sam, had not allocated the proper funds for the defense of his domains: “Thanks be to God that I am not a dinar and dirham-worshipper like Musta’ṣam who lost his life and the kingdom of Baghdad due to his parsimony and miserliness.” Rashīd al-Dīn Ṭabīb, Jāmi’ al-tawārīkh, 725.

authority on Hülegü's reign, mentions that Hülegü received the obeisance of vassals at Marāgha after the fall of Baghdad. However, neither Rashīd al-Dīn nor Wašṣāf (another major source on Hülegü's reign) mention Marāgha as a capital city. Indeed, Rashīd al-Dīn's chronicle suggests that Marāgha's privileged position may have been due in part to its selection by Ṭūsī as site of the observatory, the building of which commenced the same year as the fall of Baghdad:

And in the aforementioned date, it was decreed, that the great Maulānā ... the sultan of the learned Khwājah Naṣīr al-Dīn Ṭūsī (May the Lord conceal his faults through His mercy), in a location that he [saw] fit, set up a building for the observation of the stars. He chose a location in Marāgha.

Certainly, little mention of this city is made in Rashīd al-Dīn's history in the subsequent accounts of Hülegü's life (which are primarily devoted to his various campaigns). These accounts describe the attack on Syria, his campaign against the Mamluks, the campaigns of the Mongols in eastern Anatolia and the Caucasus, the treachery of the son Badr al-Dīn Lau' Lau (the amir of Mosul) who allied himself with the Mamluks (and suffered a particularly gruesome

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61 Rashīd al-Dīn's first mention of Marāgha, after the fall of Baghdad and the transfer of the loot from Baghdad, “and the forts of the unbelievers, and Rūm (Anatolia), and Georgia, and Armenia and the Lurs, and Kurds, likewise” to Azarbaijan, merely states that Hülegü received the obeisance of local rulers including Badr al-Dīn Lau' Lau' [the amir of Mosul] in the “vicinity of Marāgha.” Rashīd al-Dīn continues “and sent him off on the sixth of Sha'ban of that year, and on the seventh ... the Atabeg Sa'ād the son of Abu Bakr the Atabeg of Fars, offered his obeisance and felicitations on the conquest of Baghdad.” See Rashīd al-Dīn Ṭūbīḥī, Jāmī’ al-tawārīkh, 717. However the two Seljukid amirs Izz al-Dīn and Rukn al-Dīn (who arrived subsequently) were received in a different locality (i.e., Mausaq, near Tabriz). Rashīd al-Dīn Ṭūbīḥī, Jāmī’ al-tawārīkh, Ibid.

Tabriz was to become the official capital of the Ilkhanid dynasty under Hülegü's successor, Abūqā, shortly after his accession on June 19, 1265/ third of Ramadan 663. Jāmī’ al-tawārīkh, 742-743.

62 Rashīd al-Dīn Ṭūbīḥī, Jāmī’ al-tawārīkh, 718.
63 Rashīd al-Dīn Ṭūbīḥī, Jāmī’ al-tawārīkh, 719-725.
64 Rashīd al-Dīn Ṭūbīḥī, Jāmī’ al-tawārīkh, 721-725.
65 Rashīd al-Dīn Ṭūbīḥī, Jāmī’ al-tawārīkh, 725-729.
death), the outbreak of internecine warfare between Hülegü and Berke the khān of the Golden Horde. It is certain that for the majority of these episodes Hülegü would have been residing in his great mobile tent compound, or *ordū*. Indeed, when Marāgha is mentioned again in the final chapter of Hülegü's life, it is in connection with the observatory (again suggesting that the observatory was what lent Marāgha its unique importance):

Hulākū loved buildings exceedingly, and of those that he has decreed many have survived. He built a palace in Alatagh and built pagodas in Khoy and spent that year in the establishment of buildings and in the provident consideration of the welfare of the kingdom, the army, and the populace. When Fall arrived, desiring to establish his winter encampment at the Zarrīneh-rūd, [the river] which is called Jaghātū by the Mongols, he went to Marāgha and exerted his full efforts in the completion of the [observatory].

According to Rashīd al-Dīn, of the amirs that Hülegü received in Marāgha after the fall of Baghdad were the governors of Shīrāzī's home province of Fars (the Atabag Saʿad) as well as the brothers Rukn al-Dīn and ʿIzz al-Dīn, who were rival Sultans in Rūm (Anatolia) having been installed in 1246 C. E.

Subsequent to the sack of Aleppo and Damascus by the Mongols in 1259, news of the death of Möngke caused Hülegü to withdraw a portion of his forces to the East. Subsequently his general Kitbogha was defeated by the Mamluks of Egypt at ‘Ayn Jalūt (or “the spring of Goliath”). This was a significant reversal of Ilkhanid fortune, for it halted the westward advance of the Mongol military machine, and established the Euphrates as the general boundary between the two polities. It confirmed as well, the Mamluks as the primary rival for Mongol hegemony in the eastern Mediterranean – a rivalry that was to last for the remainder of the

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70 Cahen, *Pre-Ottoman Turkey a General Survey of the Material and Spiritual Culture and History C. 1071-1330*, 271-273. These figures are the very same who greeted Hülegū on his arrival (see note 48).
Ilkhanid era.\textsuperscript{72}

The Mamluk Turks – themselves of a Central Asian and nomadic background – had begun to consolidate their power upon the appointment of one of their members, Qutuz, to the regency of Egypt in the aftermath of the defeat of the French monarch Louix IX and his fellow crusaders.\textsuperscript{73} Mamluk-Mongol relations were to greatly preoccupy the subsequent Ilkhan rulers; at least until Öljeitü's last campaign against them in 1313 C. E.\textsuperscript{74} These relations were bitterly antagonistic, and were the cause of repeated attempts by the Mongols and European armies both within the crusader states in Syria, and in Europe proper to form alliances with each other, against the Mamluks.\textsuperscript{75} The Mongol defeat at ‘Ayn Jalūt, which had followed a less definitive defeat of a smaller Mongol force in Gaza (where the Mamluks had again been led by Qutuz) was followed by yet another Mongol defeat on the 10\textsuperscript{th} of December 1260 C. E., at Homs. Baybars, who had led the Mamluk army to victory at Homs, and who had been instrumental in the victory at ‘Ayn Jalūt had by them become the new Mamluk ruler; having assassinated Qutuz in the short interval between ‘Ayn Jalūt and Homs.\textsuperscript{76} He was to be an indefatigable opponent of the Mongols until his death in 1277 C. E.\textsuperscript{77}

In the last chapter on Hülegü’s life Rashīd al-Dīn describes the manner in which he delegated the rule of his vast conquests, consigning Iraq, Khurāsān, and Māzandarān to the shores of the Oxus to his “oldest and best son,” Abāqā, and “Arrān and Azarbaijān … to Prince Yashmūt, and Diyārbakir and the Rabi’ area region up to the Euphrates to the Amir Tudān, and Rūm to Mu‘īn al-Dīn Suleimān Parvānep.”\textsuperscript{78} As we we will see, Mu‘īn al-Dīn was to become one of

\textsuperscript{72} Ibid.

\textsuperscript{73} Syedah Fatima Sadeque, 	extit{Baybars I of Egypt}, (Dacca, Oxford University Press, 1956), 36.

\textsuperscript{74} Boyle, “Dynastic and Political History of the Il-khāns,” 403.

\textsuperscript{75} Constantinople was reclaimed by the Byzantines from the Latins in 1261, leaving the crusader cities of the Levant as the only representatives of the crusaders in the eastern Mediterranean. See R. L. Wolff, “The Latin Empire of Constantinople, 1204 - 1261,” in 	extit{The History of the Crusades}, vol. 2 (Philadelphia: University of Pennsylvania, 1962), 231-233.

\textsuperscript{76} Sadeque, 	extit{Baybars I of Egypt}, 39 – 42. For the origin of the term al-Bunduqdārī or Bunduqdār, the title by which Baybars was known (and by which Rashīd al-Dīn refers to this energetic and successful ruler) see ibid., 30.

\textsuperscript{77} Sadeque, 	extit{Baybars I of Egypt}, 46 - 54, 64 - 69.

\textsuperscript{78} Rashīd al-Dīn Ṭabīb, 	extit{Jāmi’ al-tawārīkh}, 734.
Shīrāzī's patrons. In Chapter Three we use the execution date of Mu'īn al-Dīn's execution (in 1277 C. E., by the order of Hülegü's son, Abāqā) to help pin some of the dates in Shīrāzī's life. Rashīd al-Dīn states that Hülegü assigned Shīrāzī's home region of Fārs – ruled as we saw by the Salghūrid dynasty who were vassals to the Mongols – to the Amir Iknānū, presumably as an overseer of Mongol interests in that vassal state. Hülegū selected Shams al-Dīn Muḥammad Juwaynī, Ata’ Malik Juwaynī’s brother (and subsequently a patron of Shīrāzī), as the vizier of his domains, “granting him full and absolute power in the [administration of the] kingdom.”\textsuperscript{80} The author of the History of the World Conqueror himself was granted the important governorship of Baghdad.\textsuperscript{81}

Hülegū's death occurred in the year 663 A. H. (1265 C. E.):

\begin{quote}
As the year of the Bull arrived in the Rabī’ al-Awwal of the year 663 (Dec. 1264/Jan. 1265) he was busy with hunting and festivities (tuy). Suddenly after the bath an illness returned to his body, through which he felt heavy and became bedridden. And on Tuesday the seventh of Rabī’ al-‘akhir he took from the hand of the Chinese doctors a laxative, which resulted in unconsciousness and led to a stroke. And no matter how diligently the capable doctors attempted the purge they were unable to deflect the malady since the levels of vitality had reached the point of morbidity, and no fateful arrangement could be found that was fruitful, nor a providential drug could be found that was useful. And at that time a comet came into view, [shaped] as a conical rod, appearing every night, and as it disappeared on Sunday night of the nineteenth of Rabī’ al-‘akhir of the year 663 the great event took place. His age was 48 full solar years and on the banks of the Jaghātū he left the wayhouse of anhihilation for the eternal abode.\textsuperscript{82}
\end{quote}

Hülegū's funeral appears to have been the last Mongol burial in Persia involving human sacrifice. Rashīd al-Dīn discretely omits any mention of this, simply stating: “They built his tomb in the Shāhī mountain that faces Dehkhāregān and in his camp they held mourning

\begin{footnotes}
\textsuperscript{79} Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, 2, 734; Thackson's rendition of this name is Vangianu. See Rashīd al-Dīn Ṭābīb, Rashīduddin Fazlullah's Jāmi’u ’l-Tawarīkh = Compendium of Chronicles, 2, 513.
\textsuperscript{80} This he does fter executing Amir Sayf al-Dīn Batīkhū, the previous holder of the post. See Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, Ibid. We can only speculate on how the administrative duties of Shams al-Dīn may have affected Ṭūṣī’s role as chief administrator of the religious endowments. Certainly that Shams al-Dīn's brother does not mention Ṭūṣī in his accounts of the fall of the Ismailis is one of the striking omissions in the World Conqueror.
\textsuperscript{81} Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, Ibid.
\textsuperscript{82} Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, 736.
\end{footnotes}
cere monies, and buried his coffin in the tomb.” The reference appears rather in Wasṣāf: “And in the manner of the Mongols they built a crypt, and poured great quantities of jewels and gold in it, and several [ravishing beauties] were made to [accompany him in his eternal] sleep, so that he would be immune to the fear of [oblivion].”

2. The Mamluk Challenge: Abāqā (1265 – 1282 C. E.)

The day for Abāqā's accession ceremony was determined by Khwājah Naṣīr al-Dīn to be the third of Ramadan, 663 A. H. (June 19th, 1265 C. E.) with Virgo ascendant (bi ṭaliʿ-i sunbula). Despite the purported auspiciousness of this day, Abāqā was soon faced with threats from the neighboring Mongol factions of the Golden Horde, and the Chaghatai Khānate of central Asia. The conflict with the Golden Horde was resolved in 1266 C. E. with the death of Berke, Abāqā's uncle and the khān of the Golden Horde. The Chaghatai armies were dealt a bloody defeat at Harāt on the first of Dhūl al-Ḥajja 668/22 July 1270; though raiding parties from central asia continued to menace the eastern regions of the Ilkhanate, periodically.

Abāqā appears to have taken over the rulership of the Ilkhans with the seemingly unanimous support of the Ilkhanid nobles, yet had to wait for confirmation by the great Khān, Qubilai who had succeeded his brother Möngke and had consolidated his rule against the majority of his rivals by 1264 C. E. Rashīd al-Dīn states that “despite being the protector (wali) [i.e., the rightful owner] of the crown and the throne – until the arrival of the messengers from his highness Qubilai Khān and their bringing the yarlıgh in his name – he conducted his

83 Rashīd al-Dīn Ṭāḥīb, Jāmiʿ al-tawārīkh, Ibid.
84 'Abd Allāh ibn Fazl Allāh Wasṣāf al-Ḥazrat, Geschichte Wassafs (Wien: Verlag der Österreichischen Akademie der Wissenschaften, 2010), 101.
85 Rashīd al-Dīn Ṭāḥīb, Jāmiʿ al-tawārīkh, 742; Kutubī, Fawāt al-wafāyāt wa al-dhayl ʿalayhā, 3, 249.
87 Peter Jackson, “ABAQA.”
88 Peter Jackson, “ABAQA.”
affairs seated on a chair.” The *yarligh* with Qubilai’s endorsement did not arrive until 1270.\(^90\)

This may explain why, upon his (first, unofficial) accession, Abāqā was munificent to the extreme. According to Rashi al-Dīn “he gave an untold amount of money and jewelry and fine clothing to the courtiers (*khawātīn*), the princes and the amirs, so much so that [even] most of the soldiery were able to benefit.”\(^91\) In addition, “he made nearly one hundred well-known scientist who were the students of the teacher of mankind, Khwājah Naṣīr al-Dīn Ṭūsī, May the Lord have mercy upon him, the beneficiaries of [an all-embracing] boon.”\(^92\)

Despite threats by his kinsmen in the Caucasus and central Asia, the adversaries that were to demand the most attention during Abāqā’s rule were the Mamluks. The intense rivalry of these two polities played itself out repeatedly in Syria and in Anatolia throughout Abāqā’s reign. The first twelve years of Abāqā’s reign coincided with the reign of Baybars (who, as we said, died in 1277 C. E.). By 1261 C. E. Baybars had re-established Mamluk control over Damascus and Aleppo, and had had a new Caliph installed in Cairo to help legitimize his rule.\(^93\) He had also formed an alliance with Berke, the khān of the Golden Horde, in 1264 C. E. In 1267 C. E. a skirmish with the Mongols under their new ruler Abāqā ended in a retreat of the Mongol forces.\(^94\) In the face of such an energetic adversary, Abāqā in turn sought an alliance with Prince Edward of England (later King Edward I) who was leading the crusaders against the Mamluk armies. This alliance was not particularly fruitful, however, since the size of the Mongol forces that were dispatched was apparently too small.\(^95\) In 1277 Baybars invaded Rūm, roundly defeating the Mongol army at Abulustān.\(^96\) In retaliation for the tepid support of his Seljuk vassals Abāqā ordered the destruction of the area between Qaisarīya and Erzerum, in the same year; calling off the slaughter and the mayhem only after the *Ṣaḥib Dīwān* Shams al-Dīn's

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\(^90\) Rashīd al-Dīn Ṭabīb, *Jāmi‘ al-tawārīkh*, 765. Also see Peter Jackson, “ABAQA,” in *Encyclopaedia Iranica*.


\(^92\) Ibid., 744.


\(^94\) Sadeque, *Baybars I of Egypt*, 57.


intervention. Mu‘īn al-Dīn Suleimān (also known as the keeper of the seals or “the Parvāneh”), whom as we saw had been confirmed in his role the Mongol-appointed administrator of Rūm by Hülegū, was accused of supporting the Mamluk attack, and paid with his life for this alleged intrigue with Baybars. Rashīd al-Dīn states that in addition to leaving Shams al-Dīn in power as the chief administrator of the Mongol realms at the beginning of his reign, Abāqā appointed his son, Bahā’ al-Dīn Muḥammad as the governor of ‘Iraq-i ‘Ajam. Bahā’ al-Dīn continued his service under Abāqā, until his death in the year 678 A. H. (1279/1280). In his introduction to the Durra/Pearl Mishkat identifies Bahā’ al-Dīn as the dedicatee of Shīrāzī's Nihāya/Limit. This identification creates an immediate chronological problem and (if the date of Baha’ al-Dīn’s death is accepted as valid) cannot be correct. (We will revisit the problem of identifying the dedicatee of the Nihāya/Limit in Chapter Three.) Shams al-Dīn and his brother had to contend with forceful attempts by fellow courtiers to dislodge them from their positions of prominence. In addition to being charged with embezzlement, the brothers were charged with the perhaps even more serious crime of harboring pro-Mamluk sympathies. Bahā’ al-Dīn was punished by being humiliatingly paraded in Baghdad, and was subsequently imprisoned in Hamadan. Indeed Abāqā’s death in Hamadān on the twentieth of Dhū al-Ḥajja 680/April 1st, 1282 C. E., after an evening of excessive drinking, would no doubt have been a reprieve for both Juwaynī brothers.

99 Rashīd al-Dīn Ṭabīb, Jāmī’ al-tawārīkh, 744.
102 As we will see the Nihāya/Limit was completed in November of 1281 C. E. and so postdates Bahā’ al-Dīn’s death by approximately a year.
103 Rashīd al-Dīn Ṭabīb, Jāmī’ al-tawārīkh, 774.
3. An Adoption of Popular Customs: Tegüder Aḥmad (1282 – 1284 C. E.)

A notable feature of the reign of Tegüder Aḥmad (or Takūdār, in the Persian sources) is his conversion to Islam (whence the Arabic name Aḥmad), is reported rather tepidly in the account by the Syrian historian Abū al-Fidāʾ. “And when Abāqāʾ died, his brother Aḥmad the son of Hülegū became king and the name of this aforementioned Aḥmad was Bikdar [sic], and since when he [assumed power] he professed Islam he was called Aḥmad Sultan.”105 As a Mamluk historian the lukewarm tone in Abū al-Fidāʾ's report is perhaps understandable. Rashīd al-Dīn appears to be as unimpressed as Abū al-Fidāʾ, however: “They sat him on the throne, and celebrated in the manner to which the Mongols are accustomed, and since he professed Islam they called him Sultan Aḥmad.”106 This presentation is in stark contrast with that of Rashīd al-Dīn's employer Sultan Ghāzān, whose conversion to Islam is described by Rashīd al-Dīn in a rarefied and ornate language. One of the possible reasons for the ambivalence regarding Aḥmad's profession of Islam is the questionable reputation of the man said to be responsible for his conversion: Tegüder Aḥmad's “adviser,” Sheikh ʻAbd al-Raḥmān of Mosul, was considered by some to be a charlatan.107 In Rashīd al-Dīn's description, the Sheikh is depicted as something of a distraction to Aḥmad's official duties.

[Aḥmad] had a great intimacy with ʻAbd al-Raḥmān, so much so that he called him bābā [i.e., father], and he called Išhan Manklī who was a follower of Bābī Yaʻqūb, who had a station in Arrān, qarindash [i.e., brother], and would go to their house at all times (Išhan Manklī's house was in the back of the [Royal encampment]) and participate in the samāʾ. And he was less likely to attend to the organization and arrangement of governmental issues, and his

105 Abū al-Fidāʾ Ismāʿīl ibn Ṭālib, al-Mukhtaṣar fī akhbār al-bashar, pt. 4, 63 (See note 27, p. 18).

106 Rashīd al-Dīn Ṭūḥī, Jāmīʿ al-tawārīkh, 785. It is understandable that Rashīd al-Dīn saves his choicest accolades for the conversion of his own employer, Sultan Ghāzān. In addition the copier of the manuscript available for the Karimi edition appears to have had a personal experience with Sultan Aḥmad; a petition of his for which he nearly pays with his life, and includes and account of this encounter as a reprobation of Aḥmad. See Ibid. 801.

mother Quti Khatun who was wise and capable to the extreme, ensured the interests of the various realms were met, together with Asāq.108

The Sheikh is important for our study, since Rashīd al-Dīn states that “it was at the suggestion of the Sheikh ‘Abd al-Raḥmān and Shams al-Dīn (i.e., Juwaynī) the Ṣaḥīb Dīwān, that [Sultan Tegüder Aḥmad] sent Maulānā Qutb al-Dīn Shīrāzī who was a learned man as a messenger to Egypt on the nineteenth of Jumāda I, 681 (Aug. 25, 1282 A. H.).”109 This embassy, which surely signifies the great prestige of Shīrāzī as a scholar in the court of Tegüder, was the first of two sent by Tegüder Aḥmad. The embassy conveyed a written message which appears in full in Shāfiʻ’s account (and is described by him as clattering “with the clatter of [Persian-speakers]”).110 It opens with thanks to the Lord for guiding the ruler to Islam, and describes Tegüder's desire for peace – despite a Mongol assembly (Kuriltai) in which the notables had voiced their desire for a continuation of Abāqā's antagonism with the Mamluks. It lists, as well, Tegüder's reforms which had allowed for improvements in providing for the welfare of his subjects.111 Modern historians have generally viewed the embassy as a gesture of peace by the newly converted Mongol ruler.112 However, the presence of a fragment of verse 17:15 of the Qur'an, “And we do not mete out torment until after we have sent a messenger [to warn]” in the closing of the

108 Rashīd al-Dīn Ṭābīb, Jāmiʻ al-tawārīkh, 788. Sheikh ‘Abd al-Raḥmān is also described as a person with supernatural powers. In an episode depicting the intrigue of the courtier Majd al-Mulk against his patrons the Juwaynī brothers we read: “A decree was passed stipulating the return of the possessions and articles of Khwājah ‘Ala’ al-Dīn Ata’ Malik [Juwaynī] that had been … confiscated [to their owner].... ‘Ala’ al-Dīn prepared them and presented them [stating]: “What we brothers have accomplished has been through the all-encompassing blessing of the Ilkhāns. In this quriltai [i.e., assembly] your servant [willingly disburses these items back to the treasury].... And it was decreed that Majd al-Mulk [stand trial instead] …. [During the trial] in the midst of his trappings they found a fragment of a lion's skin, upon which something had been written in yellow and red with an illegible hand, and since the Mongols detest sorcery to the extreme, they were terrified of the script ….. The … sorcerers said that the protective charm should be doused with water, and that [Majd al-Mulk] be forced to drink the extract so that the magical evil would be neutralized. And they prompted Majd al-Mulk to carry this out, but he refused, since the protective charm was one that Sheikh Abd al-Rahman had devised, and [one he] had planted in his trappings and he was sure that it could not be devoid of [evil powers].” Rashīd al-Dīn Ṭābīb, Jāmiʻ al-tawārīkh, 787. See also Bar Hebraeus, The Chronography of Gregory Abū’l Faraj, 474; and Amitai, “Sufis and Shamans.”

109 Ibid.

110 Shāfiʻ ibn ‘Aḥl Ibni ‘Asākir, Šāfiʻ ibn ‘Aḥl’s Biography of the Mamluk Sultan Qalāwūn (Warsaw: Dialog, 2000), 309. This letter may have been written by Shīrāzī himself as we will see in Chapter 3, Section E.

111 Ibid., 309-316.

letter, as well as other features have led one modern historian to conclude that the letter is
actually a sort of ultimatum by the Mongol Khān to the Mamluk ruler.\textsuperscript{113} In any event, the
mission was a failure, either as ultimatum or indeed as far as changing the status quo between
the warring states.

The Mamluk historian ‘Abd al-Zāhir writes of the embassy that it was a large one,
consisting of “subjects, groups [of courtiers?], slave boys, slave soldiers and notables, all in great
splendour.”\textsuperscript{114} He adds: “When they had reached Bira [on the Euphrates, i.e., the frontier] the
Sultan wrote to his deputies to guard against them and [to ensure] that none of the [muslims]
should see them or associate with them, nor were they to speak with them even a word, and that
they [i.e., the Mongol contingent] were not to travel except at night.”\textsuperscript{115} Despite the heavy
security, as we will see in Chapter Three, Shīrāzī tells us of his success, in Cairo, of locating
several much needed books for his commentary on Avicenna's the Canon. A loosening of
security once the embassy was in Cairo seems highly unlikely, and it is therefore not clear
exactly how Shīrāzī was able to obtain his beloved books.

Of the mission's return ‘Abd al-Zāhir states that the embassy headed first to Aleppo,
“reaching it on the sixth of Shawwāl 681 (Jan. 7\textsuperscript{th}, 1283), and from there, headed back to [its own
land].”\textsuperscript{116} News of Tegüder Aḥmad's death arrived at Cairo during a second embassy. That
embassy did not include Shīrāzī, but it was headed by Sheikh ‘Abd al-Raḥmān himself.\textsuperscript{117} (In
addition the second embassy included four dervishes “for the sake of chanting and samā’,” at
which ‘Abd al-Zāhir expresses his astonishment and wonder.)\textsuperscript{118} According to ‘Abd al-Zāhir it
was the Mamluk sultan himself who conveyed news of Aḥmad's death to his sheikh, upon which

\textsuperscript{113} Adel Allouche, “Teguder's Ultimatum to Qalawun,” \textit{International Journal of Middle East Studies} 22, no. 4
(November 1990): 437-446.
\textsuperscript{114} Muḥyi al-Dīn Ibn ‘Abd al-Zāhir, \textit{Tashrīf al-ayyām wa al-‘usūr fī sīrat al-malik al-mansūr}, 1st ed. (al-Qāhirah:
\textsuperscript{115} Ibid.
\textsuperscript{116} Ibid., 16.
\textsuperscript{117} Ibn ‘Asākir, \textit{Ṣāfi’ Ibn ‘Alī's Biography of the Mamluk Sultan Qalāwūn}, 328.
the sheikh “fell into his arms, unconscious,” dying shortly thereafter.\textsuperscript{119}

In Rashīd al-Dīn's account of Ahmad's rule, his rivalry with his nephew (and Abāqā's son), Arghūn, through which he ultimately lost his kingdom and his life, is a constant and ever-present theme.\textsuperscript{120} In Bar Hebraeus's \textit{Chronography} we see Arghūn providing the following justification for the elimination of his uncle:

Inasmuch as Ahmad turned aside from the laws of our fathers, and trod the path of Islam, which our fathers did not know, all the princes agreed and they cast him forth from the kingdom, and sent him to the Khān, our great father, that he might judge him; and they seated me on the throne of the kingdom from the river Gihon to Frankistan.\textsuperscript{121}

Given the skepticism with which foes, and some friends, even, considered Tegüder Ahmad's conversion to Islam, there is a fair amount of irony in this rationalization for Ahmad's end.

\textbf{4. A Return to Mongol Traditions: Arghūn (1284-1291 C. E.)}

Like Abāqā, Arghūn had to await an official endorsement from Karakorum at his assumption to power,\textsuperscript{122} and like him he had to contend with both the Golden Horde and the Chaghatai Khānate, his rivals to the north, and the east.\textsuperscript{123} Though the purported proclamation by Arghūn in which he condemns Ahmad Tegüder's conversion to Islam does not appear in Rashīd al-Dīn's history, his rule may have been characterized by a certain anti-Islamic sentiment (though some of what is reflected in the muslim chronicles is no doubt due to the Mongol tolerance of the various religions of their subjects). Upon assuming the throne Arghūn opted for non-Muslim viziers, first appointing Buqa, a Mongol notable, and subsequently Saʻd al-Daula who was a Jew.\textsuperscript{124} Arghūn also appears to have forbidden the employment of muslim scribes in the court.

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119 Ibn ʻAsākir, Šâfiʻ Ibn ʻAţī's \textit{Biography of the Mamluk Sultan Qalāwūn}, 332.
121 Bar Hebraeus, \textit{The Chronography}, 474. Gihon is the Oxus River, from the Persian Jaiḥūn.
\end{flushleft}
bureaucracy.\textsuperscript{125} Arghūn's reign is also one in which Shams al-Dīn, the Ṣahib Dīwān under Hülegū, Abāqā, and Ahmad, was put on trial and executed (Oct. 16th, 1284 C. E. / Fourth of Shaʿbān, 683 A. H.).\textsuperscript{126} Already during the reign of Ahmad, Arghūn had charged Shams al-Dīn and his brother with the poisoning of Abāqā. The charge for which the great statesman was finally executed, however, was financial misappropriation.\textsuperscript{127} ʿAlāʾ al-Dīn Juwaynī, Shams al-Dīn's brother and author of the \textit{History of the World Conqueror}, had already died in 1283 C. E., likely from a stroke induced by the charges brought against him as a party to Abāqā's death.\textsuperscript{128}

Though a protege of Shams al-Dīn Shīrzāī appears to have weathered the politics and intrigue of the court in this period and was even able to intercede for an acquaintance. We read about this in the first of two episodes recorded by Rashīd al-Dīn in which Shīrzāī appears in Arghūn's presence. This episode belongs to sometime after the 13\textsuperscript{th} of Jumāda al-ulā 689 A. H. (i.e., May 24, 1290):

\textit{And at a post on the road to Van, as the Sultan was returning from Alātāgh, Shīrzāī was received [in humility], and he made a presentation on the western sea and its harbors and its shores, which include many western and northern regions, and the king found his company to be exceedingly pleasant, as while recounting the regions of Rūm (Anatolia) the king had noticed Ammorium, which is in Rūm, and asked Shīrzāī to explain it [further]. He [i.e., Shīrzāī] presented a report of utmost eloquence containing prayers and acclamations for the king, and a description of the subject, which greatly impressed Arghūn. And as he was leaving for the hunt, he said to the Maulānā [i.e., Shīrzāī]: “When I return, come so that we may speak some more, for you speak wonderfully.” He then pointed to Saʿd al-Daula [the vizier] and indicated that they bring all three, meaning Amīrshāh, Fakhr al-Dīn Mustaufī, and the son of Hajjī Laylī, for they had taken all three from Rūm and had brought them. And Maulānā Shīrzāī reproached Saʿd al-Daula in regard to Amīrshāh, and hastened him after the King, thus winning

We will meet Amîrshâh again in Chapter Three. The administrator of the loan taken by the Seljuk rulers from the Mongol treasury, Amîrshâh was also the dedicatee of the Tuhfa/Offering, and thus a former patron of Shîrâzî. That Shîrâzî appears to have been able to chasten the vizier with respect to a prisoner and that he was even able to win the prisoner's release indicates the extent of his authority during this period.

The second episode does not appear in the copy of the Jami‘ al-Tawârîkh that was the main reference for this study. It is included by Thackston in his translation of the Jami‘ al-tawârîkh with a footnote stating that the text is absent from all manuscripts save a few. The fragment which references Shîrâzî is reproduced here from Thackston's translation:

[In addition to building, Arghûn] was also enthralled by alchemy, and alchemists came to his court from far and wide to encourage him in this art. Untold amounts of money were spent on it, but he never chided them for it and even cheerfully authorized more expenditures. One day an extremely subtle point was discussed in the presence of Maulânâ Qutbuddin Shîrâzî. When the alchemists had left, Arghûn said to the Maulânâ [i.e., Shîrâzî], “Since I am only a Turk and you are a wise man, do you think these people are taking me for a ride? I have often wanted to put them to death, but since it is certain that this science exists and there must be someone who knows about it, if I withdraw my patronage from these ignorant men and put them to the sword, that one learned person will not trust me.” In short, during Arghûn Khân's reign the alchemists spent untold amounts on their various experiments, but after much experimentation and tests, the veil of doubt was lifted from everyone's eyes, and nothing had been achieved other than financial loss and ruin.

This episode which is referred to in this fragment is undated, appearing instead under the title "Part Three, on [Arghûn's] conduct and character; the pronouncements and orders he gave; incidents that occurred during his reign that were not included in the previous two sections but learned from various persons.” The “lifting of the veil of doubt” in regard to alchemy could not

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129 Rashîd al-Dîn Tabîb, Jâmi‘ al-tawârîkh, 822-823. Shîrâzî would have been fifty-five years old.
130 Rashîd al-Dîn Tabîb, Jâmi‘ al-tawârîkh, edited by Bahman Karîmî (Tehrân: Iqbl, 1338)
131 Rashîd al-Dîn Tabîb, Rashîduddin Fazlullah's Jami‘ u’t-Tawarikh = Compendium of Chronicles, 577.
132 Rashîd al-Dîn Tabîb, Compendium of Chronicles, ibid.
have referred to the ruler himself, however, for in Rashīd al-Dīn's final chapter on Arghūn's life we see him still consorting with his alchemists:

Arghūn Khān’s belief in holy men and their customs was extremely strong, and he always sponsored and promoted that group. From India there came a holy man and claimed [the knowledge to] a long life. They asked him through what means is the life of holy men prolonged there? He said through a special draught. Arghūn asked him whether the draught was found locally. He said it was. Arghūn obliged the fashioning of it. The holy man produced a brew which contained Sulphur and Mercury. And he [i.e., Arghūn] partook of it for eight months at the end of which he spent forty days in seclusion in the fort of Tabriz, and at that time no mortal was with him, except Orduquya and Qucan, and Sa’d al-Daula, and the holy men who were constantly present and busy discussing their beliefs. When he left seclusion he decamped for Alatāgh and there an ailment appeared suddenly upon his humours, and Khwāja Amīn al-Daula, who was the physician at court, exerted himself, together with the other physicians, so that after a bit through their wise words some signs of health reappeared. [But] suddenly one day a holy man came and gave Arghūn three glasses of wine. Since he was still convalescing the illness returned and became terminal. And the doctors were unable to cure it and after two months of his sickness the generals started discussing and searching for the causes of his illness. Some said that the cause was the evil eye and that alms-giving was thus necessary, and some admitted that the shamans (who observed portents through the “art of the scapulae”) were saying that the cause for the illness was sorcery and they placed the accusation on Tughanjūq Khatun and through the beatings and the tortures of her trial they interrogated her and finally they drowned her and some other women. And this occurred on the 16th of Muḥarram of the year 690 A. H., and the Lord knows the truth of things.  

According to Rashīd al-Dīn, Arghūn commenced on taking the draught c. Ramadan of 688 A. H. (September 1289 C. E.): “On the fourth of Ramadan of 688 Arghūn Khān decamped in Marāgha and toured the observatory – and he commenced on drinking the black drug, that will be described henceforth, at that location [i.e., at Marāgha]. He then left for the cold-weather camp at Aran.” It is difficult to know what to make of this tantalizing fragment, other than to emphasize the clear association of Marāgha with the alchemical draught. The passage quoted earlier with respect to Arghūn’s patronage of the alchemists has an interesting parallel in the final

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133 Rashīd al-Dīn Ṭabīb, Jāmiʿ al-tawārīkh, 824.
134 Ibid., 821.
chapter of Hülegü's life which raises, at least, the possibility that Hülegü may have dabbled with alchemically produced potions and their purportedly life-prolonging qualities, as well. Interestingly, this account also includes as the setting of its preamble the observatory at Marāgha; a connection that was already noted in the excellent survey by Sayılı:135

When fall arrived, aiming for the warm-weather camp at Zarrîneh-rūd, [the river] which the Mongols call Jaghātū, he [i.e., Hülegü] arrived at Marāgha and exerted himself in the completion of the observatory. And he loved knowledge exceedingly, and would encourage scientists in the pursuit of the ancient sciences (awā‘il) and he had assigned salaries to all, and had embellished his court with the presence of the scientists and learned men, and he was interested in the science of alchemy, and [thus was] keenly interested in this group [i.e., the alchemists]. They lit many flames and burnt many drugs and blew through many useless bellows, large and small, and they had constructed pots from the “clay of wisdom,” yet the concoctions only benefitted them as far as their breakfast and dinner meals. They were ineffective as far as transmutation was concerned but in dishonesty and duplicity they had miraculous powers. They were unable to fuse a single dinar, nor were they able to mould a single dirham, yet they scattered the stores of the workshop of Divine Power to a place of oblivion and nonexistence. So much was spent on their provisions, desiderata, and stores that Qarun himself … had not been able to produce during his entire life [through the use of his elixir].136

I will discuss the possibility of the presence of a non-Islamic tradition of alchemy at Marāgha in Chapter Six. Here we note that, if Hülegü's death, which as we saw involved the sudden return of symptoms such as weakness and an undefined symptom “upon his body” (a rash, perhaps?), was due to the ingestion by mercury or other toxic substance, then the irony of Rashīd al-Dīn's observations on the wastefulness of alchemy is amplified. As it is, Rashīd al-Dīn's account indicates that Arghūn, most certainly succumbed to voluntary poisoning, and that Hülegü may very well have done the same.

5. Culminating Crisis: Gaykhātū (1291-1295 C. E.) and Baydu (1295 C. E.)

Subsequent to Arghūn death, it was his brother Gaykhātū who succeeded him. As with

135 Sayılı, The Observatory in Islam and Its Place in the General History of the Observatory, 193.
136 Rashīd al-Dīn Ṭabīb, Jāmiʾ al-tawārīkh, 734.
his uncle, Tegüder Ahamd, the beginning of his reign triggered a crisis of succession. The rival
claimant in this case was Baydū, Gaykhātū's cousin; and Hülegū's grandson through his fifth son,
Taraqai. Gaykhātū, as he appears in Bar Hebraeus and other historians, is a dissipated monarch
given to debauchery with minors, forcing many of the Mongol nobility to send their children
away to outlying districts. His short reign included a military campaign to Anatolia, but none
against the Mamluks.

Rashīd al-Dīn refers to Gaykhātū's introduction of paper money, at the instigation of his
Ṣahib Dīwān Sadr al-Dīn Zanjānī and other courtiers, as an “account of the inauspicious chau.”

Describing Gaykhātū's endorsement of this plan, Rashīd al-Dīn writes:

“[Since] Gaykhātū was an extremely liberal (sakhī) monarch and
gave liberally [so that] the wealth of the entire world could not
satisfy his generosity, he approved it.... And on the Monday of the
nineteenth of Shawwāl of 693 A. H., they presented and set into
circulation the chau in Tabriz, and it had been decreed that whoever
would not accept it would be executed instantly. For a week they
took it, fearful of the sword .... And most of the population of
Tabriz had been forced to leave and goods and foodstuffs had been
removed from the bazaar, so that nothing was left, and the people
took refuge in the orchards, and a city of such dense population was
utterly emptied of its people and the thugs and hooligans would
strip of his belongings whomever they found in the streets.

Rashīd al-Dīn writes that angered people mobbed a Quṭb al-Dīn “on a Friday in the

al-tawārīkh*, 681.
138 Bar Hebraeus, *The Chronography of Gregory Abū'l Faraj, the Son of Aaron, the Hebrew Physician, Commonly
Known as Bar Hebraeus*, 494; B. Spuler, “Gaykhātū,” in *Encyclopaedia of Islam, Second Edition*, Edited by: P.
140 Rashīd al-Dīn Ṭabīb, *Jāmi’ al-tawārīkh*, 835; Also Bar Hebraeus for the “immeasurable liberality of hand”
which appears to be connected to his dissipated lifestyle (i.e., a lack of moral discipline in conjunction with a lack
of fiscal discipline) “Whosoever hath in his hand silver, and doth not carry it to the offices of the Government
to be stamped therein with [the word] Shaw, and giveth it up and taketh [in exchange] Shaw shall die the death.’
And thus men remained in a state of great tribulation and indescribable difficulty for a space of two months.”
Bar Hebraeus, *The Chronography of Gregory Abū'l Faraj, the Son of Aaron, the Hebrew Physician, Commonly
Known as Bar Hebraeus; Being the First Part of His Political History of the World*, 496.
congregational mosque.” Though not identified further, this Quṭb al-Dīn figure is almost certainly not our Quṭb al-Dīn but is rather the brother of Ṣadr al-Dīn Zanjānī (i.e., the mastermind behind the fiasco), who is identified as a chief judge in his own right, in the preceding chapter of the chronicle. The experiment with paper money was a miserable failure, and appears to have petered out on its own once officials determined that it was unworkable. Gaykhātū's rule did not outlive this fiasco by long. He was forced to deal with an insurrection by Baydū that ultimately ended his rule. He was executed on Thursday, the Sixth of Jumāda al-ūlā of 694 A. H. (March 24th, 1295). Though the reign of Gaykhātū is not particularly relevant to our study of Shīrāzī, we have looked briefly at his reign both to provide a sense of historic continuity as well as to highlight the fact that there exists a likelier candidate for the Quṭb al-Dīn that makes his appearance in it, than our Shīrāzī. Indeed, as we will see in Chapter Three, the reign of Gaykhātū (together with the very brief reign of Gaykhātū's successor, Baydū) is the only era during Shīrāzī's adult career in which there does not exist any evidence for the presence of Shīrāzī at the Ilkhan court.

In loyalty to his employer Rashīd al-Dīn includes the account of the short reign of Ghāzān's rival, Baydū, in the chapter devoted to Ghāzān himself. Since the account is of recent historical events the narrative achieves a level of detail that is lacking in earlier chapters. Rashīd al-Dīn's narrative of Baydū culminates with his capture by the capable general Naurūz, roughly six months after taking the reigns of power. Upon hearing his request for a private audience, Ghāzān (Hülegū's grandson through Arghūn) requests instead that he be “finished off where he is,” with the execution occurring in the “evening on Wednesday, the twenty third of

141 Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, 836.
142 Ibid. 833; Rashīd al-Dīn Ṭābīb; At least one modern translation identifies this Quṭb al-Dīn with our Quṭb al-Dīn Shīrāzī, Rashīduddin Fazlullah’s Jāmi’ u’t-Tawārīkh = Compendium of Chronicles, 808.
143 Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, 836; Bar Hebraeus, The Chronography, 496.
144 Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, 883.
145 Rashīd al-Dīn Ṭābīb, Jāmi’ al-tawārīkh, 915.
Dhū al-Qa‘da, 694 A. H. [Oct. 4, 1295].”¹⁴⁶

6. Reformation and Recovery: Ghāzān (1295-1304 C. E.)

Ghāzān is recognized for reversing the ruinous fiscal policy of his predecessor Ilkhanid rulers. Rashīd al-Dīn's ʿJāmiʿ al-tawārīkh, which includes within it some of Ghāzān's reform-minded proclamations, is the authoritative historical source for his reign. Ghāzān's reforms include a restructuring of the taxation system, a repeal of the expectation that Ilkhanid subjects provide quarters for travelling military and official personnel, a limiting of the burden on the Ilkhanid subjects of the provision of carriage animals for the governmental business, as well as other measures.¹⁴⁷ Morgan and others have pointed out that Rashīd al-Dīn was not an impartial observer in regard to his employer,¹⁴⁸ and it is certainly not surprising that Rashīd al-Dīn would have exaggerated the beneficence of his master, Ghāzān, as well, perhaps, as the abuses perpetrated by his forebears. However, the reforms by Ghāzān of the exploitative system of taxation (which as the ʿJāmiʿ al-Tawārīkh fragment at the beginning of the chapter indicates had driven entire regions into ruin) were very likely effective in salvaging the plight of the Ilkhanid subjects (and of the peasants, especially) -- as can be seen in the appreciable rise of agricultural production during his reign.¹⁴⁹

As we have noted Ghāzān's conversion to Islam is a topic to which Rashīd al-Dīn's devotes a considerable amount of space. An unfortunate side-effect with Ghāzān's conversion to Islam, however, was the reversal of the decades long Ilkhanid policy of tolerance for the various religious practices of their subjects: “And on Wednesday the twenty-fourth of Dhū al-Qa‘da, of the year 694 A. H. [Oct. 4, 1295 C. E.] it was proclaimed that in the capital Tabriz, and in

¹⁴⁹ Ibid., 495-496.
Baghdad and the other regions of Islam all of the temples of the shamans and the Buddhists and the churches and the synagogues be destroyed.”

Ghāzān's accession was complicated by rebellions that, at their root, were due to the crisis of succession at the end of Gaykhātū's reign. The situation appears to have taken several years to sort out, and was only settled after the execution of a rather long list of claimants to the royal throne. Also significant were a series of rebellions in Rūm (Anatolia), several of these by the Mongol overseers themselves (who were aided by various local factions). These were put out by Ghāzān by 1299 C. E. The Seljuks of Rūm, in whose polity Shīrāzī had spent some years as a young man, disappeared from the historical record in the first years of the following century, outliving these final spasms of violence by a handful of years, at most. Cahen notes the curious nature of the disappearance of the once powerful Seljuks of Rūm by stating that the “Sultanate disappeared in a manner so obscure that contemporaries do not mention it and authors who tried to account for it in retrospect disagree in regard to both dates and facts.”

Ghāzān's war against the Mamluks includes the military campaign of 1299 C. E./699 A. H. in which the Mongols were victorious, and temporarily occupied Damascus. A final

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150 Rashīd al-Dīn Ṭabīb, Jāmi‘ al-tawārīkh, 908; Waṣṣāf al-Ḥazrat, Tahrīr-i tārīkh-i Waṣṣāf, 223. That traditional Mongol beliefs and practices outlasted this forceful top-down conversion effort can be seen, however, in an episode that appears in Kāshānī's history of Ghāzān's successor, Öljeytü. Of particular interest are several episodes in the year 709 A. H. (1309 – 1310 C. E.). A heated debate between the supporters of the Ḥanafī and Shāfi‘ī schools in the court of Öljeytü appears to have been particularly vexing to the ruler. Öljeytü, who was born in 680/1282 and thus presumably followed Buddhism and the shamanism of his ancestors, not converting to Islam until the accession of his father, when he was fifteen – appears to have cut short his audience by storming out. Subsequently, high-ranking officials had complained audibly for the good old peaceful days of the Mongol yasa system. ‘Abd Allāh ibn ‘Alī Kāshānī, Tarīkh-i Īljeytū, Tarīkh-i pādishāh-i sa‘īd Ghiyath al-dunya va al-Dīn Īljeytū Sultān Muḥammad (Tehrān: Bungah-i Tarjumah va Nashr-i Kitāb, 1348), 96. In the same year a lightning strike killed several courtiers, in the presence of the frightened ruler, forcing him to reconsider his religious convictions. “The amirs conveyed [to the Ilkhan] that according to the old conventions and the yasa of Chingiz Khan [he should be cleansed by fire]. They assembled the shamans who were in charge of this and said: this frightful lightning and incendiary and ruinous[?] bolt is due to the ill omen of Islam and muslims. Should the King abandon the daily prayers and the adhan recital … his passing through fire would be successful.” Kāshānī, Tarīkh-i Īljeytū, 98.

151 Cahen, Pre-Ottoman Turkey, 300-301.
152 Cahen, Pre-Ottoman Turkey, 301.
153 It is not known with certainty why the Mongols subsequently abandoned Syria, only to make a second unsuccessful attempt to retake it in the winter of 1300 C. E./700 A. H.
campaign against the Mamluks, in 1303 C. E./702 A. H., however, resulted in a decisive defeat of the Mongols.154

On the cultural front, it was Ghāzān who commissioned Rashīd al-Dīn to compose his history.155 Waṣṣāf also mentions his construction of an observatory in Tabriz, as part of a large complex that was started in 697 A. H. and finished in 702 A. H.156


Though Rashīd al-Dīn was alive during the reign of Öljeytū and appears to have written a history of his reign, this history has not survived.157 Our main sources for the reign of this ruler are instead Kāshānī's Tāreh-kh-i Oljaitu, Waṣṣāf's history, as well as histories by Mustaufī, and Banākatī.158 It is through Kāshānī's text that we learn of Öljeytū's siege of the fort of Rahba on the Western bank of the Euphrates, in April of 1313 C. E. This event, that was instigated by a group of renegade Syrian amirs, was to be the last Ilkhanid expedition against their arch-enemies, the Mamluks.159 Despite this military campaign, which appears to have been a short and inconclusive affair and a 1314 C. E. conflict with the Chaghatai army in the east, Öljeytū's reign is generally characterized as a relatively peaceful one.160

Of relevance to our discussion is a fascinating episode in Öljeytū's career that involved a

156 Waṣṣāf al-Hazrat, Tahrīr-i tāreh-kh-i Waṣṣāf, 229.
157 Morgan, “Rashīd al-Dīn Ṭabīb.”
military campaign against the region of Gilan.\textsuperscript{161} This episode is remarkable partly due to the fact that Gilan is located virtually at the heart of the Ilkhanid realms. That the region would require pacification a half-century after the arrival of Hülegü in Persia is, therefore, something of an enigma.\textsuperscript{162} Though this episode appears in a number of Persian and Mamluk sources the details are not clear. It appears as though the campaign ended with a disastrous defeat on the part of the Mongols, forcing the Persian sources (who were generally loyal to the Ilkhans) to whitewash this uncomfortable fact.\textsuperscript{163} The geography of the region – as characterized both by the rugged topography of the Alburz range, and by its heavy rainfall – was no doubt a factor in the defeat of the Mongols. One of the local rulers of Gilan, Amira Dabāj, who appears briefly in these accounts is the dedicatee of Shīrāzī's encyclopedic work the \textit{Durra/Pearl}. The significance of this fact for our study of Shīrāzī's life is discussed in Chapter Three.

It should also be noted here that Öljeitü was responsible for moving the capital city from Tabriz, where it had been from the time of Abāqā, to the town of Suľāniyya. Öljeitü's mausoleum, recognized as a supreme instance of Persian architecture during the Ilkhanid era, still stands in Suľāniyya, where it was once part of a large religious complex.\textsuperscript{164} It thus appears as though Shīrāzī was to live the last portion of his life a distance away from the politics and the hustle and bustle of the capital. If the accounts of his sufism are to be believed, this likely would have been a welcome change for him.

8. The Waning Years: Abū Sa‘īd (1316 - 1335)


\textsuperscript{162} Kāshānī mentions the ruler of Gilān as having paid homage to Hülegü upon the Mongol rulers arrival in Persia. Kāshānī, \textit{Tarīkh-i Īljāyatū}, \textit{Tarīkh-i Pādishāh-i Sa‘īd Ghiyath al-dunyā va al-Dīn Īljāyatū Suľān Muḥammad}, 57.

\textsuperscript{163} Melville, “The Ilkhan Öljeitü's Conquest of Gilān (1307): Rumour and Reality,” 118.

Coming to power after the death of his father in 1316, Abū Ša‘īd was the last of the Ilkhanid line to rule Persia. His death in 30 November 1335, which may have been by poisoning, precipitated a crisis of succession and a prolonged power struggle. That his death marked the end of an era can be seen from the fact that the historical records suddenly fall silent about the details of these power struggles in which the protagonists were soon, in Boyle's words, so insignificant “that we are not even informed as to the time and manner of their death.” Thus the rule of the Ilkhanid dynasty ended with a whimper that was a faint echo of the demise of their vassals, the Seljuks of Rūm three and a half decades earlier.

As we saw Quṭb al-Dīn died five years prior to the accession of Abū Ša‘īd and so the history of the Abū Ša‘īd's reign is not directly relevant to our discussion. It should also be noted here, however, that it was during the reign of Abū Ša‘īd that the great statesman and remarkable historian Rashīd al-Dīn, who, along with Juwaynī, has left us the most important and detailed chronicles of this important period, finally succumbed to the intrigue of the Ilkhanid court and was executed. His charge was the poisoning of Öljeitü.

D. Some Observations in Regard to the Mongols and their Patronage of the Sciences

Having briefly reviewed the dynastic history of the Ilkhans and of their Mongol forbears in Persia I will now attempt a provisional interpretation of the historical record in regard to the patronage of the sciences and especially of astronomy in this period. While recognizing the violence of the original campaigns early in the 13th century (a cataclysm that led not only to the demise of entire cultures in central Asia and is linked, as well, to the extinction of certain cultural traditions such as the production of sumptuous textiles in eastern Persia and the

166 Morgan, Medieval Persia, 1040-1797, 79.
disappearance of mīnāʾī ceramics, for example\textsuperscript{169} modern studies on the Mongols point out the culturally productive conditions of the subsequent decades: the patronage of luxury goods, the facilitation of trade across the Asian landmass along with the concomitant diffusion of new ideas of governance and religion, as well as the diffusion of various technologies related to arts and crafts through the relocation of artisans. Though the situation with science and scholarship is not clear, these cultural enterprises presumably would have experienced a fate similar to that of other cultural traditions of the afflicted regions. It wouldn't be surprising if certain scholarly and scientific traditions of the eastern Islamic world did not survive the conflagration (that had had, as we saw, the wholesale slaughter of urban populations as one of its characteristics), while others managed to survive and perhaps even to be enriched by the culturally conducive factors listed above.

It perhaps bears pointing out here that the region afflicted by the military campaigns of the Mongols was one with a distinguished intellectual tradition. When the last of the Chingiz's armies withdrew from Persia in 1226, the formerly bustling population centers that, according to the historical record, had been transformed to grizzly killing fields on an unimaginable scale (as we saw in the case of Balkh, Herat, Merv, Nishapur, Tus) were many of the same that in earlier centuries had nurtured some of the luminaries of Islamic culture. A discussion of the factors that had led to the amazing military success of the Mongol armies is not within the scope of this study.\textsuperscript{170} It is, however, worth remembering that had the conditions that allowed for the blinding success of Chingiz Khan and his army coalesced two centuries earlier, the resulting disruptions would have been contemporaneous with the lives of such luminaries as Bīrunī, Ghazzālī, Ibn Sīnā (Avicenna), Rāzī (Rhazes), and Khayyām, and might very likely had a withering effect on the cultural milieu in which these well-known scholars were born and raised.\textsuperscript{171}

\textsuperscript{171} In what can only be seen as a testament to the quality of scientific production in Persian-speaking lands in both
There are, needless to say, factors that complicate a study of the impact of the Mongol campaigns on the scientific production of the era; among them the compounding effect of earlier trends (see the introductory section of this chapter) and the fact that the events themselves no doubt represent a partial obliteration of historical data that may be particularly difficult to reconstruct and interpret after a span of eight hundred years. In a study based on biographical dictionaries covering the 8th to the 13th century C. E. Bulliet observes a percipitous decline in the scholarly activities of Persian scholars in the early decades of the eleventh century. This decline is therefore considerably earlier than the 13th century, and has ultimately been linked by Bulliet to environmental factors that affected the lucrative cotton crop of Persia.\footnote{Richard Bulliet, “Abu Muslim and Charlemagne,” in Community, State, History and Changes: Festschrift for Prof. Ridwan al-Sayyid (Beirut: Arab Network for Research and Publishing, 2011), 25-26. See also, Richard Bulliet, \textit{Cotton, Climate, and Camels in Early Islamic Iran} (New York: Columbia University Press, 2009), 142.} It is hoped that in due course enough studies are carried out on the surviving manuscripts themselves (both of the Mongol and preceding eras) to enable scholars to form a concrete picture of what traditions of scholarship were obliterated or transformed by the military campaigns of the Mongols under Chingiz Khan. In Chapter Five the work of the great historian Ibn Khaldūn will be examined briefly, and his comments on Persian scientists will be used to suggest, at least, that the impact of the Mongol campaigns on the cultural production of the Persia was considerably more obvious to medieval historians than they are to modern scholars of the Mongol period.

A Mongol practice that has been cited as a factor for cultural productivity in periods subsequent to the original Mongol campaigns is that of the relocation of war-captives who possessed artisanal skills to faraway destinations. Some of the buildings of Karakorum, for instance, are said to have been built with the assistance of “muslim” masons.\footnote{Juwaynī, \textit{Genghis Khan}, 237.} Though the account of Juwaynī was written some thirty years after the initial campaign and a certain
blurring of details may have occurred, it is important to note that while artisans (and occasionally young women) are mentioned by him as having been relocated as war-captives there is no mention of a similar policy for scholars.\textsuperscript{174} Indeed, given the tenor of the historical narratives of the Mongol campaigns under Chingiz, and their affinity to particularly large and highly-organized pillaging campaigns it is not unreasonable to assume that these conquests would not have had their policy the need to preserve scholars and the scholarship of the conquered lands in western Asia. Some Persian-speaking scholars would no doubt have preserved to act as interpreters and functionaries in the bureaucracy of the Mongol empire, especially in the Persian-speaking areas to the north and north-east of the Oxus river. Yet the extent of the destruction argues against a policy of preservation of war captives except in the most limited sense (e.g., artisans).

It is also not unreasonable to assume that during the era of the viceroys the scientists and intellectuals who had lived in the lands that had been on the war-path of the Mongol armies, would have had greater concerns than the pursuit of knowledge or the seeking of patronage for such pursuits. In Harawī's account of the aftermath of the fall of Harāt we read that a small number of survivors (twenty to forty souls) lived initially on “the flesh of humans and of dogs,” and that for the subsequent four years they were forced to prey on passing caravans for survival.\textsuperscript{175} Harawī also relates that “from the year 619 A. H. to 634 A. H. (i. e., 1222/1223 to

\begin{itemize}
\item \textsuperscript{174} Juwaynī, \textit{Genghis Khan}, 107; Sayf ibn Muḥammad ibn Yaʿqūb, \textit{The Taʾrīkh Nāma-i-Harat (The History of Harāt)} of Sayf Ibn Muḥammad Ibn Yaʿqūb Al-Harawi, 81.
\item \textsuperscript{175} Sayf ibn Muhammad ibn Yaʿqūb, \textit{The Taʾrīkh Nāma-i-Harat (The History of Harāt)} of Sayf Ibn Muḥammad Ibn Yaʿqūb Al-Harawi, 81-90. Harawi describes the transformation of the once-bustling metropolis of a hundred-thousand souls to an eerie moonscape as follows: “And in these four years, the few places in the city that had remained undamaged collapsed by virtue of the falling of the rain and the density of the snow, and the city became a place of such [terror] it was as though at each rest a ghoul [was hiding] or at each step [one could hear] a keening wail.” Ibid. 90.
\end{itemize}

In the same source we read that, as Chingiz Khan had followed a scorched earth policy, “from the environs of Balkh to Damghan people ate the flesh of humans, dogs and cats for one year.” This indicates that the campaigns managed to blight not merely the cities that had been targeted militarily but to destroy the entire countryside as well, as the agricultural systems of the whole region collapsed. Ibid. 87.
1236/1237 C. E.) the city was a ruin; so that in these fifteen years no creature lived here, other than the occasional brigands [āyyār] that were either in Harāt or in the [nearby] foothills.”

Under these conditions it is likely that the scientists who had survived the onslaught and would have had the ability would have sought refuge and patronage in well-defended locations, as in the case of Ṭūsī who, in this period, joined the Ismailis with their virtually impregnable forts.

To imagine the pace of the recovery during the reign of the viceroy (i.e., the three decades separating the withdrawal of Chingiz and the arrival of his grandson Hülegü) and of the Ilkhans, we need only note that by the time Qazwīnī was writing his Nuzhat al-qulāb during the reign of Ghāzān (i.e. a little under a century after the original conflagration), of those destroyed cities that had been rebuilt many were done so in reduced forms: towns had been transformed into small towns or villages (and small towns to villages, etc). Indeed, among the towns that were rebuilt in such reduced circumstances Qazwīnī lists a considerable number; we note here Qum, Sīrāf, Mīāneh and Kermānshāh as examples. However, Qazwīnī is careful to point out as well that many of the towns (such as Khurrābād, Saimara, Arrajān, and Dārābjird) were still in ruins in his time, nearly a century after their destruction. Indeed, some of the major

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176 Ibid., 93.

177 Mudarris Razavi, Ahwāl waAthār-i Muḥammad Ibn Muḥammad Ibn al-Ḥasan al-Ṭūsī, 4. Several historical sources state that Ṭūsī was held by the Isami’īs against his will. Ibid. Certainly anti-Ismaili factionalism and the desire to rationalize Ṭūsī’s long stay with the Ismailis should be accounted for when interpreting these accounts. In the conclusion to his commentary on Avicenna’s Kitāb al-ishārāt wa al-ṭanbīḥāt (or “Book of Directives and Remarks”), which was completed in the middle of Ṣafar, 644 A. H. (c. the beginning of July, 1247 C. E.) Ṭūsī speaks of “having written the majority of the book in such straitened circumstances, that it would be impossible to imagine worse.” Razavi interprets this as indicating Ṭūsī’s difficulties with the Ismailis. In my mind the reference could be to the desolation induced by the war, for he also writes: “And [as for] the continuance of my life – its [military] ruler are my sorrows, and its soldiery are my anxieties.” Ibid. 7.


population centers of medieval Persia—Rayy, Marv, Balkh, notable among them—were abandoned permanently or were left as ruin-fields for centuries. Given the evidence of the historical record the impression can not be avoided that parts of the Persian-speaking world, at last, were transformed to virtual moonscapes or at best configured into vast expanses used as grazing fields for the vast herds of pastoralist conquerors. It is perhaps not surprising, then, that the decision to formally consolidate the Mongol holdings in Persia only happened in the sixth decade of the century. While internal factors involving politics of the Mongol rulers and population pressures were no doubt important, it was also perhaps the case that by this point enough of a recovery had taken place to make a full-scale occupation worthwhile in the first place.

As we have noted before, areas that were fortunate to not experience the Mongol armies directly would have felt the disruptions to a considerably lesser degree. Shīrāzī's home-province of Fars was one such area. We will look at Shīrāzī's life in Chapter Three. Here we merely point out that as far as we can discern from the biographical material regarding Shīrāzī, that his youth and his education do not appear to have been affected by the turmoil caused by the Mongols. Yet, as an intellectual and courtier Shīrāzī would have been frequently reminded of the political
realities of his own era that had directly resulted from the trauma earlier in the century. There is little doubt that during his travels (particularly to Khurāsān) he would have witnessed first hand, the midden-heaps to which Juwaynī refers, and which would have been a constant reminder of the violent events that had so recently affected the region.

Möngke Khān's request that Ṭūsī be sent to Karakorum belongs to the end of the viceroy era. And it may be one of the earliest records of a policy to preserve scientists from the Islamic world for the benefit of the Mongol rulers. This in turn could only have been possible due to an increased culturalization by the conquerors and an appreciation of the culture of the conquered lands and of the scientists from among the subject population of Persia. That intellectuals had been prized earlier as administrators is demonstrated by ‘Alā’ al-Dīn Juwaynī's career itself, but the case with Ṭūsī suggests that perhaps the project to attract the best scholarly “talent” of the far-flung Mongol empire to its center was widened at some point during the reign of the viceroy to include scientists as well. On the great Khan's recruitment effort Rashīd al-Dīn writes:

From among the kings of the Mongols, Möngke Qā’ān had been distinguished by [great intelligence, perspicacity, and judgement], to the level that he had solved some of the problems of Euclid. His exalted will … had obliged the building of an observatory. He appointed Jamal al-Dīn Muhammad ibn Ṭāhir ibn Muḥammad al-Zaydī Bukhārī to carry out the project, yet some of the [operational details] were unclear to him, while [at the same time] the reputation of the superior learning of Ṭūsī had been as globe-traversing as the wind. At the time of leave-taking [Möngke] had asked his brother that, as soon as the forts of the unbelievers had been taken, he send Khwāja Naṣīr al-Dīn [back to Karakorum]. Yet at the time [of the fall of the Ismaili forts], since Möngke Qā’ān was preoccupied with the conquest of the lands of the Manzī [i.e., in China] and was thus away from his throne, Hulakū decreed that he should build the observatory [in Persia] for he had become aware of [Ṭūsī's excellent qualities].

Thus, according to Juwaynī, the building of the Marāgha observatory was due to the opportunism of Hülegü, during his campaign of 1256 C. E.

Hülegū's campaign has been compared for its violence to the campaigns of Chingiz

183 Rashīd al-Dīn Ṭālibīb, Jāmi‘ al-tawārīkh, 718.
during 1216-1225 C. E.\textsuperscript{184} This is surely unfair. While the historical record offers glimpses of uprisings and resistance against his campaign (uprisings that would no doubt have resulted in violent punitive measures) the intensity of the earlier campaigns and the wide geographical extent of the destruction is not reflected in any of the historical accounts.\textsuperscript{185}

Yet neither was Hülegü a particularly benevolent ruler (as has been recently suggested by some Mongol historians).\textsuperscript{186} For, thanks to the work of Petrushevsky and others, who have examined the historical evidence of agricultural production and tax revenues for Persia under Mongol rule it is possible to trace the precipitous economic decline of Persia in the thirteenth century subsequent to the invasion of the Mongols.\textsuperscript{187} The exploitation of peasant farmers through arbitrary and often draconian taxation, and the heavy environmental impact of the great numbers of newly-arrived nomad pastoralists were factors that contributed to the onerous economic conditions of Persia during this period.\textsuperscript{188}

In discussing the social policy of the Ilkhans Petrushevsky identifies two competing processes within the Mongol aristocrats and the Persian elites allied to them: a process that aimed at “the creation of a strong central authority in the person of the Il-Khan and the adoption by the Mongol state of the old Iranian traditions of a centralized feudal from of government,” as well as a trend that was “antagonistic to settled life, agriculture and to towns,” and supported “unlimited, rapacious exploitation of settled peasants and town-dwellers.”\textsuperscript{189} Writing of the

\textsuperscript{184} Komaroff, “Introduction: On the Eve of the Mongol Conquest,” 3. In contrast, the effort to portray Hülegü as an enlightened warrior/ruler is a rather curious historical project that has gained in popularity. One of the most active proponents of this revisionist school is George Lane; see Genghis Khan and Mongol Rule (Westport, Conn: Greenwood Press, 2004), 60 - 62.

\textsuperscript{185} See Juwayni, Genghis Khan, 615.

\textsuperscript{186} One of the most active proponents of this revisionist school is George Lane; see Genghis Khan and Mongol Rule (Westport, Conn: Greenwood Press, 2004), 60 - 62.


\textsuperscript{188} Petrushevsky, “The Socio-Economic Condition of Iran Under the Il-Khans,” 490.

\textsuperscript{189} Ibid., 491.
second trend Petrushevsky states: “These representatives of the military feudal-tribal steppe aristocracy regarded themselves as a military encampment in enemy country, and made no great distinction between unsubjugated and subjugated settled peoples. The conquerors wished to plunder both … the former by seizure of the spoils of war, the latter by exacting burdensome taxes. The supporters of this policy did not care if they ended by ruining the peasantry and the townspeople; they were not interested in their preservation. The most self-seeking and avaricious members of the local Iranian bureaucracy supported the adherents of this … trend, as did the tax-farmers, who closely linked their interest to that of the conquerors and joined with them in the plunder of the settled population subjected to taxation – the raʻyat.”

It appears as though it was the policy of this second group that predominated the rule of Hülegü and his successors up to and including Baydū. The resulting enfeeblement of the economy, enervated by the turmoil of the previous decades, was no doubt factors that ultimately forced the economic reforms of Ghāzān, for which Petrushevsky credits the chief administrator (and historian) Rashīd al-Dīn, himself. Petrushevsky has traced the positive effect of the policy shift under Ghāzān, chronicling in the process the miserable state of an agrarian economy teetering on the edge of collapse due to decades of depredation and misrule.

In so far as the desire for luxury goods is cited as a creative force driving the science and technology of the period, it is reasonably certain that this mode of scientific and technological development was distinct from that which aimed at supporting the "traditional" sciences within the Perso-Islamic realms. It is the second mode that is particularly interesting for our study and of which we can catch glimpses through the works of Shīrāzī and other scholars. This mode of cultural production would likely have been less wide-spread than the first, and as far as its sponsorship was concerned would have certainly been limited to the first group of elites in Petrushevsky's scheme: i. e., those favoring the adoption of local Iranian traditions.

190 Ibid., 492.
191 Ibid., 495.
192 Ibid., 494 - 500.
One of the most notable acts of cultural patronage under the Ilkhan, the building of the observatory at Marāgha, is in many ways a unique achievement, however, and requires its own discussion. While we will see evidence later in the thesis for the association of the observatory complex with alchemy (together with an association with the production of precious metals), we should note that this could not have been the main goal of the observatory itself. In addition as a site for astronomical observations the Marāgha observatory would have represented a new institutional form as far as more academic pursuits were concerned. To obtain a better sense of this new, *sui generis*, form of scientific patronage it is useful, therefore, to look at the history of Hülegü's involvement with this project.

At the fall of Alamut Juwaynī tells us of his ability to visit the library and the observatory. Hülegü is not mentioned in this account at all, and this suggests at least that at this stage the Mongol warlord was not yet overtly concerned with the construction of an observatory. Yet, this situation appears to have changed on the way to Baghdad, suggesting that an adviser (perhaps Ṭūsī, himself) may have convinced Hülegü of the importance of the founding of an observatory in Persia, itself.\(^{193}\) Indeed, the recruitment of al-‘Urdī (who as the builder of the instruments would have been one of the earliest members of the Marāgha observatory team) suggests that by the time of his Syrian campaigns (less than a year after the fall of Baghdad) Hülegü was committed to acquiring the best talent for his observatory. Though the precise circumstance of al-‘Urdī’s trip to Maragheh are not known, al-‘Urdī himself writes that he was unhappy at Marāgha, for being away from his homeland and for being tasked with things that were not “within his main line of work.”\(^{194}\) The tone of frustration suggest that he may have been taken to Marāgha against his will. Indeed, the circumstances of al-‘Urdī's trip to Marāgha may have been similar to Muḥyi al-Dīn al-Maghribī's, whose professional capacities as an


astronomer ensured that his life alone, from among those of his companions at the court of Malik Nāṣir at Damascus, was spared. al-Maghribī's first-person account appears in Bar Hebraeus's history and in it he describes how he saved himself in the nick of time by declaring his profession during the course of an ambush by Mongol soldiers.195 al-Maghribī was subsequently sent to Marāgha, again suggesting that Möngke's project for collecting scientific talent had by this stage been adopted by Hülegū himself.

As we saw Rashīd al-Dīn's account of the founding of Marāgha credits Hülegū (albeit in vague terms) as the person responsible for the founding of the Marāgha observatory.196 Yet, other accounts exist that explicitly credit Ṭūsī as the mastermind behind the Marāgha observatory. These accounts, though of a fabulous nature, are more consistent with the facts that at the outset the observatory project was initiated by Möngke. Furthermore, as we saw, Hülegū was absent in Juwaynī's account of the library and astronomical instruments at Alamut being consigned to flames. The following anecdote in which Ibn Shākir attributes the founding of Marāgha to Ṭūsī appears in the Fawāt al-wafāyāt:

They say that when he [i.e., Ṭūsī] desired to [build the observatory] Hulakū saw what he was longing for, and so said to him: Of what use is this science that is related to the stars? Can what has been ordained be avoided? [Ṭūsī said:] I will show you an example: “[Order O Khān?] someone to climb to that location and to throw from its top a large copper vessel without anyone knowing of it.” So he did so. And when this occurred a great noise [was created] so that all who were present were terrified, some to the point of passing out, but as for Ṭūsī and Hulakū, not a thing happened to them by virtue of their knowledge of what had occurred. So he said to him: “The science of the stars [i.e., astrology/astronomy] has this benefit: he who is conversant in it is aware of what is happening, so the fear that is created for the oblivious and unaware [does not affect] him.” So [Hülegū] said: “There is no harm in this,” and ordered him to commence [in the building of the observatory].”197

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196 Rashīd al-Dīn Ṭabīb, Jāmi‘ al-tawārīkh, 718.
Though there is no way to ascertain Hülegü's feelings on astrology we could perhaps speculate that his appreciation for this art was likely similar to the views of his grandson with respect to alchemy: a recognition of ones ignorance coupled with certainty as to the validity and the critical importance of the esoteric craft.\textsuperscript{198}

It is certainly true that the belief about celestial bodies and how their influence suffused the sublunar realm was universal in the medieval world. It would be a mistake to dismiss the many references to fate and the workings of the celestial bodies in historical works of the period such as Juwaynī's, for example, as figures of speech. In the introduction of his history, Juwaynī follows a declaration of the importance of patronage to literature and to scholarship, with a lamentation on the capriciousness of Fate (one of many that appears in his work):

\begin{quote}
But because of the fickleness of Fate, and the influence of the reeling heavens, and the revolution of the vile wheel, and the variance of the chameleon world, colleges of study have been obliterated and seminaries of learning have vanished away; and the order of students has been trampled upon by events and crushed underfoot by treacherous Fate and deceitful Destiny.\textsuperscript{199}
\end{quote}

While using here some of the rhetorical flourishes that were common to an educated man of his cultural background, there is again little reason to doubt Juwaynī's underlying belief that inexplicable terrestrial phenomena (such as the cataclysm of the Mongol invasions themselves) were caused by the “influence of the reeling heaves.”\textsuperscript{200} The strategic role of the stars and their influence on the events in the sublunar world are also glimpsed in Rashīd al-Dīn's account of the accession of Abāqā, the date of which, as we saw was chosen by Tūsī. Elsewhere in Rashīd al-Dīn's history, in the episode of the siege of Baghdad in which Hülegü consults with his newly acquired adviser in regard to the providential risks associated with his siege of Baghdad.

Though Tūsī's astronomical knowledge is not explicitly part of his counter-argument to those who are opposed to the campaign it is not difficult to imagine how Tūsī's knowledge of the stars


\textsuperscript{199} Juwaynī, \textit{Genghis Khan}, 5.

\textsuperscript{200} Waṣṣāf, \textit{Geschichte Wassaf's}, 100.
would have been an important part of the expertise upon which his and authority rested. Indeed, earlier in the same episode Hülegü asks another of his courtiers by the name of Ḥusām al-Dīn-i Munajjim (i.e., Ḥusām al-Dīn, the astrologer/astronomer) “who had escorted him by order of the Qā’ān (i.e., Möngke) so [as to choose the moment of his] mounting and dismounting [from his horse] to tell, without embellishment all the portents of the stars.”

It is reasonably clear, therefore, that Hülegü's patronage of the Marāgha observatory was due to its importance in the security, prosperity, and success of the ruler and (by extension) of the Ilkhanid state. In his patronage of this institution, he may have perhaps lavished attention similar to that which is lavished today on a research-center focused on cutting edge technology, for the purpose of preserving the security and welfare of the state.

201 Rashīd al-Dīn Ṭabīb, Jāmiʿ al-tawārīkh, 706.
202 The situation is clearly similar with the patronage of the other scientific activity that garners multiple references in the historical sources: that of alchemy. This enterprise would have been viewed in connection to the granting of eternal life to the Ilkhan, as we saw in the episode of Abāqā’s death, it would have been a particularly important recipient of royal patronage.
Chapter 3: Shīrāzī’s Life

A. Introduction

A survey of the biographical information that has reached us in regard to Shīrāzī appears in two publications in Persian: Minovi’s article in the Minorsky festschrift, Yādnāmeh-i Irānī-i Minorsky, and a biography by Mir.¹ Much of this information has in turn been translated into English by Walbridge for use in his book The Science of Mystic Lights.² A brief glance at all three works indicates that in addition to certain coherent features of the various accounts a considerable amount of material has been added to Shīrāzī’s lore by way of accretion in the years that have passed since his death. In this chapter I will review this surviving biographical information on Shīrāzī with an emphasis on the episodes that are presented with some consistency in the earliest surviving sources. For a comprehensive list of the reported events of Shīrāzī’s life the reader is referred to the excellent works by Minovi, Mir, and Walbridge.

The sources for this chapter have been listed in Chapter One (Section C.2). They include Shīrāzī’s autobiography, and the information appearing in the works of Ibn al-Fuwatī (1244-1323 C. E. / 642 – 723 A. H.), al-Dhahabī (1274 – 1348 C. E. / 673 – 748 A. H.), al-Sallāmī (d. 1372 C. E. / 774 A. H.), and Ibn Ḥajar al-‘Asqalānī (1372-1449 C. E. / 773 – 852 A. H.).

In the subsequent sections of this chapter Shīrāzī’s autobiography will be examined first in an effort to identify the key episodes of his life. Material from the other sources listed will be added to both provide additional detail to Shīrāzī’s account as well as to describe those episodes about which Shīrāzī is silent in his autobiographical notes. A comparison with the works by Minovi, Mir, and Walbridge suggests that these authors cover a great deal of what can

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² Walbridge, The Science of Mystic Lights; See also Walbridge, “The Philosophy of Qutb al-Dīn Shirazi; a study in the integration of Islamic philosophy.”
reasonably be said about Shīrāzī's life. A notable exception to this, however, is critical
information that appears in an unpublished section of the Durra/Pearl. I did not have access to
this text, and so relied instead on the works of Mir and Walbridge who have studied the relevant
portions of this work.

B. Shīrāzī's Biographical information in the al-Tuhfa al-Saʿdiya

Shīrāzī's al-Tuhfa al-Saʿdiya is a commentary on the first book of Avicenna's Canon of
Medicine.3 It is the only known work of Shīrāzī that has a biographical introduction, and it is
thus likely that Shīrāzī considered it his major work. Minovi suggests that Shīrāzī wrote a
commentary on the entirety of Avicenna's Canon of Medicine.4 Walbridge doubts that this is the
case, suggesting that Shīrāzī's commentary is limited to the first book of the Canon, i.e., the
kulliyāt or principles.5 As we have said the fragment of Shīrāzī's introduction to his commentary
has been reproduced nearly in its entirety in Mishkat's edition of the Durra/Pearl. This is the
dition that was generally used for the present study. The manuscript Suleimaniya 3649 was
used to fill in the gaps for this text.6

Shīrāzī begins by giving a brief account of his family members and their experience in
medicine:

I was from a household that was famed in this art, … by virtue of
[my family's] success in the treatment and the correction of the
complexions with Jesus-like breathes and Moses-like hands, I [too]
rejoiced, in the bloom of my youth, in attaining and comprehending
it both in detail and in summary. And I engaged in all that was
associated with medicine and with ophthalmology as far as the
manual techniques such as bleedings, extractions, al-tashmīr[?],
and the [treatment of cataracts and of the conjunctiva] and others....
And all of this I did beside my father, Imam Diyaʾ al-Dīn Masʿūd

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5 Walbridge, The Science of Mystic Lights, 186.
6 Quṭb al-Dīn Shīrāzī, al-Tuhfa al-saʿdiya fī al-ṭibb, Suleimaniya MS 3649. In addition a partial Persian
translation of this text appears in Nurani’s edition of the Sharḥ hikmat al-īshtāq. Quṭb al-Dīn Shīrāzī, Sharḥ-i
Hikmat al-Ishraq-i Suhravardi, v - x.
Ibn al-Mušliḥ al-Kāzerūnī ... [who was considered to be] the Hippocrates of his age and the Galen of his day.\(^7\)

At his father's death, Shīrāzī who was still an adolescent was promoted to take his place:

And since I had developed a reputation as one with a good instinct and acumen I was made a physician and ophthalmologist in the Muzaffarī hospital in Shīrāz after the death of my father, when I was fourteen years old. And I stayed there for ten years as one of the doctors who did not desist from studies except to provide treatment ... for the reason that my soul was not satisfied with that which my contemporaries were content ... rather it drove me to exert [my utmost in it] so that I would attain the highest level of achievement.\(^8\)

It was at this stage of Shīrāzī's career that he initiated a project that was to preoccupy him for the rest of his life, the study of Avicenna's *Canon on Medicine*.

So I started [the study] of the principles of the *Canon* with my paternal uncle, the king of scientists ... Kamal al-Dīn Abu al-Khayr Ibn al-Mušliḥ-i Kāzerūnī, and with ... Shams al-Dīn Muḥammad Ibn Aḥmad al-Ḥakim al-Kīshī, then with the savant of the age, Shāraf al-Dīn Zākī al-Būshkānī, since they were famous for the teaching of this work and the distinguishing of the chaff from the grain, while having a clear view to the solution of its problems and the uncovering of its complexities. May the Lord bless them .... Yet, by virtue of this book being the most difficult composed in this art as far as comprehension, and the most straitened in terms of its course, [this due to the inclusion] of sagacious remarks, exact scientific [formulations] and wondrous points and extraordinary mysteries, the minds of the [contemporaries] were perplexed and the strength of others of the moderns failed to reach the apogees of their grains, while having a clear view to the solution of its problems and the uncovering of its complexities. May the Lord bless them .... Yet, by virtue of this book being the most difficult composed in this art as far as comprehension, and the most straitened in terms of its course, [this due to the inclusion] of sagacious remarks, exact scientific [formulations] and wondrous points and extraordinary mysteries, the minds of the [contemporaries] were perplexed and the strength of others of the moderns failed to reach the apogees of

\(^7\) Quṭb al-Dīn Shīrāzī, *Durrat al-tāj li-ghurrat al-dabāj*, kh.

\(^8\) Quṭb al-Dīn Shīrāzī, *Durrat al-tāj li-ghurrat al-dabāj*, 5; Minovi, “Mulla Qutb Shīrāzī,” 166.

و لما اشتهرت بالحسد الصانع و النظر الثاقب في تدجيل العلاج و تبجيل المزاج رتوني طبيباً و كحلاً في المطران المظفر بشيراز بعد وفاته والدي رحمه الله و آنا ابن اربع عشرة سنة و بقيت عليه عsher سنين كحلا الأطباء الذين لا يتنفعون لمطاعنة اللهم إلا المعاملة. وللنظر في دليل ليم في دليل خابت نفسى أن أكتفي من تعلم هذه الصناعة مما اكتفى به المعاصرون و هو القدر الذي به يكتبون و لا أعمله يتسوقون بل كفني أن أبلغ فيها الجلابة الفصوى و الدرجة العليا.
At this point Shīrāzī lists some of the exceptional commentaries that he had come across and faults them for not adding to the discussion as it appears in Avicenna's book, but rather of “speaking on the topics that he had spoken” and “keeping silent about that which he had been silent.” Despondent over the state of the commentaries on Avicenna's *Canon* Shīrāzī then sets out to meet the illustrious savant Ṭūsī:

> [So] I turned my attention to that city of knowledge and that face of the *ka‘aba* of wisdom; the high, precious, holy, splendid presence and the elevated, immaculate, masterly and philosophical threshold ... of [Naṣīr al-Dīn Ṭūsī] may the Lord sanctify his soul and embalm his tomb, [so that] some of the obscure points were clarified with others remaining obscure, since a mastery of the principles of theory is not sufficient for the comprehension of this book. Rather it is necessary, in addition, for the person to be a practiced physician with [experience] in the principles of treatment via the equilibration of the complexions.10

It is perhaps worth noting that Ṭūsī was by this point in the service of Hülegū, and Shīrāzī's tutelage under him would of necessity have been at Marāgha. Shīrāzī tells us that the subsequent stage of his project with respect to the *Canon* was to embark on an extended journey

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9 Quṭb al-Dīn Shīrāzī, al-Tuhfa al-sā‘īdiyya fī al-tibb, Suleimaniya MS 3649, 3r. Note this portion of the *Durrat al-tāy* appears to have errors, so the Suleimaniye manuscript was used instead.

10 Quṭb al-Dīn Shīrāzī, *Durrat al-tāy* li-ghurrat al-dabāj, ٣r. توجهت بلغة الدولة المعمّقة -- و شكل كعبة الحكمة و هي الحضرة العليّة البهية الفقهيّة و الساذة السِنيّة النزاعية الفيلسوفية الإستاذية النصيرة. فقد كتب الله نفسه و روحه في خلل بعض المنطق و بعض البعض إلّا أن يكفي في معنى هذا الكتّاب الإحاطة بالقواعد الحكمة بل يجب أن يكون الشخص مع ذلك طبيب النفس ذا دربيّة و ممارسة يُطلق عليها في تعديل المزاج.
and to thus cast his net farther and wider for information pertaining to the *Canon*.

I then travelled to Khurāsān and from there to the cities of the ‘Irāq-i ʿajam then to ‘Irāq-i ʿarab, Baghdād and its environs and from there to Rūm and I engaged in discussions with the scientists of these realms and the physicians of these parts and I asked them of the truths of these difficulties, and I benefitted from what they possessed as far as detailed knowledge so that I had amassed what no one had amassed as far as [knowledge] and yet despite all of this effort and peregrinations even to Rūm, what was [unknown] in the book remained more than what was apparent.¹¹

The subsequent episode that Shīrāzī includes in his autobiography is his service as Tegüder Ahmad's ambassador to the Mamlūk court, in 681 A. H. In his decades-long zeal for unlocking the mysteries of the *Canon*, Shīrāzī was apparently able to benefit from this diplomatic mission by obtaining new commentaries for the *Canon* in Cairo. At long last these manuscripts enabled Shīrāzī to embark on authoring his own commentary of the *Canon*:

There I succeeded in obtaining three of the comprehensive commentaries on the *kulliyāt*: one from the … philosopher ʿAlā al-Dīn Abu al-Ḥasan ʿAlī Ibn Abū al-Ḥazm al-Qurashī who is known as Ibn al-Nafis, and the second from the [exceptional] physician Yaʿqūb Ibn Ishaq al-Sāmeri al-Mutatabbīb and the third the physician Abu al-Faraj Yaʿqūb Ibn Ishaq al-Mutatabbīb al-Masīhī known as Ibn al-Qīff and I succeeded in obtaining [as well] the responses of al-Sāmerī to the questions of the physician Najm al-Dīn Ibn al-Miftāḥ on some of the viewpoints of the book, [obtaining as well] a recension of the *Canon* by Hibbatallah Ibn Jamīʿ al-Yahūdī al-Maṣrī in which he refuted the Sheikh [i.e., Avicenna], and in addition some of the … notes written by Amīn al-Daula ibn Tilmīdh upon the margins of the book, [obtaining as well] the book of … the Imām ʿAbd al-Latīf Ibn Yūsuf Ibn Muḥammad al-Baghdādī in which he refuted Ibn Jamīʿ [in regard to his recension of the Canon]. When I studied these commentaries and others which I had obtained, the remainder of the book became clear such that there did not remain within it obscurity or difficulty nor was there left room for disputation. And since I had collected what no person had collected in regard to the knowledge of the

¹¹ Ibid., d.

تم سافرت إلى بلاد خراسان و منها إلى بلاد عراق العجم ثم إلى عراق العرب بغداد و نواحيه و منها إلى بلاد الروم. و بتحت مع حكماء هذه الأمصار و أطباء تلك الاقطار و سألتهم عن حقائق تلك المعضلات و استفدت ما كان عندهم من الحقائق حتى اجتمع عندي ما لم يتمعن عند أحد من الحقائق و كان مع كل هذا الأجهزة و تطور البهاء إلى الروم المجهول من الكتاب أكثر من المعلوم.
decipherment of this book and of the separation of what within it is as the chaff to the grain I [finally] saw fit to write a commentary upon it so as to [reduce] the difficulty of the words, and to remove from the face of the meanings the mask [of obscurity] ... and an indication of the responses to that which every commentator had [found objectionable, following a spirit of fairness and avoiding injustice and lack of due consideration] for to God we return and He is most worthy of [our] fear.\textsuperscript{12}

Shīrāzī states that he started the composition for this work in 682 A. H. (i.e., 1283-84 C. E.) and he also states “I gathered in it all that was difficult and unusual for others to collect, in as much as my intellect and my abilities permitted.” He adds that his book was an “expansive commentary [based upon principles] that contained a multitude of questions and answers and lengthy marginalia and follow-up comments,” and that it gained wide renown.\textsuperscript{13} Indeed, the success of Shīrāzī's commentary on the principles of the \textit{Canon} was apparently such that he was approached and asked repeatedly to complete his commentary (presumably for the remaining portions of the \textit{Canon}). Among the reasons that Shīrāzī provided for refusing these requests were the perverse “constancy of the Fates” (that forced him to leave his homeland on dangerous journeys, all the while preventing him from writing).\textsuperscript{14} Also responsible were:

a continuous string of cataclysms afflicting learned men [one following the other] until they had effaced the worksites of religion

\textsuperscript{12} Ibid.

\textsuperscript{13} Ibid., ذ.

\textsuperscript{14} Ibid., 86.
and until the pillars of religious law had weakened utterly, oppressing knowledge and its [practitioners] and obstructing from all directions its [valued offerings, so that] its minaret lay in ruins and all traces of it were obliterated.\textsuperscript{15} It is interesting to note that one of Shīrāzī's concerns in regard to the detrimental effect of the mayhem let loose by the Fates, was its effect on his acumen and judgement: “Some learned men do not issue fatwas on Saturday and Wednesday and claim [as their excuse] that holidays on Friday and Tuesday weaken understanding … and if holidays are a single day … so what then would you think of a twenty year long hiatus, without debates, study, [scholarly] work, and disputation.”\textsuperscript{16} (We should note here that the period 1280-84 C. E. appears to have been particularly productive with respect to publications: In addition to the first edition of his commentary on the Canon, Shīrāzī's three works on astronomy belong to this period, as we will see). Shīrāzī's reference to the “string of cataclysms” is clarified somewhat in his description of how the dismal state of affairs finally comes to an end and is reversed:

\begin{quote}
Until the Lord brought forth from it [i.e., religion] victory and triumph and provided the Muslims with strength and power, and the star of Islam appeared and the government of [Ghāzān] rose [as the sun] upon the sleepers, may his elevated threshold be [ever] surrounded by the swords of victory, etc.\textsuperscript{17}
\end{quote}

The cataclysms are then dated to the period subsequent to Shīrāzī's trip to Cairo (in 1282 C. E.) and the accession of Ghāzān in 1295 C. E. Presumably the death of Shīrāzī's patrons, 'Alā al-Dīn and Shams al-Dīn in 1283 and 1284 C. E., respectively, were among the earliest of the cataclysms that Shīrāzī alludes to. In the remainder of his introduction to his commentary on theCanon Shīrāzī dedicates the work to his patron, the minister Sa'd al-Dīn Sāvajī (d. 1311-12

\textsuperscript{15} Ibid.

منها توالى الدواب على اهل الفضل تترى تلتبت كل واحدة منها الاخرى حتى انطمس من الدين معامله و وهت من قواعد الشرع قوانمه و اهتمم العلم و اهله و منع من كل جانب بنله و اندرس مناره و عفت اثاره.

\textsuperscript{16} Ibid.

إلى ان جاء الله من عهد بالظهر و النصرة و امد المسلمين بالقوة و القدرة فظهر كوكب الإسلام و اشرق شمس الدولة الخاقانية الغازانية على الامام لا زالت سنته العليا محفوظة بسبيف النصر و ايامه الزاهرة غرة على جبهة الدهر و لا يبرحه رقاب

\textsuperscript{17} Ibid.
C. E.), and describes some of the details of what appears to be, in effect, a new edition of his
work of 682 A. H. (i.e., 1283-84 C. E.).

C. Biographical information in Ibn al-Fuwatī's Majmaʿ al-ādāb fī muʿjam al-alqāb

As the librarian of the observatory at Marāgha Ibn al-Fuwatī apparently knew Shīrāzī
personally (see, for example, Shīrāzī's ijāza in Section E of this chapter). Unfortunately Ibn
al-Fuwatī's original work has been lost, and what has survived is merely an abridgment of the
original. This is especially unfortunate because Ibn al-Fuwatī begins his biography of Shīrāzī by
describing him as: “A learned man, whom, were I to commence in describing, I would [in so
doing] require an entire volume by itself.” As it is, the surviving text by Ibn al-Fuwatī only
touches on two of the main episodes of Shīrāzī's life. The first is his trip to Marāgha seeking
Ṭūsī's tutelage, for which Ibn al-Fuwatī supplies the date 658 A. H. (i.e. 1259-60 C. E.). In
describing this trip to Marāgha Ibn al-Fuwatī lists two of Shīrāzī's other teachers, as well:

In addition to Ṭūsī and al-ʻUrḍī, Najm al-Dīn al-Kātibī (d. 657 A. H./1276 C. E.) was one of the
important scientists working at Marāgha. He is one of four astronomers whose contributions

18 See Walbridge for information on Shīrāzī's patron; The Science of Mystic Lights, 186. In his dedication to this
work Shīrāzī invokes the name of the ruler Ghāzīn, as well. This is unusual and speaks of the high regard of
Shīrāzī for the Ilkhanid ruler.
Edition (Brill Online, 2010), <http://www.brillonline.nl/subscriber/entry?entry=islam_SIM-4023>; Bar
Hebraeus, Tārīkh mukhtaṣar al-duwal (Bayrūt: al-Maṭbaʻah al-Kāthūlkīyah lil-Ăbā ʻal-Yasūʻīn, 1890), 151;
are acknowledged by name in the planetary table compiled at Marāgha, the *Zīj-i Ilkhānī*. He may also have been responsible for taking Shīrāzī away from Marāgha for a period, as we will see in section E of this chapter.

The other episode that is captured in Ibn al-Fuwatī’s surviving text is one on which Shīrāzī is silent, i.e., the episode involving his appointment as judge in Sivas: “and he was appointed judge in Rūm and lived in Sivas for a while then returned to Azarbaijan and became a resident of Tabriz.” As we will see this appointment would have preceded Shīrāzī’s role as ambassador to Cairo. In his opening Ibn al-Fuwatī describes Shīrāzī as possessing “a prophetic disposition, divine knowledge, a noble soul, a towering mind, generosity and beneficence.” He concludes by noting that, upon his return from Cairo, Shīrāzī “busied himself with writing and research and his presence became the gathering place for the wise and learned men. And he was mild-tempered and witty in discussions. He was also intimate with sultans and viziers. He was born in 630 A. H. and he died in Tabriz in the year 710 A. H. and was buried in the Jarandāb [cemetery].”

D. Biographical information in al-Dhahabi’s *Tārīkh al-Islām*

al-Dhahabi’s biography of Shīrāzī as it appears in his monumental *Tārīkh al-Islām*, provides many additional details in regard to Shīrāzī’s life. al-Dhahabi was a generation younger than Ibn al-Fuwatī and though he doesn't mention his sources on Shīrāzī it is likely that Walbridge, *The Science of Mystic Lights*, 11; Mudarris Razavī, *Aḥwāl wa Athār-i Muḥammad Ibn Muḥammad Ibn al-Ḥasan al-Ṭūsī*, 130.


23 Ibid., vols. 4, 331.

24 Ibid., vols. 3, 441.

وصلب أخلاقيتهُ والعلومُ وآفاقهاُ وهوُ من خريجيَّة مجمع العلماءُ والفاضلين* *وكان دمث الإخلاق طريف الممارسة* *وكان مغربًا عند الساداتين ووزراءهم* *وكان مولده سنة ثلاثين وستماثله وتوفي بتبنيز في شهر رمضان سنة عشرون سبعمئة* *ودفن بصبرتهم.
some of the information in Ibn al-Fuwatī's *Majma‘ al-ansāb* (now, as we said, lost) would have found its way into the *Ṭārīkh al-Islām*. The information that Shīrāzī himself cites in regard to his early schooling appears in al-Dhahabī, as well. This information is rather garbled, however, at least in the modern edition of al-Dhahabī's work: “He was born in Shiraz in 634 A. H., his father was a doctor and his paternal uncle was of the learned men so he studied with them and with al-Shams al-Kutubī and with Sharaf al-Dīn Zakī and Zakī al-Barshakānī.”25 While al-Dhahabī correctly lists both Shīrāzī's father and uncle as his teachers, it is clear that by al-Kutubī he is referring to Shams al-Dīn al-Kīshī, and that Sharaf al-Dīn Zakī and Zakī al-Barshakānī both refer to the same person, i. e., Sharaf al-Dīn al-Būshkānī.26

al-Dhahabī also lists ‘Alā‘ al-Dīn Muḥammad Ibn Abu Bakr al-Ṭā‘ūsī as having taught *fiqh*, or jurisprudence, to Shīrāzī, though this episode is apparently of a later period, when Shīrāzī had left Shiraz and was in Qazvin.27 Minovi writes of Shīrāzī meeting a certain Diā‘ al-Dīn Ţūsī in Qazvin. Shīrāzī relates the reason for his residence to Diā‘ al-Dīn who reports it in turn: “He said I was engaged in the practice of medicine, but I left the [practice] and started travelling and learned theology (*ʻilm al-kalām*) and the other intelligible sciences (*al-ma‘qūlāt*), but I was ever yearning and my soul would not be content. Yet, I had no knowledge of the transmitted sciences (*al-manqūlāt*) and especially of jurisprudence (*fiqh*). It is for this reason that I study with Sheikh ‘Alā‘ al-Dīn.”28

At this point al-Dhahabī briefly states Shīrāzī's early career as a teenage physician and his trip to Marāgha: “and he was made a physician in the hospital while he was young, and he travelled to Naṣīr al-Dīn al-Ţūsī and [joined his retinue] and studied under him his commentary on *al-Ishārāt* and mathematics and *hay‘a* and he [excelled in these].”29 Of particular interest to

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our discussion is the fact that al-Dhahabī lists Ţūsī as having taught hay’a to the young Shīrāzī (recall that in his autobiographical material Shīrāzī's stated purpose for seeking Ţūsī was his desire to acquire medical knowledge). The commentary in question here is the one that Ţūsī wrote on Avicenna's *al-Ishārāt wa al-tanbihāt*, or "Remarks and Admonitions."\(^{30}\)

A considerable amount has been written about a purported antipathy between Shīrāzī and his teacher Ţūsī. The origins of these accounts are generally the late historical sources such as Mir Khwand. Some of this material has been disproved effectively by Razavi.\(^{31}\) As we saw Shīrāzī addresses his deceased teacher with the utmost respect in the *al-Tuḥfa al-sa'dīya*. Furthermore, his last book on hay’a, *Fa’altu fa lā talum*, is dedicated to Ţūsī's son Aṣīl al-Dīn. al-Dhahabī's history, however, includes a short comment that is quoted by later historians and that may have served as the source for the other, more dubious, accounts. He says: “[Shīrāzī consorted] with Hulākū and Abaqā and he [i.e., Abaqā] said to him: 'you are the best student of [Ţūsī] and he has grown old. Strive, therefore, so that you do not [miss] any of his knowledge. He replied: I have done so, and there does not remain for me a need [for it].'”\(^{32}\) It is not clear what to make of this strange (purported) remark. Indeed, given the apparent esteem in which Shīrāzī held Ţūsī, it is surprising to not hear a confession of inadequacy or some gesture of demurral by Shīrāzī.

Though it is impossible to imagine the circumstances in which this interview took place the account resonates dimly with an episode we saw reported in Rashīd al-Dīn's history on the eve of the siege of Baghdad. There Hülegū had reacted to advice by his astrologer as to the wisdom of attacking Baghdad by asking Ţūsī's opinion. Rashīd al-Dīn says that Ţūsī was “alarmed, as though this was a test,” and quickly offered his full support for the siege of

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\(^{31}\) Ibid., 71.

Baghdad. Whatever the original conversation between Shīrāzī and Abaqā’ – the dim echo of which has reached us through the span of some seven hundred years – it would be a mistake to think of Abaqā’s comment as an innocent or benevolent remark. Ṭūsī, Shīrāzī, and their cohorts were of great strategic importance to the Ilkhans and the concern that Ṭūsī’s work continue after his death could not have been taken lightly. It is possible that Shīrāzī, too, felt as though he was being tested, and was constrained therefore to give an expeditious answer.

The subsequent portion of al-Dhahabī’s biography deals with Shīrāzī’s judgeship in Anatolia and his mission to Cairo: “He then went to Rūm and the Barvānāh honored him and appointed him as the judge of Sivas and Malatiya. And he went to Syria as the ambassador of [Tegüder] Aḥmad and when Aḥmad was murdered [Shīrāzī went back to court] and Arghūn honored him.” The Barvānāh or, more properly, Parvāne, in question is Mu‘īn al-Dīn, the administrator appointed by the Mongols for Anatolia on the eve of Hülegū’s campaigns in Persia. As we saw in Chapter Two, Mu‘īn al-Dīn payed with his life in 1277 C. E., for allegedly intriguing with the Mamluk ruler Baybars. If, therefore, al-Dhahabī is correct in claiming that Shīrāzī’s residence in Anatolia was at the behest of the Parvāne, then this would date Shīrāzī’s appointment as judge to the period prior to 1277 C. E. which is the date of the Parvāne’s execution and probably before 1275 C. E. which is the date for the commencement of Baybars’s adventure in Anatolia. It should be noted here that Shīrāzī’s translation into Persian of Ṭūsī’s Tahrīr-i Uqlīdus (Exposition of Euclid) is dedicated to this statesman.

33 Rashīd al-Dīn Ṭabīb, Jāmi‘ al-tawārīkh, 717.
34 Razavī quotes an uncited source as to the fact that Ṭūsī bequeathed his work on the Zīj-i Ilkhānī to his son Aṣīl al-Dīn and to Shīrāzī: Ahwāl wa Athār-i Muḥammad Ibn Muḥammad Ibn al-Ḥasan al-Ṭūsī, 32.
36 Cahen, Pre-Ottoman Turkey a General Survey of the Material and Spiritual Culture and History C. 1071-1330, 273 - 276.
37 Ibid., 276-291.
38 Ibid., 286.
39 Mir, Sharh-i hal waasar-i ‘allamah Qutb al-Dīn Mahmud Ibn Mas‘ud Shīrāzī, danishmand-i ‘ali qadr-i qarn-i haftum, (634-710 A.H.), 69. A firm date for this work should be particularly useful in understanding the period
At some point after his return from Cairo, though al-Dhahabī does not make clear exactly when, Shīrāzī appears to have settled in Tabriz and focused on the study of hadith literature. As Wiedeman suggests this could very well refer to the end of Shīrāzī's life.40 That this may have been the case is supported by al-Dhahabī's narrative which switches here from an episodic format to a list of general remarks. In particular, al-Dhahabī lists here four of Shīrāzī's works: “and he is the author of books, among them the Ghurrat al-Tāj [sic] on philosophy and a commentary on al-Asrār [sic] by the murdered al-Suhrawardī, and a commentary on the kulliyāt and a commentary on al-Mukhtasār by Ibn al-Hājib.”41 Ghurrat al-Tāj is clearly the Durra/Pearl. Suhrawardī's work is the Sharḥ ḥikmat al-ishrāq, which was described briefly in Chapter One. The kulliyāt in question here can only be the book of Avicenna (on which Shīrāzī wrote a commentary which included his autobiography as an introduction). Al-Mukhtasār appears to refer to the abridgment by Ibn Hājib of his own Muntahā al-su’āl wa al-āmāl fī ‘ilmay al-uṣūl wa al-jadal.”42

The remainder of al-Dhahabī's article describes the personal characteristics of Shīrāzī, noting especially his intellectual brilliance, his generosity, and his piety, but noting as well Shīrāzī's irreverence, his ability to play music on the rubāb, his fondness for wine, all of which would have been questionable behavior for a scholarly man of Shīrāzī's reputation. Al-Dhahabī also adds: “And in the end he continued to serve [his students?] teaching al-Kashshāf, al-Qānūn, al-Shifā’, and the ancient (awā’il) sciences. We ask the Lord, blessed and most high, for

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40 Dhahabī, Tārīkh al-Islām wa-wafayāt al-mashāhīr wa al-a’lām, vol. 54, 101; E. Wiedemann, “Kuṭb al- Dīn Shīrāzī, Maḥmūd b. Mas‘ūd b. Muṣliḥ,” in Encyclopaedia of Islam, Second Edition, Edited by: P. Bearman. (Brill Online, 2010), <http://www.brillonline.nl/subscriber/entry?entry=islam_SIM-4581>. Shīrāzī relates here that he studied the “Commentary on the Sunna” with a certain Muḥyi al-Dīn. I have not been able to locate additional information about this figure, but he is likely the same Muḥyi al-Dīn that is referenced in the ijāza that appears at the beginning of al-Sallāmī's discussion; see section D, of this chapter.


salvation.” Here, by al-Kashşāf al-Dhahabī is referring to al-Kashşāf ‘an ḥaqā’iq al-tanzīl, “Unveiler of the Realities of Revelations,” the renowned Qur’anic commentary by Zamakhshārī (1075 – 1144 C. E. / 467 – 538 A. H.).43 al-Qānūn is Avicenna's Canon to which we have made numerous references in this chapter. The mention of neither of these books, however, would have compelled al-Dhahabī to invoke the name of Allah. Instead it is presumably the last two of the items on his list that al-Dhahabī found alarming and that compelled him to do so: al-Shifā’, “The Healing,” by Avicenna, containing the author's Aristotelian and Neoplatonic philosophy. The ancient sciences were held as suspect in various eras by many scholars in the Islamic world; here al-Dhahabī appears to betray his ambivalence about these branches of knowledge.45

Al-Dhahabī concludes his article on Shīrāzī by stating:

And God knows his [true] intentions for of what was apparent we have spoken and what was hidden was finer [still, no doubt]. And he possessed excellent qualities, virtue, and [upstanding] morals. May the Lord [forgive his sins and ours]. Amen! For he was a sea of knowledge and a possessor of acumen and his best field was mathematics. I have witnessed his students honor him greatly.46

E. Biographical information in al-Sallāmī's Tārīkh ‘ulamā’ Baghdadī

Prior to embarking on Shīrāzī's biography proper, the published version of al-Sallāmī's article partially reproduces an ijāza, or license, that Shīrāzī purportedly wrote for Ibn al-


46 Dhahabī, Tārīkh al-Islām wa-wafayāt al-mashāhīr wa al-a‘lām, vol. 54, 102.
In this *ijāza*, Shīrāzī grants the licensee the permission to transmit two works: *Sharḥ al-sunna*, a commentary on the prophetic tradition, by Huseyn Ibn Masʿūd al-Baghwī (d. 1122 C. E./ 516 A. H.), and *Jamiʿ al-uṣūl*, by Majd al-Dīn Abū al-Saʿādat al-Mubārak Ibn al-Athīr (1149 – 1210 C. E./ 544 – 606 A. H.). In the conclusion of the *ijāza* Shīrāzī states:

> I hereby [grant permission for the transmission] of these two books on my authority and likewise other [texts] whether those that are audited or studied or those for which permission was requested [?] al-mustajāzāt] or those that have been related, subject to the conditions stipulated by [those who are the people of transmission]. And I am [to be held] inculpable insofar as modifications, distortions, transformations, and scribal errors. I ask the Lord to extend [the continuance of the licensees] through knowledge so that [submerged in it] they may discover its [treasures] and so that the sea-shells [of knowledge may] yield their riches [to them]. [May the Lord] grant them success in the goodly action that is … that [point] upon which the wayfarers [to?] the limits of virtue affix their gaze.

al-Sallāmī then starts off the biography of Shīrāzī by rendering his life up to shortly before Tūsī's death as we have seen it before, with some minor modifications:

> He worked under his father and his paternal uncle and under al-Shams al-Kutubī and Zakī al-Barṣakānī. And when his father died he was 14 years old and he was appointed to his father's position in the Muẓaffarī hospital in Shiraz, then he travelled when he was twenty something, heading for Naṣīr al-Dīn and accompanied him and studied his philosophical works and hay'a and he excelled in these [so that Tūsī would call him] the “pole of the sphere of existence” and he travelled with him to Khurāsān and then he

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50 Sallāmī, Tārīkh ʿulamāʾ Baghdādī al-musammā muntakhab al-mukhtār, 176.
returned to Baghdad and lived in the Niżāmīya and the Şāhib Dīwân [i.e., Shams al-Dīn Juwaynī] honored him and he consorted with Hüleğü and Abaqā and Abaqā said to him “you are his best student,” pointing to Ṭūsī “and he is approaching death, so strive so that you do not miss anything of his knowledge.” He replied, “I have done so and no longer have I need for additional [knowledge].”

That the erroneous rendition of Shīrāzī's early teachers are similar to al-Dhahabī's this is not surprising as al-Sallāmī expressly cites al-Dhahabī and Ibn al-Fuwatī as his sources for Shīrāzī's biography. The information seen here that is missing in al-Dhahabī (and the likely source of which, therefore, is Ibn al-Fuwatī's lost work) is Ṭūsī's characterization of the young Shīrāzī, which contains a pun on Qūṭb al-Dīn's name; qūṭb being the word for pole in Arabic. This speaks of Ṭūsī's affection and esteem, and may explain, as well, the source for Qūṭb al-Dīn's title. In addition, the episode of the trip to Khurāsān that is described by al-Sallāmī is not mentioned by al-Dhahabī (nor does it appear in the abridged Ibn al-Fuwatī). It is almost certainly, however, the same trip that Shīrāzī mentions in his autobiography (while perplexingly omitting the fact he undertook this trip as a member of Ṭūsī's party). The account of Shīrāzī's stay at the Niżāmīya in Baghdad, and the patronage of Shams al-Dīn Juwaynī is also the earliest surviving description we have of this portion of Shīrāzī's life.

In al-Sallāmī's rendition of the exchange between Shīrāzī and Abaqā the new detail is the presence of Ṭūsī, himself, and the fact that Ṭūsī is nearing his death. Though contriving a scenario for this exchange would be purely conjectural, the fact that in al-Sallāmī's account we see Ṭūsī as quite apparently failing, should at least allow us the possibility that Shīrāzī's shortness in responding to Abaqā's injunction could have been driven by his desire to avoid tormenting his teacher by the unwanted attention of an unsentimental and pragmatic Ilkhanid ruler. That the meeting between Shīrāzī and Abaqā took place near the end of Ṭūsī's life is also supported by the fact that during Ṭūsī's last visit to Baghdad (the city in which he died, and to

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51 Ibid., 177.
52 Ibid., 177, 179.
which he had gone for the sake of attending to the *awqāf* he was accompanied by Abaqā'. At least one account has both Shīrāzī and Abaqā’ present at Ṭūsī’s deathbed. At least one account has both Shīrāzī and Abaqā’ present at Ṭūsī’s deathbed.54

The account of Shīrāzī’s relocation to Anatolia appears as follows in al-Sallāmī, in what is the only surviving text that mentions anything about Shīrāzī’s children:

> So he went to Rūm and “The Eagle” honored him and ... appointed him as judge of Sivas and Malatiya and [so] he went with his children to Rūm. And Ibn al-Fuwatī relates that he was always [deep] in thought and engaged in writing and his hand was never [devoid] of a pen. And people would gather to him and [benefit from his company]. And he was good-humored and witty and generous.55

Based on the parallel account in al-Dhahābī, the character referred to as “The Eagle” is likely Muʾīn al-Dīn (i.e., the Parvāne) himself, though I have not found another reference to him by this name.56

Another episode for which there is no surviving account prior to its appearance in al-Sallāmī’s work is Shīrāzī’s residence in Juwayn (Joveyn), the hometown of Shams al-Dīn and ‘Ala’ al-Dīn): “And he left Azarbājān and resided for a spell in the school which Shams al-Dīn Muḥammad Juwaynī had built in Juwayn – the [responsibilities of it teaching program] that he had conferred upon Najm al-Dīn al-Kātibī al-Qazwīnī. And Qutb al-Dīn was the assistant in his teaching.”57 Recall that according to the surviving biography of Ibn al-Fuwatī al-Kātibī was Shīrāzī’s teacher of logic at Marāgha (see Section C of this chapter). The dates for this episode are unknown. What can be said with reasonable certainty is that it was before Shīrāzī’s residence in Anatolia. Shīrāzī himself tell us that by 1274 C. E. he was in Konya studying

54 Ibid.
56 It should be noted that in Arabic  “Eagle” and “Vulture” are designated by the same word, *al-nasr*.
57 Ibid., 178.
hadith and other topics with Ṣadr al-Dīn Qūnawī. In this case the period between 1269 C. E. (the end-date of Shīrāzī's trip to Khurāsān with Ṭūsī) and 1274 C. E. would have seen Shīrāzī in Juwayn serving as assistant to Kātibī, as well as in Baghdad at the Nizāmīya. The dates of Shīrāzī's study with Ṭa'ūsī in Qazvin are not known, but since it is hardly conceivable that he would have done this after his appointment as judge by Muʿīn al-Dīn (if we are to believe al-Dhahabī), then Shīrāzī's Qazvin episode and the other two belong to the period of roughly 1269 C. E. to 1276 C. E. If Shīrāzī's ordering of events is assumed accurate this would mean that he spent the period prior to 1274 C. E. in Marāgha, Khurāsān, Qazvin, and Baghdad, prior to travelling to Anatolia and settling in Konya. The appointment as judge in Sivas would have been prior to 1277 C. E. and he may have remained in Sivas (if not serving as judge continuously) until 1281 C. E. when he completed the Nihāya/Limit.

Al-Sallāmī's description of Shīrāzī's trip to Anatolia is unfortunately muddled, however, by the existence of second account of what appears to be the same event. Immediately after the Juwayn episode al-Sallāmī has the following:

And Shams al-Dīn appointed him as judge in Anatolia so he [went there] and took up residence in Sivas and the seekers of knowledge enjoyed and benefitted from his presence and he wrote [there] on the principles of fiqh and a commentary on Ibn al-Hājjib's book and authored the Ikhtīyārāt al-Mudafarrīya [sic] and the commentary on the Miftāḥ of Sakkaki and a commentary on the kulliyāt [of the Canon] by Avicenna and he wrote the book the Tuhfā on the science of hay'ā as well as other treatises and books.

Though it is not clear what to make of the apparently conflicting accounts of how Shīrāzī was appointed as judge in Sivas, it should be noted here that as a vassal state with what was effectively an Ilkhan-appointed or (Ilkhan-sanctioned) viceroy in the person of Muʿīn al-Dīn, the Seljuk were ultimately under the control of the Mongol Ilkhans. That Shams al-Dīn alone was

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responsible for Shīrāzī's appointment and that he did this after the death of the Parvāne (i.e., sometime after 1277 C. E.), is within the realm of possibility, though this would render al-Dhahabī's account as completely wrong. Rather than dismiss out of hand al-Dhahabī's assertion that Muʿīn al-Dīn was responsible for Shīrāzī's appointment as judge, a more probable narrative would have had both administrators, one belonging to the ruling state and one to the vassal, as having effected Shīrāzī's appointment in Sivas. Melville includes a telling detail about the Seljuk monuments in Sivas in his “Cambridge History of Turkey” article on Anatolia under Mongol rule: While the Çifte Minare Medresesi (i.e., the “Madrasa of the Twin Minarets”) was founded by Shams al-Dīn in 1272 C. E., the inscriptions on this monument do not include the names of either the Mongol or the Seljuk ruler. This fact emphasizes both Shams al-Dīn Juwaynī's personal interest in Sivas, as well as the extent of his power and prestige there. Given the contradictory accounts of Shīrāzī's appointment, the best we can do now is assume that both administrators – Shams al-Dīn from the ruling state and Muʿīn al-Dīn from the vassal state – were in some form involved in appointing Shīrāzī to judge in Sivas, some time before 1277 C. E. (and, conjecturally, after his stay in Konya in 1274 C. E.).

Of the books listed above three are known to have been completed while Shīrāzī was in Sivas these are the İkhtiyārāt/Selections the commentary on the kullīyyāt and the Tuhfa/Offering. According to Minovi Shīrāzī's commentary of Ibn al-Hājjib was dedicated to Shams al-Dīn Juwaynī and so must predate this stateman's execution in December 1284 C. E. As we will see in Chapter Four, the earliest historical evidence for Shīrāzī's residence in Sivas is apparently the Nihāya/Limit itself, which was completed in November 1281 C. E. It is therefore certainly

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60 C. Melville, “Anatolia Under the Mongols,” in Byzantium to Turkey, 1071-1453, vol. 1, The Cambridge History of Turkey (Cambridge: Cambridge University Press, 2009), 73. Despite the fact that the remains of this splendid monument were under heavy repairs in the summer of 2009 during a short visit by the present author to Sivas, the quality of the stone-carving and the tile-work (glimpsed through the scaffolding from a fair distance) where a clear indication of the rather astounding level of craftsmanship that had gone into its construction. The monument as it stood in the 13th century would have been opulent, indeed. One of the extant manuscript copies of the Nihāya/Limit was apparently written at this madrasa (see Chapter Four, note 1).

61 This work was already listed in Section C of this chapter. See Minovi, “Mulla Qutb Shīrāzī,” 195. See also, Walbridge, The Science of Mystic Lights, 189.
plausible that the commentary on Ibn al-Hājib's book was also written in Sivas. According to Walbridge, the commentary on the *Key to the sciences* of Sakkākī, is dedicated to the dedicatee of the *Durra/Pearl* and so likely belongs to the same period. If so, this commentary would have been completed long after Shīrāzī's return from Sivas, since the *Durra/Pearl* belongs to the last decade of Shīrāzī's life.⁶²

In regard to Shīrāzī's embassy to Cairo al-Sallāmī states:

He then returned to the presence of the Sultan Abaqā and when Sultan Ahmad Takūdār followed immediately in the footsteps of Abaqā he could not find anyone [worthy of] being sent to Egypt and Syria except for [Shīrāzī], who went accompanied by a letter in the year [6]81 A. H. to [Sultan Qalāwun] and he returned to Azarbāijān and we heard [!] the [contents of the letter] in his own words and most of it [had been composed by him]. And when Maulānā Qutb al-Dīn came and delivered the message [of Qalāwun?] to the Sultan [i. e., Āḥmad], casting [finally] his walking staff to the ground in Tabriz [i.e., ending his journeys there].⁶³

Al-Sallāmī's account here is slightly more detailed than al-Dhahabī's in regard to Shīrāzī's whereabouts immediately prior to his ambassadorship to Cairo. The *Nihāyā/Limit* was completed in November 1281 C. E./Sha'bān 680 A. H. with Shīrāzī in Sivas (as we will see in Chapter Four). Rashīd al-Dīn reports that Abaqā died four months later in Dhū al-Hajja. Tegüder's accession to the Ilkhanid throne did not happen until the 13th of Rabī' I of 681 (i.e., June 1282). If, therefore, al-Sallāmī is correct in his report, Shīrāzī moved from Sivas to the court in Tabriz shortly after the completion of the *Nihāyā/Limit* and stayed there for a little under a year before being sent to Cairo shortly after Tegüder's accession to power.

We do know that Shīrāzī was back in Sivas by Jumādā I of 684 A. H., because this is the date for the *Tuḥfa/Offering*, which was completed in Sivas. The period preceding the

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⁶³ Sallāmī, *Tārīkh ‘ulamā‘ Baghdād al-musammā muntakhab al-mukhtār*, 178. It is clear that al-Sallāmī is quoting Ibn al-Fuwatī directly here, since he claims to have learned of the contents of the diplomatic letters from Shīrāzī himself.
completion of the *Tuḥfa/Offering* would have been particularly strife-ridden as it saw the revolt of Arghūn and the ensuing death of Tegüder as well as the death of both Shams al-Dīn Juwaynī and his brother ‘Alā’ al-Dīn. Indeed, if we are to believe Shīrāzī’s autobiography his mission to Cairo would have occurred shortly prior to the onset of what he termed “a string of calamities.”

As we saw in section B, Shīrāzī himself viewed the accession of Ghāzān as the end of a long and dark era. Indeed, Ghāzān’s conversion to Islam would have been partially responsible for the praise that Shīrāzī bestows upon Ghāzān in his autobiography. Yet, the conversion per se can not have been the sole source of Shīrāzī’s approbative tone, as earlier Ilkhanid rulers with whom Shīrāzī was close had been non-muslims. Indeed, statements in both al-Dhahabī and al-Sallāmī describing the great esteem that Ghāzān had for Shīrāzī may indicate a sort of restoration of Shīrāzī at the Ilkhanid court following a period of partial obscurity. We should recall, however, that Shīrāzī appears to have retained his importance even under Arghūn (as indicated by Rashīd al-Dīn). If he suffered any professional or public setbacks due to the unspecified cataclysms to which he alludes, therefore, these would have had to have occurred during the reign of Gaykhātu (1291 – 1295 C. E.), whose name along with that of short-reigned Bāydu (1295 C. E.), does not appear in any biographical texts related to Shīrāzī.

The remainder of al-Sallāmī’s biography describes Shīrāzī’s work habits, his piety, and his disregard for worldly things. As al-Sallāmī himself states much of this is taken from al-Dhahabī and Ibn al-Fuwatī. The new bits of information that appear in the remainder of al-Sallāmī’s article may again have been taken from the lost work of Ibn al-Fuwatī. In regard to Shīrāzī’s compositions al-Sallāmī states:

> And he was dedicated to composition and writing and [study] and he composed the book *Durrat al-Tāj* for the Malik Dūbāj the king of Gilān. And he composed for Maulānā Aṣīl al-Dīn al-Ḥasan Ibn Naṣīr al-Dīn the book *Fa’altu fa lā iltām* [i.e., *I have done it, so don’t blame me*], which is a strange book in which he [blames] someone who didn’t understand what he had said, as well as other works in the intelligible and transmissible arts.64
As we have stated previously Ašīl al-Dīn was Naṣīr al-Dīn Ṭūsī’s son and he was put in charge of the Marāgha observatory after the death of his father. Al-Sallāmī also states that Shīrāzī’s students composed poems in his honor and that these were collected in a book.65

F. Biographical information in al-ʻAsqalānī’s al-Durar al-Kāmina

al-ʻAsqalānī’s short biography of Shīrāzī repeats the information we have seen in Ibn al-Fuwatī, al-Dhahabī and al-Sallāmī as far as Shīrāzī’s intellectual prowess, his personal habits, his humility, and his sense of humor. When listing Shīrāzī’s book he includes the title Sharḥ al-ishrāq (sic), referring to Shīrāzī’s commentary on Suhrawardī. This is closer to the actual title of the work Sharḥ hikmat al-ishrāq, and it indicates that the reason for the error in al-Dhahabī’s biography was a straightforward misreading of asrār for ishrāq at some point from when al-Dhahabī penned his work to the present day.

In addition, al-ʻAsqalānī provides two bits of information that do not appear in the previous histories examined for this chapter. The first is his statement that the title by which Shīrāzī is known by the cognoscenti is al-shārīḥ al-ʻalāma, or “the Commentator Savant.”66 This title underscores Shīrāzī’s great prestige as an intellectual and recalls the fragment by Bar Hebraeus that we saw in Chapter One. The second new piece of information by al-ʻAsqalānī is included in the following statement: “And when Ṣafī al-Dīn al-Muṭrib [i.e., Ṣafī al-Dīn the minstrel] went to him, he gave him two thousand dirhams, and he taught al-Kashshāf, the Canon, al-Shifā’ and other books in Damascus.”67 The first part of the statement clearly parallels a statement in al-Dhahabī: “And when Ṣafī al-Dīn Ṣafī al-Dīn ʻAbd al-Mu’min al-Maṭarī went to him he gave him two thousand dirhams.” (al-Maṭarī is an obvious misreading of al-Muṭrib, or vice

65 Ibid., 179.
67 Ibid., vol. 5, 108.
The second part of the statement also appears to be derived from al-Dhahabī who, as we saw, said Shīrāzī taught *al-Kashshāf*, the *Canon, al-Shifā’* and the Ancient sciences. In his version al-ʿAsqalānī has replaced “the Ancient Sciences” with *ghayriha*, or “others.” But he has also inserted the information about where this teaching supposedly took place, i.e., in Damascus. Walbridge repeats this information on al-ʿAsqalānī's authority.\(^{68}\)

The problem with this additional bit of information, however, is that the only other records of Shīrāzī being in Damascus refer to the trip undertaken as a member of Sultan Tegüder Aḥmad's embassy. The Mamluk historian al-Ẓāhir who was a courtier in Cairo, states emphatically, however, that the Sultan asked his deputies to make sure that “no one sees [the Ilkhan contingent] or associates with them, nor should anyone speak a word with them, and that they should travel only at night.”\(^{69}\) al-Ẓāhir also states that on the return trip the same security measures were taken “so that no one associated with them, or glanced at them, or saw them … and they reached Aleppo on the sixth of Shawwāl of the year 681, and [from there] made for their countries.”\(^{70}\) Given all this, it is very difficult to imagine how Shīrāzī would have been allowed to lecture or to teach during this trip. Since Al-ʿAsqalānī's statement is the only surviving reference to this teaching, his insertion of Damascus in the account that he appears to have gotten from al-Dhahabī is almost certainly in error.

### G. Biographical information from Shīrāzī's *Durra/Pearl*

Shīrāzī states that he received the “khirqa in blessing” from his father. The bestowal of this woolen frock normally signifies ones status as a sufi or a sufi disciple. Walbridge adds, however, that this *khirqa* was given “in blessing” implies that it was given as a sign of favor rather than a formal signifier of Shīrāzī having been inducted into sufism. The source for this

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\(^{68}\) Walbridge, *The Science of Mystic Lights*, 17.


\(^{70}\) Ibid., pt. 2, 16. Indeed given the great suspicion that existed between the two polities it is rather surprising that Shīrāzī was so successful in garnering his manuscripts of the *Canon.*
biographical information is the Durra/Pearl.\textsuperscript{71} Elsewhere in the same work Shīrāzī describes receiving a khirqa as an adult: “The [humble] pauper who is the author if these words … received the khirqa from the hands of the Sheikh Najīb al-Dīn ʿAlī Ibn Buzghush al-Shīrāzī, may the Lord sanctify his soul, and he [in turn] received it from the sheikh of sheikhs Shahāb al-Dīn al-Suhrawardī, may the Lord rest his soul.”\textsuperscript{72}

Of the authors that we have seen earlier in the chapter, al-Dhahabī writes: “And he was one of the smartest men of the age, and was witty and sharp and did not carry concerns of the [impermanent] world with him. And he wore the garbs of the sufis.”\textsuperscript{73} al-ʿAsqalānī writes: “And he consorted frequently and freely with kings, and was witty, and bright, and did not carry any concerns, and did not [ever] alter his sufi garb.”\textsuperscript{74} al-Sallāmī does not include a reference to Shīrāzī’s sufi garbs, but says instead: “he was not concerned with his clothes and he did not [claim the seat of honor] in gatherings.”\textsuperscript{75} It is reasonably clear from these words that Shīrāzī was a sufi (or at least a sufi disciple) for all of his adult life. It is in view of this information that his somewhat unorthodox personal habits with respect to music, and alcohol, and his apparent disregard for worldly pomp should be understood.\textsuperscript{76}

**H. Shīrāzī: The Last Decades**

Shīrāzī appears to have spent the last two decades of his life (i.e., c. 1290 C. E. to 1311 C. E.) in the Ilkhanid capital of Tabriz. Though information that can be traced to this period of Shīrāzī’s life is scarce, all of the sources we have examined state or imply that he remained active in teaching, and several imply as well that he focused more on the religious sciences as

\textsuperscript{71} Quṭb al-Dīn Shīrāzī, Durrat al-tāj li-ghurrat al-dabāj, Ǧ; See also Walbridge, The Science of Mystic Lights, 9. The source for both accounts is an unpublished portion of the Durra/Pearl that I have not had an opportunity to see.


\textsuperscript{73} Dhahabī, Tārīkh al-Islām wa-wafayāt al-mashāḥīr wa al-aʿlām, vol. 54, 101.

\textsuperscript{74} Ibn Ḥajar al-ʿAsqalānī, al-Durar al-kāminah fī aʿyān al-mīʿah al-thāmīnāh, vol. 5, 108.

\textsuperscript{75} Sallāmī, Tārīkh ʿulamāʾ Baghdaḏ al-musammā muntakhab al-mukhtār, 179.

\textsuperscript{76} Amitai, “Sufis and Shamans.”
time wore on. As we saw, Shīrāzī publicly affirmed his high regard for Ghāzān (1295 C. E. to 1304 C. E.) and of the sources we have seen al-Dhahabī and al-ʻAsqalānī also mention Ghāzān by name, implying that this esteem was mutual. In addition al-Dhahabī and al-ʻAsqalānī imply that Shīrāzī was able to intercede to Ghāzān on behalf of others. In a rather odd remark al-Dhahabī implies that Shīrāzī was intimate, as well, with Öljeitū, the subsequent Ilkhanid ruler, and the one during whose reign Shīrāzī died: "And [Shīrāzī] had mastered magical tricks and he played the rubāb and he presented variegated jests in the presence of Kharband and [also] in his lessons."77 Kharbandeh was one of the titles of Öljeitū and it is reasonably certain that al-Dhahabī is referencing this ruler. There is no record that Shīrāzī followed the court of Öljeitū when the ruler relocated from Tabriz to Sulṭāniyya c. 1305.78 However, al-Dhahabī’s remarks could suggest that he was well-regarded at court to his death in 1311 C. E. The expenses for the rather lavish funeral were payed for by ‘Īzz al-Dīn Tayyibī, an affluent disciple of Shīrāzī.79

As opposed to Shīrāzī's peregrinations in his youth, and adulthood this final phase of Shīrāzī's life appears to have been a relatively settled period. Walbridge places Shīrāzī in Gilan c. 1305, based on the fact that he dedicates his Durra/Pearl to the ruler "Amira al-Dabāj" who was one of the rulers of Gilan at the time.80 It is rather difficult to believe that Shīrāzī would have undertaken this journey to the untamed region of Gilan, during the last decade of his life. It is known that al-Dabāj paid a visit to the Ilkhanid court prior to Öljeitū's ruinous and ultimately unsuccessful campaing in Gilan c. 1306 C. E.81 It is therefore much more likely that Shīrāzī completed his book in Tabriz and dedicated it to the visiting dignitary from the frontier area, perhaps in circumstances similar to his dedication of the Ikhtīyārāt/Selections (see below).

77 Dhahabī, Ibid. It is certainly conceivable that al-Dhahabī's words depict Shīrāzī at court with a youthful Öljeitū, prior to his ascension in 1304 C. E.
79 Walbridge, “The Philosophy of Qutb al-Dīn Shirazi; a study in the integration of Islamic philosophy,” 34-35.
80 He also dates the authoring of Shīrāzī's work Miftāḥ al-miftāḥ to the period of the purported trip to Gilan, though it is not clear if this is based on evidence from the Miftāḥ al-miftāḥ, itself. Ibid., 33.
I. The Patrons

Shīrāzī dedicates the Ṣāḥib Dīwān to “Muḥammad Ibn … Bahā’ al-Dīn Muḥammad Juwaynī.” Misḥkat interprets this to mean Bahā’ al-Dīn Muḥammad Juwaynī, the infamously harsh governor of Isfahān and ‘Irāq-i ajam and son of Shams al-Dīn the great Ṣāḥib Dīwān (which would make Bahā’ al-Dīn nephew of the great historian ‘Alā’ al-Dīn Juwaynī). Mir follows Mishkat in identifying Shams al-Dīn's son as the dedicatee of this work. This identification is immediately problematic, however, due to the disagreement between the name of the dedicatee as it appears in Shīrāzī's book and the name of the candidate suggested by Mishkat and Mir. It is reasonably clear that Shīrāzī's patrons name was Muḥammad and that he was the son of Bahā’ al-Dīn. There is, in addition, a chronological problem with the aforementioned identification, for the date of Bahā’ al-Dīn’s death is 1278 C.E./678 A.H., i.e. three years before the completion of the Ṣāḥib Dīwān. The correct identification of the dedicatee of this work appears, instead, in Walbridge's The Science of Mystic Lights. Noting the chronological problem with the dedicatee proposed by Mishkat and Mir Walbridge proposes Shams al-Dīn the Ṣāḥib Dīwān himself as the dedicatee of this work. As we saw in Chapter Two, Shams al-Dīn was put to death by Arghūn in Nov. 1284 C.E./Sha' bān 683 A.H., which would have been three years after the completion of the Ṣāḥib Dīwān. In addition Shams al-Dīn's given name was Muḥammad. Furthermore, his father is identified as Bahā’ al-Dīn (the son of Muḥammad) by Spuler in his EI article on Shams al-Dīn. The definitive proof for Shams al-

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82 Quṭb al-Dīn Shīrāzī, Nihāyat al-‘idrāk fī dirāyat al-aflāk, Köprülus MS 957, 1r.
Dīn's identity as the dedicatee of the *Nihāya/Limit* lies in Shīrāzī's dedication itself, for in it we also see included the name Shams al-Dīn and the title *Ṣāhib Dīwān.* Since according to al-Sallāmī, Shīrāzī worked as an assistant to al-Kātībī in Shams al-Dīn's school (presumably sometime in the period between 1269 and 1274 C. E.) he would likely have been a beneficiary of Shams al-Dīn's patronage for at least seven years before the completion of his *Nihāya/Limit*, making the great administrator a natural choice as someone to whom a major scientific work would be dedicated.

Rather than a central and important figure such as Shams al-Dīn, the dedicatee of the *Ikhtīyārāt/Selections*, Muẓaffar al-Dīn Yavlaq (or possibly Yūlūq) Arslan, appears to have been a minor ruler from the somewhat peripheral Anatolian principality of Qaṣṭamūnī (i.e., modern Kastamonu which lies not far from the coast of the Black Sea, near Sinope). As we will see in Chapter Four, the *Ikhtīyārāt/Selections* was completed shortly after the *Nihāya/Limit*. As we have already seen Shīrāzī had lived in Anatolia for some years prior to the completion of the *Nihāya/Limit*. It is also perhaps fair to surmise that subsequent to the execution of Muʻīn al-Dīn in 1277 C. E., Shīrāzī's patron, Shams al-Dīn would have had an even more direct say in the administration of this vassal state of the Ilkhan. Still, the localities that are associated with Shīrāzī's stay in Anatolia (i.e., Sivas, Malatiya, and even Konya) are at a fair geographical distance from Qaṣṭamūnī/Kastamonu.

What reason, then, could compel Shīrāzī to dedicate his work to Muẓaffar al-Dīn? Cahen notes Kastamonu's “remoteness from the political centers” as an explanation for the lack of historical information regarding its establishment as a principality. Indeed a comparison of the

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88 Quṭb al-Dīn Shīrāzī, *Nihāyat al-idrāk fī dirāyat al-aflāk*, Köprüülü MS 957, 1r. Indeed, the colophon of Köprüülü MS 956 indicates that this work was completed in the very school that was founded by Shams al-Dīn in Sivas. See note 1, Ch. 4.

89 Cahen, *Pre-Ottoman Turkey a General Survey of the Material and Spiritual Culture and History C. 1071-1330*,
secondary literature indicates that there is disagreement even as to the name of the rulers of Kastamonu and their regnal years through the course of the thirteenth century.\(^90\) The historical evidence such as it is, consists primarily of short entries in the history of Ibn Bībī and in Aqsärāī's chronicle (Chapter One, Section 2.G).

The most relevant account referencing the dedicatee of the *Ikhtīyārāt/Selections* appears at the end of (the abridged version of ) Ibn Bībī's history. There we see Muẓaffar al-Dīn play a notable role in connection with the succession issues that faced the Seljuks in the aftermath of Baybars's adventure in Anatolia, c. 1275-77 C. E. Up until Muʿīn al-Dīn's rule, the Mongols had successfully followed a shrewd policy of appointing rival Seljuk claimants to “rule” different parts of Anatolia.\(^91\) Shortly after the coming to power, Muʿīn al-Dīn had managed to orchestrate a “unification” of the Seljuk territories, causing one of the pair of Seljuk sultans ruling the Seljuk realms, ʿIzz al-Dīn, to flee to Constantinople and then to the Crimea. The period from 1261 to 1277 C. E. had seen, therefore, the nominal rule of a single Seljuk ruler, the Sultan Rukn al-Dīn, with Muʿīn al-Dīn Parvāne wielding actual power.\(^92\) The events of 1275-77 C. E. were concurrent with the violent uprising of numerous “Turcomen” entities.\(^93\) These entities were generally Anatolian tribal groups, such as those ruling Kastamonu and other frontier areas, that were often not under direct Seljuk rule. No doubt enticed by the mayhem (as well, perhaps, by


\(^{91}\) Cahen, *Pre-Ottoman Turkey a General Survey of the Material and Spiritual Culture and History C. 1071-1330*, 278.

\(^{92}\) Ibid., 280. See also Chapter Two, Section C.1.

tribal affiliations dating from the period leading to the ousting of his father) it was the son of the Seljuk Sultan 'Izz al-Dīn, who in 1280 C. E. sailed across the Black Sea from Crimea and landed in Sinope with the goal of reclaiming his throne. Ibn Bībī recounts the allegiance of Mużaaffar al-Dīn, Shīrāzī's patron, to the new claimant, Ghiyāth al-Dīn Masʿūd, as follows:

The news reached Prince Muḥammad al-Dīn Ibn al-Buyūrj, whose ancestors had conquered and held those regions for generations, and he joined [the claimant] …. The Sultan [i.e., the claimant, and soon to be Sultan, Ghiyāth al-Dīn] … added the Prince Muẓaffar al-Dīn to his retinue and turned towards the great [Mongol] general Samāḥār Bahādur who was the governor and the protector of the *limes* of Rūm. When he arrived, everyone – Mongol and Muslim – was struck by his comely face and all were impressed by his comportment and presence and each [paid his respects/expressed his kindness] according to his abilities. The Mongol commanders dispatched Prince Muẓaffar al-Dīn as a member of his high retinue to the service of the threshold of the most high *ordū* [i.e., the Mongol court in Tabriz], despite the fact that the host of winter was on the offensive and water … had turned as stiff as a miser's hand, and in no time he was received at the glorious ... court. He was bequeathed prodigious and unanticipated honors and was granted the region of Amid [i.e., Diyarbakır] and the lands of Kharberd [i.e., modern Elâziğ] and Malatiya and Sivas together with their citadels and their revenues, and was bolstered, as well, by many goodly promises.⁹⁴

It is important to note here that the arrival of Muẓaffar al-Dīn at the Mongol court c. 1281 corresponds roughly with the completion of the *Nihāya/Limit* (i.e., Nov. 1281). If, as Aqsārāī states, Ghiyāth al-Dīn Masʿūd, was received by Abaqā, then his arrival at court would have occurred before Abaqā's death in April of 1282 C. E / 20 Dhū al-Hajja 680 A. H.⁹⁵ In Chapter Four we will see that the *Ikhtiyārāt/Selections* was completed sometime before December 1284.

Though Ibn Bībī's account of Muẓaffar al-Dīn arrival at the Mongol court does not allow us to

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refine our date for the completion (or, rather, the dedication) of the Ikhtīyārāt/Selections, it provides us with an idea of how Mużaffar al-Dīn came to be the dedicatee for this work. Though we don't know the extent of Mużaffar al-Dīn's stay at the Mongol court, the fact that he was there removes one of the mysteries of the dedication of this work. It is almost certainly the case that Shīrāzī's decision to dedicate this work to the amir of far-flung Kastamonu was a result of the “Turcomen” amir's arrival in Tabriz in the early 1280's, and his meeting with Shīrāzī at the Ilkhanid court.

Rather remarkably, 679 A. H. (1280 C. E./1281 C. E.) is the year in which Mujīr al-Dīn Amīrshāh, the dedicatee for Shīrāzī's third book on astronomy (the Tuḥfa/Offering) rose to prominence at Mongol court, as well. Assuming the post that had belonged to his father, Tāj al-Dīn al-Muṭazz – the Mongol-appointed financial supervisor who oversaw the repayment of Seljuk loans dating from Hülegü's campaign,\(^96\)

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\text{Mujīr al-Dīn Muḥammad Ibn al-Muṭazz came to Rūm and [by virtue of?] the yarlıghs and the paizas [obtained] in the year 679 A. H. from the [Great King] Abaqā with royal honors, revived the position of his father, and took control of the injū and muqaṭṭāt of the kingdom that had been earmarked for the treasury of the High Presence [of the royal court] as well as the bālish. And, verily, the kingdom [flourished greatly] through his [constructive efforts].} \quad ^{97}
\]

A description of the various forms of state revenue listed in the fragment appears in Cahen.\(^98\)

\(\text{Muqāṭṭāt}\) refers to the leasing of tax farms for regions or natural resources, and \(\text{injū}\) to lands that belonged to the state (and that provided revenues to the central treasury). The meaning of the term \(\text{bālish}\) is not known, though it is obviously a form of tax or tribute. It should be noted

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\(^{96}\) Cahen, *Pre-Ottoman Turkey a General Survey of the Material and Spiritual Culture and History C. 1071-1330*, 332.

\(^{97}\) Aksarayi, *Tarikh-i Salājīqah, yā, Musāmarāt al-akhbār wa musāyarāt al-akhīr*, 134.

\(^{98}\) Cahen, *Pre-Ottoman Turkey a General Survey of the Material and Spiritual Culture and History C. 1071-1330*, 333.
here that Mujīr al-Dīn's position obtained via Abaqā'ī's decree granted him control over the principality of Kastamonu among other locales, and thus Mużaffār al-Dīn's appearance at court (as a partisan of Mas'ūd's claims to the Seljuk throne) could hardly have been a mere coincidence.99 Though the historical details of this episode have not survived, it is clear that a more forceful presence of the Mongol officials at Kastamonu would have required some response by the ruler of that principality (even if the historical record of that response depicts little more than a trip to the capital and an affirmation of allegiance).

By the time of the dedication of the Tuhfa/Offering Mujīr al-Dīn had seen a steady increase in his fortunes. Abaqā'ī's successor, Tegüder Aḥmad, had decided to revert to the time-tested Mongol system of divide and conquer, appointing Ghiyāth al-Dīn Mas'ūd as ruler to the traditional realms of the Seljuk polity, and re-assigned the existing Sultan Ghiyāth al-Dīn Kay-Khosrow as ruler of the southern coast of Anatolia. Mujīr al-Dīn had been assigned as Ghiyāth al-Dīn Mas'ūd's deputy, or the nāʿib al-saltana.100 Given the fact that this appointment would have made him one of the most powerful men in Rūm, his choice as dedicatee of a major scientific work, is, therefore, not difficult to understand.

J. Observations in Regard to Shīrāzī's Patrons

Though the details of how Mużaffār al-Dīn came to be the dedicatee of the Ikhtiyārāt/Selections have not reached us, his choice as dedicatee of this work allows us to draw a provisional conclusion, based on what we have seen so far. For it appears as though those of Shīrāzī's major works on astronomy, the ones that were written in Arabic were in turn dedicated

99 Ibid., 332.
100 Melville, “Anatolia Under the Mongols,” 73.
to administrators of the Mongol court who, as educated man raised in the chancery would have had a firm grasp of Arabic. The *Ikhtiyārāt/Selections* is dedicated to a ruler of Kastamonu who in all likelihood had a limited ability in Arabic. Indeed, that Muẓaffar al-Dīn was able to read the *Ikhtiyārāt/Selections* in Persian (which is quite different from his native Turkish) suggests a certain level of education. A clear parallel exists between the dedication of the *Ikhtiyārāt/Selections* and that of the *Durra/Pearl*. Like the *Ikhtiyārāt/Selections* the *Durra/Pearl* is dedicated to a minor ruler (rather than a powerful administrator working for the Ilkhanid state). There can be little doubt that the abilities of “Amira Dobāj” from the backwaters of Gilan would have been as limited as that of Muẓaffar al-Dīn in regard to facility in Arabic.

As a final observation in regard to the dedicatees of Shīrāzī's astronomical works, I would also like to note that a rather striking feature is their association with Rūm or Anatolia. As we saw Shīrāzī lived in Rūm for extended periods. Was his dedicating his books on astronomy to administrators or rulers in Rūm a coincidence or was he aiming to nurture the relationship of clientage with powerful figures in Rūm, in particular? To answer this question properly a great deal more work remains to be done. In particular, given the fact that Shīrāzī was a prolific author, it would be important to know how the dedicatees of his other titles were, and where and when these works were dedicated. In addition other historical evidence (similar to the dedication inscription at the madrasa in Sivas) need to be included to fill in the numerous blanks that exist in regard to Shīrāzī's whereabouts and the relationship with his patrons.

That having been said, we should note that a comparative study of the works of Ibn al-Fuwatī, al-Dhahabī, al-Sallāmī, and al-ʻAsqalānī together with Shīrāzī's autobiographical notes allows us to track a rough trajectory of Shīrāzī's whereabouts through his life as a scholar. This
trajectory would have taken Shīrāzī from his birthplace to Marāgha in 1259-1260 C. E., and then to Juwayn, Qazwīn, and Baghdad in the subsequent period of a little over a decade. Shīrāzī appears to have then moved to Anatolia, for he tells us of his residence in Konya in 1274 C. E. The historical accounts reviewed in this chapter suggest strongly that his appointment as judge in Sivas would have occurred shortly after 1274 C. E. for one of his main benefactors, Muʻīn al-Dīn (whose name is associated historically with Shīrāzī's appointment) was executed in 1277 C. E. Shīrāzī would presumably have remained in Sivas until the completion of the \textit{Nihāya/Limit} which was in Nov. 1281 C. E.

The ensuing period appears to have been particularly busy for him. In particular he left Sivas for Tabriz, perhaps upon the death of Abāqā, in April 21st 1282 C. E., and shortly thereafter went on his embassy to Cairo (Aug. 1282 to Jan. 1283). In addition, he dedicated the \textit{Ikhtīyārāt/Selections} to the visiting amīr of Kastamonu, perhaps as early as Aug. 1282, but certainly before December 1284 C. E.. Yet, by August 1285 C. E., Shīrāzī was back in Sivas where he completed the \textit{Tuhfa/Offering}. In all likelihood the events surrounding the death of Tegüder Aḥmad (August 1284 C. E.) and especially the execution of Shīrāzī's benefactor Shams al-Dīn Juwaynī (October 1284 C. E.) were at least partly responsible for this. In the absence of other historical data we may reasonably wonder if the account of Shīrāzī's meeting with Arghūn in Anatolia c. May 1290 C. E., does not in some form signify his coming back into favor at the court in Tabriz. Whatever, the case may have been the sources that we have looked at are unanimous in stating that Shīrāzī spent the last decades of his life in Tabriz, and that he was buried there. Based on the information from Shīrāzī's autobiography, the period following Ghāzān's accession in 1295 C. E. was a particularly happy and stable one for him. The historical
narratives we have studied mention that he was busy with his scholarship during this period. Several of his books including the *Durra/Pearl* are the fruits of this late period in Shīrāzī's life.
Chapter 4. A Comparison of the Primary Astronomical Sources:

A. Chronological Considerations

Existing manuscript copies that have reached us of both the Nihāya/Limit and the Tuhfa/Offering include the dates in which these works were completed. The colophon in Köprülü 956 indicates that the Nihāya/Limit was completed in the middle of Sha‘bān in 680 A. H., corresponding to late November or early December in 1281, C. E. in the city of Sivas.¹ This date is repeated in Köprülü 957 which references a work written in the author’s own hand.² BN Arabe 2516, a manuscript of the Tuhfa/Offering indicates that this work was also completed in Sivas and that the date of its completion was in August, 1285.³ In contrast, none of the copies of the Ikhtīyārat/Selections examined for this study include a date. It is possible, as will be seen in this chapter, however, to assign this book to the same period as the Nihāya/Limit based on the internal evidence from the texts themselves as well as from historical evidence related to the dedicatee of this work.⁴ As we saw in Chapter 3, the patron listed in the introduction of this work first rose to prominence by making his appearance at the Ilkhanid court in the winter of 679 A. H. (1280 - 1281 C. E.) in roughly the same period as the completion of the Nihāya/Limit.

¹ Quṭb al-Dīn Shīrāzī, Nihāyat al-īдрāk fī dirāyat al-aflāk, Köprülü MS 956, 148r.

² Quṭb al-Dīn Shīrāzī, Nihāyat al-īдрāk fī dirāyat al-aflāk, Köprülü MS 957, 195r.

³ Quṭb al-Dīn Shīrāzī, al-Tuhfa al-shāhīya, BN Arabe MS 2516, 118r.

⁴ It is worth noting here that the date of composition of Tūsī’s Tadhkira/Memoir does not appear to have been included in any of the surviving manuscripts. The reason may have to do with the fact that the work was emended repeatedly. See Ragep 1993, p. 71 and p. 74.
Furthermore, as will be shown, the completion of the Köprülü 956 manuscript of the
*Nihāya/Limit* places an effective upper limit on the date of composition for the
*Ikhtīyārāt/Selections*. The most convincing evidence for this is the reference by name in this
manuscript to the *Ikhtīyārāt/Selections* itself. In Köprülü 956 we read that the manuscript was
corrected in the presence of the author by a comparison with the author's own copy, and that this
occurred on the tenth of Shawwal, in 683 A. H. which is equivalent to the 20th of December,
1284 C. E. It is reasonably certain, therefore, that the *Ikhtīyārāt/Selections* was completed in
the period between the latter part of 1281 to the end of 1284 C. E.5

As far as his authoring of astronomical works is concerned, Shīrāzī's apparent
productivity in the period spanning 1281 C. E. to 1284 C. E. is rather striking. What were
Shīrāzī's motives and reasons for writing three major works on the same topic in such rapid
succession? Was Shīrāzī trying to say something new in each successive work, or was he
merely repackaging the same information? If these works are not repetitions of each other, then
in what ways are they different? In order to answer these questions and the question of “Why
write three books on Astronomy topic in the span of less than five years?” we turn now to look
more carefully at the books themselves.

5 The statement in the colophon of Köprülü MS 956 is:

وقع الفرغ من العرض و المقابلة مع المصنف امام الله ظله ينسخته و قرآن في عاشر شوال سنة ثلث و ثمانين و ستمائة
هجري.

Köprülü MS 957 is even earlier, having been finished less than a year after the composition of the work itself:
“Completed on the twentieth of Jumādā I, 681, A. H. (i.e., 26th of August, 1282 C. E.)....”

و فرغ من كتابته يوم الأربعا عشرين جمادى الأول سنة احدى و ثمانين و ستمائة هجري و الحمدلله اولا و آخرا. 555

Qūṭ al-Dīn Shīrāzī, *Nihāyat al-idrāk fī dirāyat al-aflāk*, Köprülü MS 956, 148v., Köprülü MS 957, 194v.; *al-
Tuhfa al-shāhīya*, BN Arabe MS 2516, 118r.
B. The Stated Purpose of the Three Works Under Consideration.

Shīrāzī declares a motive for producing each of his three books on astronomy in the
introduction for each work. In this section we will look at the introductory as well as the
concluding sections in the Nihāya/Limit, the Tuhfa/Offering, and the Ikhtiyārāt/Selections hoping
to better understand the genesis of these books and the relationship between them. In the
introduction to the Nihāya/Limit Shīrāzī states:

I had wished for a period of time to compose for myself and my brethren in the science of hay’a ... a self-sufficient epistle, inclusive of the cream of the written explications and the pith of the collected compositions on the form of the orbs, containing a summary of what has been achieved and the results of that which the utmost of attainment has reached, in order for this work to be a demonstration for the beginner [as well as] a reference for the expert; [and even more so] the foundation for those of utmost perspicuity and the limit [of this science] for those of intelligence; [yet] lesser obstacles had preoccupied and obstructed me...⁶

According to Shīrāzī, then, the Nihāya/Limit was meant as a primer for the beginning astronomer as well as a work of reference for the more accomplished practitioners of astronomy.⁷

This introductory fragment contains a rhetorical flourish that would have been apparent to knowledgeable readers, for, embedded within it are references to astronomical works that are the predecessors of the Nihāya/Limit, from which Shīrāzī's work draws. This reference subtly reinforces Shīrāzī's claims as to the comprehensiveness of his work, as well as its superiority relative to the other well-regarded works of his era (for which none of the authors' names

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⁶ Quṭb al-Dīn Shīrāzī, Nihāyat al-idrāk fī dirāyat al-aflāk, Köprülü MS 957, 1v.
⁷ See the discussion in Ragep 1993, p. 37, in regard to the Tadhkira/Memoir having been written, in part, with the student of astronomy in mind. It is also worth noting here the striking contrast between Ṭūsī's laconic style in his introduction relative to Shīrāzī's verbosity. The undefined difficulties presumably refer to the period of his work at Marāgha and his adventures during the period preceding his appointment as judge in Sivas. As we saw in Chapter 3, much of the biographical information about the period in which Shīrāzī spent at Marāgha is sketchy, as indeed are the circumstances of his being appointed judge in Sivas.
Then when I asked the Lord for guidance and commenced in the composition of this book, a person from whom I am unable to withhold a favor and one whom I am unable to contradict, being the dearest of my friends and the foremost among them in virtue, Muḥammad ibn ʿUmar al-Badhakhshānī ... requested from me that, where necessary, a gentle indication be made of [the method of] observation and an amiable sign made of the manner of extracting the motions and other things [from these observations] and that I study the words of the Tadhkira/Memoir which has no precedent from among its antecedents and which will remain unsurpassed by its successors, and to insert these in my words should the import be apparent and to simplify them if there is a species of obscurity in them. And I have met his prescription and realized his hope collecting both advantages .... And since this book has not “left out anything great or small, but takes account thereof” [The Qurʾān 18:49] nor is there a haughty pronouncement or an uncouth one without [my book] ridiculing or belittling it, [doing so] by encompassing the foremost thoughts of the ancients and containing the limits of the views of the others from amongst the moderns together with noble benefits and refined pearls originating from us – and if it is not more glorious than what we have mentioned and greater it is not lesser – I have called it the “Limits of Attainment in the Understanding of the Orbs,” in order that its name be a guide to its import and in order that its appearance bear news of its meaning and I have arranged it in four sections... and to God I pray humbly for the completion of that which I have set as my goal.9

Shīrāzī thus describes the genesis of his Nihāya/Limit as a commentary to the Tadhkira/Memoir of his teacher Ṭūsī (which according to Ragep became an important work of reference in hayʿa subsequent to its publication)10 at the behest of a his friend, a certain Badhakhshānī. Indeed, as

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8 There are references to the following works, emphasized as well at the conclusion of the Nihāya/Limit. Not all of these works can be identified. The list of references consists of al-Mughnīya (perhaps the Muʿīnīya, by Ṭūsī), al-Zubda (perhaps Zubdah-i hayʿa or Zubdat al-ıdrāk fī al-hayʿa by the same author), al-Lubāb (?), Ghāyat al-ıflāk (?), al-ʿUmda al-ʾula (?), al-Mulakhkhaṣ (?), Tarkīb al-ıflāk (perhaps Kayfiyyat tarkīb al-ıflāk, by Jauzjānī; the author of this book is mentioned unkindly in several of Shīrāzī’s works), al-Tadhkira (by Ṭūsī), al-Muḥāṣsrāt (?), Muntahā al-ıdrāk (perhaps Muntahā al-ıdrāk fī taqṣīm al-ıflāk, by al-Khiṣraqī, al-Ṭubṣira (perhaps Kitāb al- Ṭubṣira fī ʾilm al-hayʿa, also by al-Khiṣraqī, another one of the authors mentioned by Shīrāzī in his astronomical works). Ibid.

9 Quṭb al-Dīn Shīrāzī, Nihāyat al-ıdrāk fī ʿilm al-ıflāk, Köprülü MS 957, 2r.

we will, see portions of the *Nihāya/Limit* – the chapter on the upper planets, for example – consist of Ṭūsī's words interspersed with explanations and amplifications by Shīrāzī, thus complying with the basic format of a commentary. It should also be noted that the quotes from Ṭūsī's work are offered without attribution, as Shīrāzī's express claim in the introduction apparently obviated the need for any additional mention of the *Tadhkira/Memoir* in the body of the text itself. Furthermore, Shīrāzī does not consider himself as strictly bound to the material in the *Tadhkira/Memoir*: Indeed entire sections of the *Tadhkira/Memoir* are not referenced at all in the *Nihāya/Limit*. As we will see, one of Shīrāzī's goals, was to use the commentary genre as a basis for presenting his own ideas. He appears for much of the book to have followed Ṭūsī's conception of producing a primer for hay'a, but was also willing (with mixed results, as we shall see) to reject the actual scientific content of his predecessors Ṭūsī, and al-'Urḍī. Shīrāzī's implicit goal in writing the *Nihāya/Limit*, appears to have been to supplant Ṭūsī's *Tadhkira/Memoir* by addressing some of the perceived shortcomings in Ṭūsī's work.

In the conclusion of the *Nihāya/Limit* Shīrāzī writes:

> And this is the end of the book and thanks to God, the inspirer of judgement, for this is what was allowed by my disposition and thoughts, wounded [as they were] by the knocking about of the years … and uncountable preoccupations … while I was exerting the limits of my power in the uncovering and the rendering of meanings together with the abridgment and summarizing of their rules. And I produced solutions that had not occurred to anyone prior to me ....

The solutions that Shīrāzī alludes to are a clear reference to his proposed configurations for the orbs of the planets vis-a-vis those proposed by Ptolemy and by Shīrāzī's predecessors in the

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11 Ṭūsī's discussion of his implementation of the "Ṭūsī couple" in the configuration of the planetary orbs, which occupies a good portion of Book II, Chapter 11 of the *Tadhkira/Memoir* is only referenced, for example, in the briefest fashion, allowing Shīrāzī to champion alternative models instead.
Islamic world. In his implicit claim to having produced superior results Shīrāzī is conjuring the perceived inadequacies with Ptolemy's work that were the driving force for the science of *hay’a* in the Islamic world. In addition to affirming Shīrāzī's notion of having succeeded where others had failed, the subsequent text asks for a fair assessment of his work from his readers:

> And I beseech the reader of my book to avoid hastening toward the rejection of that with which he is not familiar or that which is opposed to his nature; rather it is incumbent upon him to look intently [at the book] and to avoid being inconsiderate, and subsequently to follow the path of denial or of admission … and [also I ask] that he correct what has befallen it [i.e., the book] as far as faults and corruption … And that he remember me with his most honest prayer … as Aristotle says in his Metaphysics. It is not meet to thank him who says much in regards to the Truth, rather it is meet to thank him who says little. This despite the fact that that which we have said is not inferior to what [our predecessors] have mentioned nor is it lesser; it is superior, rather, and greater.¹³

Though Shīrāzī claimed earlier to have written the *Nihāya/Limit* for the beginner as well as for the advanced astronomer, it is the experienced practitioners who are likely being addressed in this passage. Novel theoretical work in *hay’a*, concerned as it was with the structure of the cosmos itself, could not have avoided a certain tension with the models that Ptolemy had proposed. By exhorting the reader to not judge his models too hastily, Shīrāzī may also have been acknowledging the difficulties in proposing planetary configuration different from what appeared in the authoritative tradition of Ptolemy. However, by invoking Aristotle's authority immediately prior to his confident claims in regards to his own innovative work in astronomy Shīrāzī appears to be hearkening to an even greater authority on physical theory, i.e., Aristotle, from whom the principles of *hay’a* and of natural philosophy ultimately derived.¹⁴ This is

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¹³ Ibid.
suggested in the same section of the *Nihāya/Limit* itself; for, following his appeal to his colleagues for an unbiased appraisal, and subsequent to re-iterating the list of authoritative books alluded to in the introduction, Shīrāzī invokes the principles of *hay’a*:

> And perhaps this can be understood by reading the well-regarded books composed on this topic, some of which have been indicated in the introduction to this book; and by comprehending their meanings and understanding the fundamentals of their principles and then [by] a comparison between them and this book in order to distinguish the chaff from the kernel and the Lord is the inspirer of truth and well-guidedness. From Him is the beginning and to Him is [our] return. And since God has granted me the completion of what I had intended … we end the book thanking God....

Shīrāzī’s statement, that his cosmological models and those of his colleagues should be judged by “the fundamentals of their principles” is important in that it references one of the main preoccupation of the *hay’a* authors, i.e., the desire to render the workings of the universe in a physically consistent manner.

Though Shīrāzī’s other major work in Arabic under consideration here, the *Tuhfa/Offering*, was written on the same topic as the *Nihāya/Limit*, Shīrāzī’s ostensible aims, as expressed in the introduction are different for this work. As we saw, this book was also completed in Sivas after a period of four years from the completion of the *Nihāya/Limit*. We know from historical sources that Shīrāzī was preoccupied with issues other than the writing of astronomy books for much of this period. Among other things he ended up travelling to Cairo on a diplomatic mission and (while in Cairo) he eagerly searched for books to aid him in the completion of his commentary on Avicenna's *Canon*. In addition one of his principal patrons, Shams al-Dīn Juwaynī, to whom, as we saw, the *Nihāya/Limit* was dedicated, was executed

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during this period. In the introduction to the *Tuḥfa/Offering* Shīrāzī states:

> Verily the neediest of God's creatures Maḥmūd ibn Masʿūd al-Shīrāzī, may the Lord make his [earthly] ending an [admirable] one, says if it weren't for the convention that permits the lesser to [offer entertainment] to the greater [then it would be the sanctuary of their company], and the dependence upon their strength, and the pride in associating with them, [and independence through reliance upon them that would compel the weak to seek this association]. When I discovered this custom, I followed this path and commenced on [observing] this custom, seeing fit according to the bestowal of gifts to the kings of one of the two countries [?] to bestow upon … the son of Muʿtaz ibn Ṭahir … Muḥir al-Dīn Amīr Shāh … a gift that would remain for eternity and not be diminished by the passing of years and months.\(^{17}\)

Rather than having been written for fellow astronomers then the *Tuḥfa/Offering* was apparently conceived, at least as far as Shīrāzī claims in his introduction, as an offering to a powerful patron, with a view to establishing or strengthening a client-patron relationship. That this is so is suggested in the rather matter-of-fact admission of the propitious nature of such an association in the fragment quoted above. In order to provide a motive for his *choice* of offering, however, Shīrāzī begins by extolling his patron Muḥir al-Dīn's love of knowledge. “And since I had seen that knowledge was to him that which was most desirable and the most glorious of gifts before him I chose from among them the science of *hayʿa*, which praises the revelation sent to His two worlds, by virtue of His glorious words: "Those who mention God standing and sitting and recumbent upon their sides, thinking about the creation of the heavens and the earth. The Lord has not created these in vain (The Qurʿān 3:191)".\(^{18}\) In a passage that parallels a similar one in

\(^{17}\) Quṭb al-Dīn Shīrāzī, *al-Tuḥfa al-shāhīya*, BN Arabe MS 2516, 1v.

\(^{18}\) Ibid.

و لما رآيت الحمامة أفضل مراغوب فيه عنه و أجل متحف به لديه اخترت منها علم الهيئة الذي اتني التنزيل على عالميه بقوله
the *Nihāya/Limit* (but is considerably shorter) Shīrāzī also praises the virtues of astronomy as the most excellent science and then resorts to the same rhetorical device as in the *Nihāya/Limit*, embedding the precedent for the *Tuhfa/Offering* in the language describing the nature and content of the book itself:

And I composed a book to appear with his name and with [excellent words] and principles and the most elegant discourses including the indications to treasures that are the glimmers of the “limits of attainment” and hints to the secrets that are the glances of the “understanding of the heavens” while striking against [?] the falsehood in this art, and turning away from that which is subordinate to Truth; [our book rather] being confined to that which has resulted from our thoughts, and that upon which our opinion has settled, with no calumniation against the books of our companions, for there is nothing better than for us to urge on opposition in error toward agreement in the correct method.\(^{19}\)

That criticism of the faulty work of other astronomers is not included in the *Tuhfa/Offering* hints at a major difference between this book and its predecessor the *Nihāya/Limit*. This point is more clearly stated in the subsequent text:

Let it be known that if something has not been mentioned in it, it will have been mentioned in the books of our companions, furthermore [its omission here] is due to its being disparaged by people of understanding; and it is incumbent upon him who wishes to be informed of it to refer to our book entitled “*The Limits of Attainment in the Knowledge of the Spheres*” in order to distinguish with it the kernel from the chaff and lo, I start the book called the Royal Offering organized in four chapters, asking the Lord, the inspirer of what is good, to aid in its completion, for verily He is the granter of success and to Him is our return.\(^{20}\)

\(^{19}\) Ibid.

\(^{20}\) Quṭb al-Dīn Shīrāzī, *al-Tuhfa al-shāhīya*, BN Arabe MS 2516, 1v.
In addition to advertising the *Nihāya/Limit* as a reference source for astronomy, Shīrāzī is again claiming here that the *Tuhfa/Offering* contains only true astronomical knowledge and that unsuccessful theories, some of which, Shīrāzī appears to be claiming here, were presumably included in the *Nihāya/Limit*, have been omitted. Shīrāzī's stated purpose in the *Tuhfa/Offering*, then, was to provide the science of astronomy in its practical and applied form, i.e., without distracting commentaries and discussions. We will have opportunity to return to the discussion of the *Tuhfa/Offering* and its contents in the subsequent chapter of this study. In the conclusion of the *Tuhfa/Offering* Shīrāzī alludes to the practical and utilitarian qualities of this work and refers yet again to the vicissitudes of fate, specifically listing the practice of law and teaching of having served as distractions during the composition of the *Tuhfa/Offering*:

And this is what was allowed by my dull disposition and my abated understanding in the midst of what I was obliged to [face] as far as the circumstances of loathsome affairs and the perseverence of irksome worldly pursuits, including law and teaching... I have offered [it] as a token of service to his highness of the treasury of the great lord and the noblest master and as a gift to his [noble] presence; May the Lord preserve his [protective] shadow upon the totality of his servants and his clients .... And I hope that this servant's book falls into favor and that he, glory to him, is capable of obtaining his desire in regards to his fine pursuits ... and in regards to that which he wishes for. And I hope to God that he grants success to the [reader] so that the benefits of [the book] can come to him, and that [the reader] forgive me for an oversight should he stumble upon it, for I myself am dismayed by my errors and recognize my feebleness. And thanks be to God who guided us to this for we are unguided unless God guides us...

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21 That these would have been included in the *Nihāya/Limit* as a more comprehensive reference work for the astronomer are of course understandable.

Shīrāzī then concludes with the time and place at which he completed this work. Indeed, as Shīrāzī states, the very name of the his book is a reference to the name of the dedicatee, Mujīr al-Dīn Amīr Shāh, by the inclusion of the word shāh (king, in Persian). This only serves to highlight the conception of the book, as a commissioned work; or, at least, one that is closely associated with the relationship of clientage between the patron and the author.

The *Tuhfa/Offering* appears to share this naming method with Shīrāzī's other work under consideration in this study, the *Ikhtiyārāt/Selections*; for the name of the work (*Ikhtiyārāt-i Muẓaffarī*) refers to the title of the dedicatee (Muẓaffar al-Dīn). Shīrāzī begins the *Ikhtiyārāt/Selections* with a somewhat literary invocation (in Persian):

> Untold thanks and adoration is meet for the … Builder who has adorned the glass vessel [of the sky] with the gleaming pearls of the stars and the blazing jewels of the planets … the Sage who has placed the scabbard of the sword of vengeance in the grasp of Saturn, the Savant who has sheathed Jupiter with a cloak of prosperity in the seat of lordship, the Victor who has appointed Mars as sheriff in the fifth realm, the Sovereign who through the gilt disk of the Sun—which is as the pupil of the entirety of creation—has illuminated the upper and lower parts of the metaphorical world, the Beneficent who has placed the organon of arts beside famed Venus, so that [one such as] the itinerant Moon has fashioned its melodies into his dervish's cloak. the Ruler who has placed the pen of management in the hands of Mercury, who is the administrator [secretary] of the second realm…. the King whose wizard-like might has tossed seven pairs [!] of gilt dice in this azure bowl, and has set thousands of crystal game-pieces in the twelve mansions of this kohl-darkened plot, so that through their influence his geometer-like wisdom could, at times, set the token of the actions and of the appointed times for the creatures of the world moving gainfully in creation and existence and, at other times, leave these stationary in the realm of death and nonexistence. For creation and dominion are His alone. May God, this best of creators, be blessed.

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23 Both of these works, then, stand in contrast to the *Nihāya/Limit*, the title of which does not allude to the patron Juwaynī. This is consistent with Shīrāzī claim that the *Nihāya/Limit* was written as a work of reference for astronomers.

Rather than describing the impetus for the writing of the *Ikhtīyārāt*/*Selections* as having been the desire to cultivate a relationship of clientage with a courtly patron (as he does in the *Tuhfa*/Offering), however, Shīrāzī begins by praising astronomy and proceeds to criticize Ptolemy while alluding to the considerable effort expended by Shīrāzī's predecessors in ridding the Ptolemaic system of its perceived flaws.

So says the author of these lines … [Shīrāzī] that since the noblest kind of mathematics – that is a part of the theoretical sciences – is the science through the acquisition [itself] of which the human soul is ennobled by the knowledge of the configuration of the heavens and the earth and the number of the orbs and the quantities of the motions and the extent of the distances and the bodies and the situation of the simple bodies that are parts of this world is generally achieved, a considerable portion of my life was spent in discussing and searching for it. And since that science, in the manner in which the expert in this art, the master of the Almagest has described was not devoid of great difficulties and the pre-eminent ones and the moderns … had assiduously exerted a great deal of effort in solving the problems and uncovering the intricacies – and had come up short – resorting to various tricks and innovative rules, some reversing the directions of the motions from that which the master of the Almagest had stated and some leaving them as they were, [yet all of them] increasing the confusion of the orbs, and truth be told, to a person, none could fulfill this duty or emerge from within its confines, some by their own admissions and some according to our inference as to the corruption of [their physical] laws [I was obliged to write this work].

It is worth noting here that Shīrāzī's mention of Ptolemy stands somewhat in contrast to his practice in the introductory sections of both the *Nihāya*/Limit (where the works themselves rather than the authors are mentioned) and the *Tuhfa*/Offering (where the astronomical works are alluded to in the abstract). And, while the increase “in the confusion of the orbs” parallels Shīrāzī's claims of success in theoretical astronomy in the other two works, here his description

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25 Ibid., 2r.
of the failure of other astronomers is more descriptive, referring clearly to the model-building activity focused on describing and predicting planetary motion. Finally this passage is both a concession to one of the primary wellsprings of the *hay'a* tradition (i.e., the *Almagest*), as well as an explicit description of one of the main driving forces behind the works of Shīrāzī and his fellow astronomers in the Islamic world, namely that they viewed Ptolemy's work as faulty and in need of improvement.  

Shīrāzī then alludes to his success in treating the theoretical problems that have stymied his predecessors while somewhat stiltedly ascribing the genesis of *Ikhtīyārāt/Selections* to the request of his patron:

And since the [arm of victory] was adorned by the blessing of divine endorsement and the visage of that which was yearned for was embellished by the necklaces of Godly benefaction and the cloak of anticipation and mask of concealment removed from the countenance of the aims of the author of these lines so that the solution of those problems were facilitated for him—whether through consulting the books of the experts of the art or through induction and the application of thought and vision, he desired, for the purpose of the safeguarding of excellence and the participation of other seekers … to publish it and to preserve it from the affliction of obliteration and dispersal, and to present it to the seekers of the [true] path and betterment who have set their wills to the seeking of truth, and by virtue of this expedient he composed the book “the Limits of Attainment in the Understanding of the Orbs” and due to the fact that that book included the limits of the thoughts of the ancients and the farthest extent of the views of the moderns and [since] for the purposes of the beginner the criticism and dispraisal of each of these and the recognition of that which is the preferred method from that which isn't appeared difficult, this was the inception of a mental disquiet regarding the need for preserving the preferred method and the summary of its secrets. During these thoughts … there transpired an indication by … [Mużaffar al-Dīn] towards this sincere supporter and blameless adherent to arrange some chapters on the description of the orbs and the bodies and to beautify the ink of the explication of those inviolate meanings with Persian words so that it may benefit those of high rank and low ….  

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Thus, according to Shīrāzī’s introduction, *Ikhtīyārāt/Selections* was written subsequent to the *Nihāya/Limit* and that the work served a double purpose: both to preserve for the beginner what Shīrāzī considers the “preferred” method (or the select ones, whence the title of the work), and to preserve this knowledge in Persian, a language with which the patron of this particular work may have had a greater facility than with Arabic. Shīrāzī proceeds, as he did in both of his other work offering the same tropes of humility and meekness, begging forgiveness for the inadequacies of his book before starting his discussion of astronomy proper.  

In the conclusion of the *Ikhtīyārāt/Selections* Shīrāzī again formally asks the patron to overlook the faults of the book, and echoes his wish in the *Tuhfa/Offering* (but not the *Nihāya/Limit*) regarding the usefulness of the book for the practical aims of the patron:

And as what we promised in the introduction of the book has been accomplished, we [conclude the chapter with this problem, and the section with this chapter, and the book with the section]. Were it to be found pleasing to the illustrious intellect ... of that noble personage, fate will have assisted the success of the yearnings and the attainment of the desires of this sincere and blameless supporter. And if due to a transgression of the pen or fault of expression or feebleness of meaning or discordance of import [the book] is deprived of the exaltation of finding favor it is hoped, from that fount of excellence and generosity and that source of goodly character, that he cover it with the cloth of forgiveness [as] pardoning such errors by such a source of generosity itself requires no excuse ....

Shīrāzī then makes an allusion to the vicissitudes facing him during the composition of the *Ikhtīyārāt/Selections* (again echoing his words in the *Nihāya/Limit* as well as the *Tuhfa/Offering*) before calling more blessings upon the dedicatee and concluding his work.

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30 Ibid.
Though, as we have seen, Shīrāzī uses some of the same tropes in the introduction to all three of his works (e.g., the hardships faced by the author during the composition of the work, and the confident affirmation of his success in advancing the frontiers of astronomy) two of the features of *Ikhtīyārāt/Selections* are rather striking and should be pointed out. The first, of course, is the metaphor-laden opening, that has no parallel in the other two works, and clearly alludes to astrology as an important practical application of sound astronomical knowledge. This can be seen in the metaphor of God as a dice-player rolling his dice in the “azure bowl” with the stars represented, metaphorically as “thousands of crystal game-pieces in the twelve mansions of this kohl-darkened plot.” And it is through the influence of these stars that the creator can “at times, set the token of the actions and of the appointed times for the creatures of the world moving gainfully in creation and existence” or accomplish the opposite. (These words suggest, at least, that the patron's “noble pursuits” and his goals that are to be achieved via the *Tuhfa/Offering* may very well be astrology-related, as well.)

The second feature has already been pointed out and is Shīrāzī's discussion of the difficulties facing Ptolemaic astronomy and the great deal of effort that had been expended in emending his astronomical theories. As concise and cogent a description of a centuries-long *hay'a* tradition as this passage represents, it seems a bit out of place immediately following the literary introduction, and indeed raises the question: why didn't Shīrāzī include a similar statement in the introduction to the *Nihāya/Limit*, i.e. the text that is considered his seminal work?31 There is no way to answer this question with certainty, but the fact that this concise and forceful phrasing appears in the *Ikhtīyārāt/Selections* suggest that the author considered this book

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31 Recall that in the introduction to the *Nihāya/Limit* Shīrāzī makes at this point a claim to having compiling the best of the works of the ancients and the moderns in his book.
to be a serious work in its own right.

Despite the similarities seen so far between the Ikhtiyārāt/Selections and the Tuhfa/Offering, Shīrāzī does not spell out whether or not preserving the “preferred method” involved omitting from the Ikhtiyārāt/Selections astronomical knowledge that would have been included in the Nihāya/Limit. In the upcoming discussion we will therefore have the opportunity to examine this in an effort to verify Shīrāzī's claims as to the genesis of his books. However, based on the information presented by the author, of the three books, the Nihāya/Limit appears to have been the primary work, with the other two works having in some sense been derived from it; with the Tuhfa/Offering focusing primarily on the accepted (or “preferred”) astronomical theory, and the Ikhtiyārāt/Selections representing a rendition of the Nihāya/Limit in Persian.32

In the most general sense, however, the three works share Shīrāzī's aim in providing the reader with a theoretically sound description of the cosmos. Indeed, while reading the Nihāya/Limit and Shīrāzī's other two works listed in the study one can hear echoes of Ibn al-Haytham's purpose for the composition of his Maqāla/Treatise, namely, the transmission of “that which we understand of these sciences in order to instruct him who wishes to arrive at its comprehension without investigating.”33

C. The Structural Outline of the Works in Question.

The similarity of the outline of the Nihāya/Limit and Tuhfa/Offering to Ṭūsī’s Tadhkira/Memoir, as far as the outlines of these works are concerned, was first pointed out by

32 Yet, despite his claims to the contrary Shīrāzī includes more a number of models for Mercury in the Tuhfa/Offering (Saliba, personal communication).
33 Alhazen, Ibn al-Haytham's On the Configuration of the World (New York: Garland, 1990), 55; Alhazen, Ibn al-Haytham's On the Configuration of the World, 55. It should be noted as with Ṭūsī's Tadhkira/Memoir, the reader of Shīrāzī's works is generally referred to the Almagest for the mathematical proofs of the topic under discussion. The notable exceptions in this case are discussions involving novel formulations such as the Ṭūsī couple. See Ṭūsī, Naṣīr al-Dīn al-Ṭūsī's Memoir, 36.
This is in keeping not only with the influence that the great Ṭūsī must have exerted upon his student but is also with the influence of Ṭūsī’s Tadhkira/Memoir in particular on the subsequent history of astronomy in the Islamic world.\(^{35}\) Ragep, who is responsible for the modern edition of the Tadhkira/Memoir, notes the fact that Ṭūsī himself was indebted for the structural outline of the Tadhkira/Memoir to al-Khiraqī.\(^ {36}\) The table of contents for each of the three works by Shīrāzī has been listed in Appendix 4-B. The table of contents for the Tadhkira/Memoir has been reproduced from Ragep's edition of this work in Appendix 4-C. In addition to the two Arabic works the debt of the Ikhtīyārāt/Selections to Ṭūsī’s earlier work (and, indirectly, to al-Khiraqī) can be discerned at once. The organizational scheme in each of these books appears to be identical: In each work we have four books, the first containing introductory material, the second containing the configuration of the heavens, the third the configuration of the earth, the fourth on measuring the distances of celestial bodies.

As far as Shīrāzī’s books some cursory observations about the layout of the three and their relations with each other are included below:

**Book 1:** The division of the first book into three chapters is the same in all three works.

**Book 2:** The arrangement of the *second* book of the Ikhtīyārāt/Selections follows that of the Nihāya/Limit. The chapters are arranged slightly differently in Tuhfa/Offering, however.

Chapter one of the Nihāya/Limit contains materials that forms chapters 2, 3, and 4 in the Tuhfa/Offering.

**Book 3:** The Ikhtīyārāt/Selections and Tuhfa/Offering are in agreement as far as the arrangement of the third book is concerned. The minor difference between this book as it appears in these two works and the third book of the Nihāya/Limit is in the ordering of the chapters. Using the


\(^{36}\) Ibid., 36.
numbering of the chapters in the Nihāya/Limit, these chapters are arranged as follows in 

*Tuhfa/Offering* and the *Ikhtīyārāt/Selections*: 1, 2, 3, 4, 5, 6, 7, 11, 8, 9, 10, 12, 13. So, in the 
two later works, the material in chapter 11 of the Nihāya/Limit appears prior to the material that 
is presented in chapter 8 of the Nihāya/Limit.

Book 4: The *Ikhtīyārāt/Selections* and *Tuhfa/Offering* are in agreement as far as the arrangement 
of the fourth book is concerned. This book consists of three chapters in each of these books. In 
contrast the fourth book of the Nihāya/Limit contains 10 chapters. The titles of chapters 1, 2, 
and 3 in *Tuhfa/Offering* correspond roughly to chapters 1, 9, and 10 in the Nihāya/Limit.

In the next section of this chapter (section D) we will discuss results of the current 
study indicating that the *Ikhtīyārāt/Selections* was written prior to the *Tuhfa/Offering*. Given the 
close correspondence of these works for Books 1, 3, and 4, the evidence suggests that except for 
the second chapter the *Tuhfa/Offering* was modeled on the *Ikhtīyārāt/Selections*, rather than on 
the Nihāya/Limit.

It is Book 2, however, that contains the celestial models that are the specific subjects 
of this study, and in this chapter the *Ikhtīyārāt/Selections* is more similarly organized to the 
Nihāya/Limit, with the *Tuhfa/Offering* deviating somewhat from these two. Shīrāzī himself was 
well aware of the importance of this chapter for in the Nihāya/Limit he refers to it as the “main 
part of the book.”


And the true [account] in the resolution of the problem of Mercury rests upon the visualizing of its orbs in the 
manner preferred by us. We will thus describe first the orbs of the other planets in the manner in which these [are 
commonly accepted], indicating that which is preferred by us within it, we will then follow this at the end with the 
solution of Mercury and some of what remains from what we have promised to cover, then concluding the chapter
When discussing the orbs of the planets in this chapter Ṭūṣī follows a regular scheme by first discussing relevant observational data are discussed, and then presenting the number and alignment of the orbs, followed by the motions of these orbs, and the anomalies associated with the motions.\textsuperscript{38} The outline of Shīrāzī's chapter on the upper planets in each of the works appears in Appendix 4-D. As can be seen this scheme of Ṭūṣī's is present, with some modifications, in all three chapters. In the chapter on the upper planets perhaps the most significant difference, as far as the layout of the chapters is concerned comprises of a set of Shīrāzī's commentaries following the discussion of the planetary anomalies in the Nihāya/Limit and the Ikhtīyārāt/Selections (sections 5, 6, and 7 in Appendix 4-D). As far as the Tuhfa/Offering a good deal of this material is omitted outright, consistent with Shīrāzī's claims.\textsuperscript{39} We will look at Shīrāzī's commentaries following the discussion of the planetary anomalies in some detail in Chapter 5. The text of the first section (i.e., section 1 in Appendix 4-D, on the phenomenological observations of the upper planets as they related to the configuration of the orbs) is reproduced in Appendix 4-E, to provide the opportunity for a side by side comparison of the Tadhkira/Memoir, the Nihāya/Limit and the Ikhtīyārāt/Selections. As can be seen there are many instances were the texts parallel each other; but there are as well many places in which the three texts diverge.

D. Chronology Revisited

The chronology that was presented in the first two sections of this chapter is complicated considerably by a reference to the Ikhtīyārāt/Selections in the text of the Nihāya/Limit itself. This occurs in Shīrāzī's discussion of the equant in the chapter on the upper planets (i.e.,

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\textsuperscript{38} Ṭūṣī, Naṣīr al-Dīn al-Ṭūṣī's Memoir, 416.

\textsuperscript{39} Yet, even in the Tuhfa/Offering Shīrāzī apparently includes more than one model, as he claims to have to done so for the case of Mercury (Saliba, personal communication).
Comparing the behavior of the equant for the Moon and the upper planets and the constraints these place on the issue of alignments he writes: “And its true cause is uniformity of motion, since for every sphere, the center of which is moving about a point with uniform motion, there exists a diameter that is aligned with this point, regardless of whether this point is at the center of the orbit of the sphere's center or not. And we have explained this in detail in the Ikhtiyārāt-i Muzaffart, to which it is incumbent upon you to pay heed should you wish to be informed of it.”

This remarkable statement appears in the margin of the Köprülü 957, but has been incorporated into the body of the text in the later manuscript Köprülü 956. It is not clear at first how this cross-referencing could have come about. It is certainly conceivable that sometime after the completion of the Nihāya/Limit in the Winter of 1281 C. E. Shīrāzī added an improved treatment of the equant in regards to the Moon and the Upper Planets as a marginal note in the Köprülü 957 manuscript, written at the end of the Summer of 1282 C. E. Certainly the fact that this reference appears in the body of the text in Köprülü 956 indicates that this date is an effective upper limit on the date of composition for the Ikhtiyārāt/Selections. As we will see subsequently the Ikhtiyārāt/Selections must predate certain emendations that appear in the Köprülü 957 manuscript, because the text of the Ikhtiyārāt/Selections reflects the earlier versions of this text as it appears in the Nihāya/Limit. Unfortunately, there is no way of dating the marginalia in Köprülü 957 (other than stating that they were carried out prior to the completion of Köprülü 956). For this reason the best we can do at present is to leave the date for Köprülü 956 as the upper limit for the completion date of the Ikhtiyārāt/Selections.

Given the similarities of the texts of the Nihāya/Limit and the Ikhtiyārāt/Selections is it

40 Quṭb al-Dīn Shīrāzī, Nihāyat al-īdrāk fī dirāyat al-aflāk, Köprülü MS 957, 72r.
41 Quṭb al-Dīn Shīrāzī, Nihāyat al-īdrāk fī dirāyat al-aflāk, Köprülü MS 956, 58v.
42 The proposed ordering is then:
possible that the *Ikhtyārāt/Selections* was written prior to the *Nihāya/Limit*? The precedence for a Persian work on *hay'a* serving as the source of one in Arabic exists in the *al-Risāla al-mu ṭinīya* (or the *Risāla-i muṭinīya*, in Persian) which was viewed as a precedent for *Tadhkira/Memoir* by Ragep. This possibility is remote, however, and should be discounted as will be shown based on evidence from the texts themselves. For now the best we can do is accept Shīrāzī’s assertion that the *Ikhtyārāt/Selections* was a rendition of the material in the *Nihāya/Limit* into Persian, but with the understanding that these books were written close enough in time for Shīrāzī to be able to reference the *Ikhtyārāt/Selections* in two of the earliest surviving copies of the *Nihāya/Limit*.

**E. Chapter on the Hypotheses.**

Chapter five of the second book of the *Tadhkira/Memoir* is entitled “On basing some of the apparently irregular motions upon models that bring about their uniformity.” The Arabic word *aṣl* (plural *uṣūl*), translated as “model” by Ragep, can also be translated as a principle or axiom. In this chapter Ṭūṣī presents his discussion of motions via epicycles and eccentric orbs (following the Almagest III.3), demonstrating – among other things – the well-known equivalence of eccentric motion to a motion composed of concentric and epicyclic components of prescribed angular motions, a formulation generally ascribed to Apollonius. Not surprisingly, given the close correspondence of the table of contents to Ṭūṣī’s work, each of Shīrāzī’s three works has an analogous chapter, though the contents of these three chapters are somewhat varied. The corresponding chapter in the *Tuhfa/Offering*, entitled “On the Ascription of Apparently Irregular Motions Known Through Observation to Hypotheses That Entail the Possibility of Their Arising from Orbs,” has been translated and edited by Morrison. Morrison

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44 Ibid., 130.
46 R. Morrison, “Qutb al-Din al-Shirazi’s Hypotheses for Celestial Motions,” *Journal for the History of Arabic*
translates the word *aṣl* as hypothesis, thus preserving the sense of the word in its original Greek, for it is apparent that the sense in which Ptolemy understood hypothesis, was as a physical device used to mimic or model the motion of the celestial bodies.\(^{47}\) Morrison's article includes a discussion of how Shīrāzī's conception of these *uṣūl* was different than that of earlier astronomers and especially Ṭūsī's, who, unlike Shīrāzī, did not include formulations such as his own “Tusi Couple” in his chapter on the “models.” Ṭūsī discusses the “Tusi Couple,” in both planar and spherical variations in a chapter entitled “An indication of the solution – of that which is amenable to being solved – of the difficulties referred to previously that arise from the aforementioned motions of the planets.”\(^{48}\) As can be seen in the *Nihāya/Limit*, Shīrāzī's conception of the *uṣūl* is precisely as mathematical formulations akin to the “Tusi Couple” that could be used to solve the “difficulties” arising from planetary motions. In Chapter 2.5 of the *Nihāya/Limit* Shīrāzī, therefore, presents a list of nine “hypotheses” (including those of the eccentric and the epicycle, but also the “Tusi Couple” and the formulation based on ‘Urḍī’s Lemma), with each referring to an irregularity of motion for which they represent a solution.\(^{49}\)

The list of the *uṣūl* as they appear in the *Nihāya/Limit*, together with corresponding material in the other two works has been reproduced in Appendix 4-F. A comparison of the hypotheses between the *Nihāya/Limit* and the *Tuhfa/Offering* (i.e., columns 2 and 3 in Appendix 4-F) demonstrates that in the short period between the composition of the two works Shīrāzī's thinking in regard to the “hypotheses” appears to have been changing, for the number of irregularities of motion which he uses the *uṣūl* to address is fewer by two, in the *Tuhfa/Offering*.

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than in the *Nihāya/Limit*. Perhaps the most striking difference in the two works is the omission of one of the hypotheses, used in the *Nihāya/Limit* to treat the problem of the equant in the upper planets. We will have occasion to revisit shortly this “hypothesis” and a companion hypothesis that is present in the *Nihāya/Limit* but that was also omitted by Shīrāzī in the *Tuhfa/Offering*.

Also worth noting in regards to the “hypotheses” is the unusual features of the chapter on the *uṣūl* in the *Ikhtīyārāt/Selections*. As can be seen the material on the *uṣūl* is organized somewhat differently from the other two works. For one thing, many of the *uṣūl* themselves are scattered in the various chapters of Book 2. (In addition to Chapter 5, in the *Ikhtīyārāt/Selections* the *uṣūl* appear in Chapters 7, 8, and 9, as can be seen in Appendix 4-F). A brief look at the introduction of the *Ikhtīyārāt/Selections* Chapter 5 in Book 2 itself reveals that, unlike the analogous chapters in the other two works, it is formally divided into four sections. First, an “explication of the reason for fastness and slowness,” second, an “explication of the reason for retrograde, station, and direct motion,” third, on “the manner of imagining the corporeal orbs, in two and three dimensions,” fourth on the “generally accepted configuration of the orbs, and a [subtle] indication of the issues facing it.” The first two sections cover much the same material at the beginning of the *uṣūl* chapters in the other two works. As far as the discussion of “the manner of imagining the corporeal orbs” related material also appears in both of the corresponding chapters appearing in the *Nihāya/Limit* and the *Tuhfa/Offering*. The fourth section of this chapter, however (namely that of the “generally accepted configuration of the orbs”), is nowhere to be found in the corresponding chapter on the “hypotheses” in the other two works. As we will see in our discussion on the upper planets, material related to this section appears in a different location in the *Nihāya/Limit* and appears to have been omitted

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outright from the *Tuhfa/Offering*. Furthermore the location of the material labeled as the “generally accepted configuration of the orbs” in the *Nihāya/Limit* is a particularly important clue as to the organizational structure of this book and its relation to the other two works. This particular is an important indication of how Shīrāzī conceived of the organizational structure of the *Nihāya/Limit*.52

**F. On the Chapters on the Moon**

Noting the adequacy of the existing configurations of the orbs of the Sun repeatedly, Shīrāzī focuses instead on his models for the upper and lower planets and the Moon. In the *Nihāya/Limit* chapter on the Moon Shīrāzī describes its configuration as follows:

The first orb is the **parecliptic** which is also called the *jauzahr* since upon its perimeter there is a point called the *jauzahr*, with its convex surface being [inwardly] tangent to the concave of Mercury and its concave surface tangent to the convex surface of the second of its orbs which is called the **mā’il** (inclined) which is a spherical body bound by two parallel surfaces the center of the two which is its center, as well, of the world, with its concave touching the center of convex of the sphere of fire of the four elements as is generally accepted and with its equator inclined relative to the parecliptic with a fixed inclination the limit of which based on what has been found through observation is five parts and for this reason it has been called the inclined orb and its two poles are separated from the poles of the parecliptic in two reciprocal directions. The third orb is the **eccentric** in the thickness of the inclined orb in the aforementioned custom and its equator is in the plane of the equator of the inclined orb and with its two poles separated from the poles of the inclined orb in a single direction. The fourth orb is the **epicycle** in the thickness of the eccentric which carries it in a manner such that the distance of its center from the two poles of the eccentric is a single distance and the Moon is affixed within the epicycle in a manner such that its surface touches the surface of the epicycle at a point shared between the two and it accompanies its equator [i.e., that of the epicycle] which is the circle resulting from its [i.e., the Moon's] surface in the thickness of the epicycle, and this circle as we will

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52 It should be noted that *Ikhtīyārāt/Selections* exhibits a notable preoccupation with the “Conjectural Hypothesis”, the “Deductive Hypothesis,” and the “Innovative Hypothesis,” or the ḥadsī, istinbāṭī, and ibdāʿī. These adjectives are all based on Arabic nouns that have been transformed into adjectives in a practice that is common in the Persian-speaking world. In our discussion on the chapter on the Upper Planets we will be able to shed light on the the meaning of the first two, and clarify the relation of these to the hypothesis listed in the *Nihāya/Limit*. That these names are used in the *Nihāya/Limit* without being properly defined suggests that at least that some of the material upon which Shīrāzī drew to compose the *Nihāya/Limit* and the *Ikhtīyārāt/Selections* was written, or conceived of, in Persian. An explication of the ibdāʿī awaits future studies.
describe God willing is eternally in the plane of the equator of the eccentric and for this reason the Moon does not ever abandon the surface of the inclined orb and the equators of the parecliptic and the inclined orb intersect at two opposing points called the nodes. 

An illustration for this scheme appears in Figure 4-1. As has been noted by Saliba, a comparison with Ṭūsī’s lunar model as presented in the Tadhkira/Memoir chapter on the Moon indicates clearly that Ṭūsī’s model and Shīrāzī’s lunar model presented in the Nihāya/Limit chapter of the Moon are one and the same. Indeed the language of the two works bears a close affinity – again underscoring the debt of Shīrāzī’s work to Ṭūsī. In marked contrast to his model in the Nihāya/Limit, which contains four orbs, Shīrāzī's lunar model in the Ikhtīyārāt/Selections consists of six orbs, however. The first three orbs of this model, the parecliptic, inclined, and deferent orbs, are defined identically to the model in the Nihāya/Limit. Two additional orbs, are included in this model, one enclosing the other, with the Moon's epicycle nested in the innermost sphere. The orbs that make their appearance specifically for the Ikhtīyārāt/Selections are described as follows:

And the fourth orb is the encompasser, in the thickness of the eccentric in the accepted manner with its equator in the plane of the equator of the eccentric and its axis perpendicular to the plane of the equator of the inclined orb, and the fifth orb is the maintainer nested within the encompasser with its convex surface touching the concave surface [of the encompasser] at a single point and with its center separated from the center of the encompasser by the amount of the separation of the center of the corporeal (mujassam) deferent from the center of the world, and with its equator in the plane of the equator of the encompasser and its two poles [separated] in the same the direction from the two poles of the encompasser and its axis parallel to the axis of the encompasser.

53 Ḍūṭba al-Dīn Shīrāzī, Nihāyat al-īdrāk fī dirāyat al-aflāk, Köprülü MS 956, 44v.
55 Ṭūsī, Naṣīr al-Dīn al-Ṭūsī’s Memoir, 149-150.
56 Ḍūṭba al-Dīn Shīrāzī, Ikhtīyārāt-i Mużaffarī, Ayasofya MS 2575, 84r.
In the Ikhtīyārāt/Selections section immediately preceding the fragment listed above Shīrāzī refers to an “imaginary deferent” (mutawahham) in contrast to the corporeal deferent seen above, stating in regard to it “and the third orb is the orb of the eccentric in the thickness of the inclined orb as is well-known … with its distance from the center of the world equal to half of that which is generally accepted … since this is the distance of the center of the imaginary deferent from the center of the world, not that of the corporeal deferent.” This adjustment, the establishment of a new center for the deferent, is just what is needed to allow for the inclusion of ‘Urḍī's Lemma in the configuration of the Moon. What is critical to achieving al-‘Urḍī's configuration, however, is not only the location of the center of the new deferent but the direction of the rotation of the encompasser relative to the rotation of the deferent. ‘Urḍī's Lemma configuration depends on these two rotations to be in agreement (i.e., have the same direction or sense). Shīrāzī indicates his reliance on ‘Urḍī's Lemma (in the Ikhtīyārāt/Selections model for the Moon) by indicating that the the motions of both the deferent and the encompasser orbs are sequential, i.e., in the direction of the order of the signs. As a result, the motion resulting from the combination of the deferent and the encompasser allows the center of the epicycle to move along the orbit predicted by Ptolemy's lunar model (or, rather, very close to it), while at the same time avoiding the physical contradictions of that model by having the epicycle center move upon a deferent while “rotating” uniformly about a point distinct from the center of the deferent. A schematic for Shīrāzī's configuration of the Moon in the Ikhtīyārāt/Selections appears in Figure 4-2.

Since Shīrāzī is known to have used ‘Urḍī's Lemma in his configuration of the Moon in

٥٥٥ دوقبط محيطه و محور موازي محور.
the *Tuḥfa/Offering*, as well, the question that is raised is why did he not do so in the *Nihāya/Limit*, given the fact that he relies on ‘Urḍī’s Lemma for his model of the Moon in the roughly contemporary text of the *Ikhtīyārāt/Selections*. The fact that the proof for ‘Urḍī's Lemma is presented in the *Nihāya/Limit* in the chapter on the upper planets only deepens the mystery.\(^{57}\) Why present this Lemma in this work and not use it for the configuration of the Moon (as Shīrāzī did, in both the *Tuḥfa/Offering* and the *Ikhtīyārāt/Selections*)? The question of the absence of ‘Urḍī's Lemma in the model for the Moon, is resolved, however, upon review of another section of the *Nihāya/Limit*, i.e., the section on the planetary latitudes.\(^{58}\) It is there, after a lengthy discussion of the planetary latitudes themselves that Shīrāzī presents a new lunar model, resembling that of the *Tuḥfa/Offering*, and relying on the ‘Urḍī's Lemma.\(^{59}\) The only sensible explanation appears to be that the earlier sections on the Moon in the *Nihāya/Limit* is devoted to the presentation of the “generally accepted models,” much as we saw in the chapter on the hypotheses in the *Ikhtīyārāt/Selections*. And it is only at the conclusion of the section on the latitudes (appearing later in the book) that Shīrāzī ventures his own models based on the earlier work of al-‘Urḍī.\(^{60}\) In regards to the section on the Moon, then, our findings appear to corroborate, in a general sense, the author's claims as to the nature of the *Nihāya/Limit* and the *Tuḥfa/Offering*. In the *Nihāya/Limit* chapter on the Moon, Shīrāzī presents an exposition of the lunar model in a commonly accepted form (relying on Ţūsī’s work in his chapter on the Moon (but not on Ţūsī’s proposals for a revised model based on the Tusi couple in section II.11). He


\(^{58}\) Ibid., 77r.

\(^{59}\) The location of this section is vaguely reminiscent of Ţūsī’s placement of the “Tusi Couple” in the *Tadhkira/Memoir*. Ţūsī, however, discusses the “Tusi Couple” couple, in a new section, as we saw. It is in this section that Ţūsī proposes a new model of the Moon relying on his new mathematical formulation.

\(^{60}\) The lunar model in the *Tuḥfa/Offering* is similar to the other two. The primary difference is that Shīrāzī's thinking with respect to the question of alignments had apparently changed and he no longer saw a need for a “maintainer orb.”
then follows this in a later section—rather confusingly appended to the conclusion of the chapter on the planetary latitudes—by his own proposed models. In the *Tuhfa/Offering*, however, Shīrāzī appears to cut to the chase, as it were, presenting his own models in the appropriate chapter; thus leaving the reader to consult the *Tadhkira/Memoir* and the *Nihāya/Limit* for the earlier (and Shīrāzī suggests, deficient) models of his predecessors.

Our findings in the previous section allow us to answer the question we posed in the second section of this chapter: Did the *Ikhtiyārāt/Selections* include earlier models that were considered erroneous or inadequate by Shīrāzī? Based on the evidence from the texts themselves it is apparent that while the chapter on the Moon in the *Tuhfa/Offering* is devoted to Shīrāzī's own model, the *Ikhtiyārāt/Selections* and the *Nihāya/Limit* contain two models each for the moon. In the *Ikhtiyārāt/Selections*, the earlier model based on Ṭūsī, is presented in the chapter on the hypotheses or *uṣūl*, whereas Shīrāzī's own appears in the chapter on the Moon proper.

**G. On the Upper planets.**

A comparison of the number of orbs included for the upper planets as they appear in each of the corresponding chapters in the *Nihāya/Limit*, *Tuhfa/Offering*, and *Ikhtiyārāt/Selections* indicates again that we are dealing with several models.\(^{61}\) This can be seen by referring to Appendix 4-D, section 2, “The Orbs.” For instance, it is at once apparent that Shīrāzī lists three orbs for each of the upper planets in the *Nihāya/Limit* (i.e., the parecliptic, the eccentric deferent, and the epicycle of the planet), whereas in the *Ikhtiyārāt/Selections* he lists six (i.e., the parecliptic, the eccentric, the encompasser, the dirigent, the maintainer, and the planetary epicycle), while in the *Tuhfa/Offering* the list has shrunk down to five (i.e., the parecliptic, the

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eccentric deferent, the encompasser, the inclined orb, the epicycle of the planet). As with Shīrāzī's treatment of the Moon, the material that appears in the Nihāya/Limit chapter dealing with the upper planets faithfully presenting what Ṭūsī has described in the Tadhkira/Memoir:

And so they established three orbs and three motions for each of the four [planets]. The first orb is the parecliptic. For Saturn, its convex surface is contiguous with the concave surface of the eighth orb, and its concave surface is contiguous with the convex surface of Jupiter's parecliptic. The concave surface of Jupiter's parecliptic is contiguous with the convex surface of Mars's parecliptic is contiguous with the convex surface of the Sun's parecliptic. The convex surface of Venus's parecliptic is contiguous with the concave surface of the Sun's parecliptic, while its concave surface is contiguous with the convex surface of Mercury's parecliptic. And the second is the eccentric deferent [that carries] the epicycle. It is located in the thickness of the eccentric and for this reason it is called the deferent and the planets are embedded in the epicycle.62

Indeed a comparison with the corresponding lines in the Tadhkira/Memoir indicates that in this case Shīrāzī is quoting verbatim from Ṭūsī’s book.63 The three additional orbs that appear in the Ikhtīyārāt/Selections, however, are introduced as follows:

So due to the situation of these planets they demonstrated [the existence of] three orbs. However, based likewise on empirical observations, that will be described in their place, [it is known that] the uniformity of motion is about the equant point and the alignment of the mean apogee is also with respect to the same point, and the inclination of the [epicyclic] diameter passing through the apogee and perigee [of the epicycle] relative to the inclined plane occurs in a specific manner, and none of [these phenomena] can result from the three [aforementioned] orbs, so we were compelled to add three orbs for each of these planets so that the sum was six orbs and six motions, and so that these observations could be derived from the proper arrangement of these orbs.64

Based on the second fragment Shīrāzī is concerned with providing a solution that addresses both the irregular motions of the deferents of the upper planets, as well as a coherent mechanism for

62 Quṭb al-Dīn Shīrāzī, Nihāyat al-idrāk fi dirāyat al-aflāk, Köprülü MS 956, 44v.
63 Ṭūsī, Naṣīr al-Dīn al-Ṭūsī’s Memoir, 181.
64 Quṭb al-Dīn Shīrāzī, Ikhtīyārāt-i Muṣaffarī, Ayasofya MS 2575, 106r.
the planetary latitude. Ṭūsī has already treated both of these issues, in the Tadhkira/Memoir, the first with the inclusion of a planar Ṭūsī couple mechanism and the second with the spherical Ṭūsī-couple.65 Shīrāzī’s exposition in the Ikhtīyārāt/Selections is thus a clear indication that he considered his own treatment to be superior to that of his teacher. Immediately after enumerating the orbs and the motions for the upper planets, Shīrāzī proceeds to describe the orbs themselves. The outermost orb, the parecliptic, is the same as it was in the Nihāya/Limit.66 In regard to the next orbs in the sequence, Shīrāzī writes:

The second is the **deferent** in the thickness of the parecliptic as is well-known and they call it the deferent, not because they have imagined that its equator is what conveys the center of the epicycle, for this is not true as will be shown, rather this is because the center of the epicycle is as one of the parts of the deferent. . . . And the third is the **encompasser**, with its center on the equator of the deferent and its convex touching the convex and concave of the deferent at two points and its equator intersecting the equator of the deferent by the fixed amount of the maximum inclination of the apogee of that planet. And the fourth is the **dirigent** centered on the center of the encompasser and enclosed with it, yet with its equator eternally in the plane of the equator of the deferent, and its axis intersecting the axis [of the encompasser] at [their centers]. And the fifth is the **maintainer** enclosed within the encompasser in a way such that its equator is in the plane of the equator of the encompasser and its center separated from the encompasser's center by the amount of the distance between . . . the center of the world and the center of the deferent . . . And sixth the **epicycle** orb within the maintainer such that their centers and equator and diameter are in agreement and with its equator never departing from the equator of the maintainer and the planet upon the epicycle moving along [the epicycle's] equator.67

65 Ṭūsī, Naṣīr al-Dīn al-Ṭūsī’s Memoir, 50.
66 Rather than following the scheme in the Nihāya/Limit, Shīrāzī follows al-`Urḍī’s scheme by placing Venus’s convex adjacent to the concave of Mars, as he does indeed for the Tuhfa/Offering, when he describes the order of the nested orbs. See note 60.
67 Qūṭ al-Dīn Shīrāzī, Ikhtīyārāt-i Muẓaffari, Ayasofya MS 2575, 106r.
An illustration for the Nihāyāt/Limit and Ikhtiyārāt/Selections configurations, as they appear in the two fragments above, appears in Figures 4-3 and 4-4. The addition of three new orbs, each with a specified inclination presents a rather more complicated picture in latitude (as well as in longitude), affirming Shīrāzī's claim as to his preoccupation with presenting a coherent description of latitude in his newly proposed model. Here we see Shīrāzī, as well, reiterating the distinction between what is the commonly (and falsely) assumed deferent (with its associated issues of non-uniformity of motion) and the “true” deferent (the so-called embodied or corporeal deferent which will be discussed subsequently), highlighting also Shīrāzī's conceptualization of the use of additional epicycles to treat the equant issue.

Since Shīrāzī is aware of 'Urdī's Lemma, having used it in the earlier section on the Moon, and since al-'Urdī himself has used this lemma in his modeling of the planets, it is natural to assume that Shīrāzī's arrangement for the upper planets in the Ikhtiyārāt/Selections relies on 'Urdī's Lemma.68 Further reading of this section in the Ikhtiyārāt/Selections conveys a startlingly different picture, however. For, in a description of the motions of the orbs he has decreed for the upper planets Shīrāzī writes:

And third the motion of encompasser equal to the motion of its own center meaning the motion of the eccentric of that planet such that in the manner that in the upper half it is against the motion of the eccentric meaning countersequential. And fourth is the motion of the dirigent as the motion of the encompasser exactly, in both direction and measure. And fifth the motion of the maintainer

68 Saliba 1990, p. 204.
which is twice the motion of the encompasser and sequential in the upper half. So due to the equivalence of the motion of the encompasser and the deferent [in magnitude] and the opposition [in direction] as well as the fact that we assumed the distance between the center of the epicycle and that of the encompasser is equal to the difference [between the center of the world and the center of the deferent] what results from the [motion] of the center of the epicycle through the compounded motion of these two [i.e., the encompasser and the deferent] is an orbit equal to the equator of the deferent, as was described in the Conjectural Principle at the conclusion of the Chapter on the Moon.69

The direction indicated by Shīrāzī for the rotation of the encompasser orb here is opposite to what one would expect for an implementation of ‘Urḍī’s Lemma. With the encompasser orb rotating in the opposite sense of its deferent orb, the resulting configuration resembles a description of the Apollonius's Theorem, in which the motion caused by an eccentric deferent can be shown to be equivalent to the motion caused by the combination of a concentric deferent and an epicycle. This “hypothesis” appears in Shīrāzī’s own list in the Nihāya/Limit as number 3 (cf. Appendix 4-F).70 Shīrāzī is correct in stating that the motion of the epicyclic center would be uniform about the equant point in this configuration. If we choose the direction of motion as Shīrāzī describes in this passage, however, the resulting trajectory can not but help deviating grossly from the expected one, i.e., the Ptolemaic deferent which was determined by observation and thus had to be maintained.71

Could this reading of the Ikhtīyārāt/Selections text be in error? Could the desired sense of the rotation of the encompasser have been the opposite of what we have assumed it to be based on our reading of his text? Shīrāzī himself provides an additional clue by referencing the “Conjectural Principle” at the end of the chapter on the Moon. The text for this section appears in Appendix 4-G leaves no doubt that Shīrāzī’s intended direction of rotation for the

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69 Quṭb al-Dīn Shīrāzī, Ikhtīyārāt-i Muẓaffarī, Ayasofya MS 2575, 108v.
70 This finding was presented by Gamini at the International Congress of History of Science, Budapest, 2009, and has been published as well by Gamini in “The Planetary Models of Quṭb al-Dīn Shīrāzī in the Ikhtīyārāt-i Muẓaffarī,” Tarīkh-i ‘ilm, no. 8 (1388): 39-54.
71 Ibid.
encompasser is the one we have assumed, i.e., that the solution he offers in the *Ikhtiyārāt/Selections* is not based on an implementation of ‘Urḍī's Lemma, at all. This unexpected finding in regard to Shīrāzī's treatment of the upper planets in the *Ikhtiyārāt/Selections* was only discovered thanks to a careful reading of this work by Gamini.

The reason for Shīrāzī's choice of model is unexpected especially since near the end of the very same chapter in which the model for the upper planets is presented, we see one of the proofs, or, more accurately, descriptions of ‘Urḍī's Lemma in the *Ikhtiyārāt/Selections*. At the conclusion of this discussion Shīrāzī comments upon the utility of this principle for treating issues related to the equant:

> And if one ponders this hypothesis (aṣl) it becomes apparent that the characteristic of this situation is such that the motion of a point that is moving by a compound motion is uniform about a point the distance of which relative to the center of the corporeal deferent is equal to the distance of the moving point relative to the center of the dirigent (mudīr).

Here Shīrāzī is referring to the additional epicycle which encompasses the epicycle of the planet the dirigent. This dirigent is the epicycle we have seen referred to before as the encompasser.

Its appearance here as the dirigent helps clarify the labeling of ‘Urḍī's Lemma in both the *Nihāya/Limit* and the *Ikhtiyārāt/Selections* as the hypothesis of the dirigent and the maintainer.

Shīrāzī continues:

> And the situation of that point will be different depending on the situation of the epicycle. For if the center of the epicycle is assumed at the lower half of its orbit [i.e., the circle ESA in the Figure 4-5] as the master of this principle has it, by necessity the

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74 Quṭb al-Dīn Shīrāzī, *Ikhtiyārāt-i Muẓaffarī*, Ayasofya MS 2575, 114r.
76 Shīrāzī's terminology is rather unfortunate and confusing. When referring to ‘Urḍī's Lemma as a hypothesis in his two earlier books he uses the term dirigent to refer to the orb encapsulating the epicycle. Encompasser is used for the Apollonius hypothesis (in the two earlier books), but also the orb encapsulating the epicycle in the Moon in the ‘Urḍī picture.
uniformity of motion will be relative to a point above the center of the embodied deferent, and if it is assumed in the upper half [of circle ESA] then uniformity of motion will be relative to the point below the center of the embodied deferent. And since for the Moon the desired uniformity was relative to a point below the embodied deferent, we had no recourse but to set the center of the embodied deferent under the imaginary deferent so that which was desired would be achieved.\textsuperscript{77} That the location of the epicycle at the apogee of the deferent is a relevant parameter had been implicitly pointed out by Ṭūsī in his discussion of the application of the Ṭūsī couple for celestial bodies other than the Moon.\textsuperscript{78} Shīrāzī follows the same approach to the configurations based on ‘Urḍī’s Lemma as well as those based on Apollonius's theorem:

And know that these two laws (ḥukm) are only useful when the motion of the dirigent in the upper half is the same as the motion of the deferent. For if [the motion is in the opposite direction] both laws are inverted, such that in this reckoning if the center of the epicycle is assumed to be above the center of it [i.e., the dirigent] uniformity will be relative to a point above the center of the embodied deferent and if it is assumed to be under [the center of the dirigent] then uniformity of motion will be relative to a point below [the center of the dirigent] then uniformity of motion will be relative to a point below [the center of the embodied deferent]. And according to these [two last] schemes the center of the epicycle traverses a [truly circular trajectory] such that the [point about which the motion is uniform] is at the center, unlike the case of the first two reckonings, since for them the center [i.e., the center of the secondary/small epicycle] does not traverse a [truly circular trajectory].\textsuperscript{79}

Here Shīrāzī is pointing out that a trajectory based on ‘Urḍī’s Lemma is not exactly circular. Indeed the predicted trajectory for a body moving via a configuration based on ‘Urḍī's Lemma experiences a minor deviation for a circular orbit, but these deviations from a circular trajectory

\textsuperscript{77} Ḥusayn b. Ḥusayn al-Dīn Shīrāzī, 
\textit{Ikhṭīyārāt-i Muẓaffarī}, Ayasofya MS 2575, 114v.

\textsuperscript{78} Ṭūsī, 
\textit{Naṣīr al-Dīn al-Ṭūsī’s Memoir}, 446.

\textsuperscript{79} Ḥusayn b. Ḥusayn al-Dīn Shīrāzī, 
\textit{Ikhṭīyārāt-i Muẓaffarī}, Ayasofya MS 2575, 114v.
are negligible for the mathematical parameters of the Solar System. Could this, then, be the ultimate source of Shīrāzī's rejection of ‘Urḍī's Lemma for the upper planets? We will return to this question in Chapter Five.

Shīrāzī labels “that division of the ‘deductive’ that requires a uniformity of motion relative to a point above the center of the embodied deferent” the “superior” and the other the “inferior.” We are left with a four-part scheme involving ‘Urḍī's Lemma and Apollonius's Theorem. An illustration of these four “hypotheses,” to which Shīrāzī refers to more than once in the Nihāya/Limit, but which only receive a full exposition in the Ikhtīyārāt/Selections appears in Figure 4-6.

The Conjectural Hypotheses result from a deferent and an encompasser that are turning in the opposite sense (e.g., with the deferent turning counterclockwise and the the encompasser turning counter-clockwise, or vice versa). Shīrāzī takes the standard configuration of Apollonius's theorem, and calls this the Conjectural-Superior. In the Conjectural-Inferior configuration the deferent and the encompasser maintain the same sense of rotation as that of the Conjectural-Superior but the orientation of the encompasser at the apogee of the deferent is different: for this configuration the encompasser is rotated about its center L by 180 degrees relative to its analogous configuration in the Conjectural-Superior (see figs. 4-6 a and b).

As can be seen in the figure the Deductive Hypotheses are both based on ‘Urḍī's Lemma. As before, the Deductive-Inferior and Deductive-Superior are related by a simple rotation of the encompasser (about its center L) by 180 degrees (see figs. 4-6 c and d). In both the Deductive-Superior and the Conjectural-Superior the motion of the center of the epicycle (marked E in figs. 4-5 and 4-6 a and c) appears as though it is uniform relative to a point falling above the center of the deferent, i.e., point A in the figure. Whereas in the Deductive-Inferior and the Conjectural-Inferior the motion of the center of the epicycle E is uniform relative to a point falling below the center of the deferent (i.e., point B in figs. 4-6 b and d).
As we said, Shīrāzī's choice of the Conjectural-Superior Hypothesis for the upper planets in the *Ikhtīyārāt/Selections* was one that he reconsidered in the *Tuhfā/Offering*. In that work Shīrāzī opts for Ṣūrī's Lemma (or, to use the nomenclature of his *Ikhtīyārāt/Selections* scheme, the Deductive-Superior Hypothesis).\(^{80}\) While considering Shīrāzī's choice of upper planets in these two works it is important to reiterate that he successfully implemented Ṣūrī's Lemma in his lunar model.\(^{81}\) Indeed, his choice of model for the upper planets here is especially surprising because Shīrāzī leaves no doubt as to the fact that he was aware of Ṣūrī's models for the upper planets themselves, as he affirms by stating:

> And since in the Moon the desired uniformity was relative to a point below the corporeal deferent, we had no recourse but to set the center of the corporeal deferent under the imaginary deferent.... 
> And since for [the upper planest] the desired uniformity of motion is relative to point above the center of the imaginary deferent, the master of this hypothesis had to assume that the center of the embodied deferent be above the imaginary deferent.\(^{82}\)

where by “the master of this hypothesis” Shīrāzī is plainly referring to al-Ṣūrī, and the configuration refers to the standard al-Ṣūrī configuration.

So much for the treatment of the upper planets in *Ikhtīyārāt/Selections*. Following the example of the Moon it is tempting to look at other sections within the *Nihāya/Limit* and to see what Shīrāzī has included there. Prior to an extensive search of this work however, it is easy to verify that what Shīrāzī has included in his chapter on the upper planets proper, faithfully reproduces Ṭūsī's model in the chapter on the upper planets. In order to answer the critical question “Did Shīrāzī include models for the upper planets different from Ṭūsī's models as they

\(^{80}\) Shīrāzī indicates that he is using the same parameters for the two hypotheses i.e., the same eccentricity and radius for the deferent. It is reasonably straightforward to see that his chosen hypothesis would not yield the desired trajectory, i.e., that determined by Ptolemy regardless of the parameters chosen, as the Deductive-Superior and Conjectural-Superior are irreconcilable as far as their predictions, regardless of the parameters chosen.

\(^{81}\) Quṭb al-Dīn Shīrāzī, *Ikhtīyārāt-i Muẓaffarī*, Ayasofya MS 2575, 115r.

\(^{82}\) Ibid., 114v.
appear in the chapter on the upper planets in the *Nihāya/Limit*?*” we need to look no further than the end of the chapter on the planetary latitudes, where, after having dispensed with his model of the Moon, Shīrāzī states:

And as for the orbs of the upper planets each includes six orbs, **three of them the ecliptic and the deferent and the epicycle** as [accepted by all] as far as motions and the magnitude and directions of these and in their location except for the epicycle, **and the remaining three are those which we have added**. The first an **encompasser** orb and it is in the thickness of the epicycle with its equator always fixed to the [plane of the] equator of the deferent. And the second the **dirigent** in the thickness of the encompasser and with the same center as it, yet with its equator crossing the equator of the deferent and constantly inclined with respect to it, by as much as the inclination of that planet from the inclined orb, and its axis intersecting the axis of the encompasser at the center. And the third the **maintainer** enclosed by the dirigent, such that its equator is in the plane of the equator of the dirigent and its center separated from the center of the dirigent by the distance separating the center of the deferent of the planet from the center of the world, with this point [i.e., the center of the maintainer] lying upon the plane of the equator of the dirigent and with its axis parallel to the axis of the dirigent. And the epicycle is in the maintainer agreeing with it as far as equator and center and poles and axis at all times.\(^\text{83}\)

Based on this fragment we see that Shīrāzī's proposed configuration for the upper planets in the *Nihāya/Limit* is quite similar to that which appears in the subsequently completed *Ikhtīyārāt/Selections*, (this is especially true as far as the projection of the orbs on the ecliptic plane; that is, the motion in longitude).\(^\text{84}\)

As far as the motion of the encompasser Shīrāzī has the following:

And the motion of encompasser is equal to the motion of its center, meaning the motion of the deferent of the planet such that in the


\(^\text{84}\) What is different in this section of the *Nihāya/Limit* relative to the *Ikhtīyārāt/Selections*, is the orientation of the orbs. This is likely due to Shīrāzī's treatment of the thorny problem of planetary latitudes. In the model for the upper planets as it appears in the *Ikhtīyārāt/Selections* the deferent and the dirigent were assumed to oriented such as to share the plane of their equators, turning on parallel axes; while the equators for the encompasser, maintainer, and the epicycle shared the same plane. In the *Nihāya/Limit* the encompasser is aligned with the deferent whereas the equator for the dirigent, maintainer, and epicycle all lie in the same plane.
upper half it is in the direction opposite to that of the deferent.\textsuperscript{85}

It is thus clear that, as far as the motion in longitude, this model is practically identical to that of
the *Ikhtīyārāt/Selections* and that in choosing it Shīrāzī has once again rejected using ‘Urḍī's
Lemma in favor of a scheme based on Apollonius's Theorem.

One of the interesting features of the two texts as they appear in the manuscripts used for
this study (i.e., Köprülü 956 and 957, that were completed, as we saw, one year and four years,
respectively, after the book was first written) is the evidence for extensive revision in this part of
the book. This is particularly true of a long section on the planetary latitudes in Köprülü 957
that has been crossed out entirely and supplanted by a revised text. Of interest to our discussion
is the fact that in each of the two copies the short statements pertaining to the orientation of the
orbs (i.e., the orientation of their equators relative to the ecliptic) have also been crossed out,
with a revised set of orientations being appended to the text in the margins. This is presented in
Appendix 4-H where the crossed out text is underlined. The text of the *Ikhtīyārāt/Selections*
appears in an adjacent column for comparison. It is clear that what has been preserved in the
*Ikhtīyārāt/Selections* is the earlier version of Shīrāzī's proposed alignment of the spheres.
Though it is not clear when the revisions were undertaken, it is quite reasonably clear that these
would have been carried out prior to these revisions, and certainly prior to the completion of the
*Tuhfa/Offering* since by then Shīrāzī appears to have reconsidered his own model, and instead
proposed a model based on ‘Urḍī's Lemma. While this information does not allow us to
determine the date on which the *Ikhtīyārāt/Selections* was completed more accurately than we
already have, it is an affirmation of our original conclusion that the *Ikhtīyārāt/Selections* and the
*Nihāya/Limit* were completed in close succession time-wise.

The numerous revisions and emendations in the discussion of the planetary models
(embedded as we saw as they were in the chapter on the planetary latitudes) are unexpected and

make the manuscripts appear as though they are drafts of a work in progress. This evidence for extensive reworking of the text is especially surprising given the author's claims as to a long gestation period for the work (see, for instance, the author's introduction at the beginning of this chapter).

The evidence for Shīrāzī's dissatisfaction with his planetary theory (a dissatisfaction that would have been a driving force for the abundant revisions) is present not only in the abundant marginal notes but in the main body of the text itself. In the chapter on the latitudes after presenting his theory for the upper planets (a theory that was to be revised shortly in the *Tuḥfa/Offering*) he writes:

So the difficulties occurring in the motion of these three have been overcome by the three orbs which we have added, and this is the figure of the corporeal orbs all three as it is possible to imagine them in a plane and this is according to the conjectural principle, not according to what we have chosen[!!!].

One might perhaps be tempted to assign this rejected theory the same status as that of Ṭūsī's models earlier in Book 2 of the *Nihāya/Limit*. Could this theory, in other words, have been presented here for illustrative or pedagogical purposes? The evidence from the text itself makes this proposition highly unlikely, however. For, there is reasonably clear evidence in the earliest manuscripts that Shīrāzī's rejection of his model for the upper planets was an afterthought, and that the model presented in the chapter on the latitudes was considered sound by Shīrāzī when he first composed the *Nihāya/Limit*. Indeed, in Köprülü 957 the final statement would read “and this is according to the conjectural principle, according to what we have chosen,” if not for the negative particle lā. A careful look at this line in the manuscript suggests strongly that the lā, which is squeezed in to space between its neighboring words, is a later addition (See figure 4-7).

That the conjectural principle was Shīrāzī's chosen model at the time the *Nihāya/Limit* was originally composed is also evident by the fact that the subsequent text containing the emended

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86 Chapter 2.8 of the *Nihāya/Limit* (on the upper planets) is also one of the sections of the book that show similar evidence of revision.

87 Quṭb al-Dīn Shīrāzī, *Nihāyat al--idrāk fī dirāyat al-aflāk*, Köprülü MS 957, 98r.
models, a considerable fragment more than a page long, could only be added to the margins of the folio.\textsuperscript{88} The additional text continues: “for the [correctly] imagined method is different than this, and it is that we assume for all of the upper planets and encompasser orb … with its motion equal to the motion of the center of the epicycle for the planet and in the upper half in the sequential direction.”\textsuperscript{89}

It appears then that at the time this revision was carried out that Shīrāzī had finally settled on ‘Urḍī's Lemma as the correct model for the planets. But even here, Shīrāzī appears to be struggling with his choice of model, since the word khilāf (counter) has been crossed out from the marginal text which would originally have read “with its motion equal to the motion of the center of the epicycle for the planet and in the upper half in the counter-sequential direction.” It is only after struggling considerably that Shīrāzī settles on ‘Urḍī's Lemma as his preferred solution by stating in a marginal commentary upon the marginal commentary: “And as for the uniformity of the motion of the center of the epicycle about the equant and the alignment of its diameter, this is as was [described] in the principle of the maintainer and the dirigent.”\textsuperscript{90} At the end of the extensive revisions of the model for upper planets immediately prior to moving on to a discussion of the lower planets Shīrāzī adds, tellingly: “the secret unraveled during the writing [of this tract, after] I became aware of it [i.e., the model].”\textsuperscript{91}

In the chapter on the upper planets in the \textit{Tuhfa/Offering}, written four years after the \textit{Nihāya/Limit}, Shīrāzī offers his revised model of the upper planets:

And so they established five orbs and five simple motions. The first orb the \textbf{parecliptic} … . The second the \textbf{eccentric deferent} in the thickness of the parecliptic such that the distance of its center from the center of the world is equal to one-half the distance between the center of the imagined deferent and the center of the world.... The

\begin{footnotesize}
\begin{itemize}
    \item[^88] Ibid., 98 r.
    \item[^89] Ibid.
    \item[^90] Ibid.
    \item[^91] Ibid.
\end{itemize}
\end{footnotesize}
third the **encompasser** in the thickness of the eccentric …. The fourth the **incliner** (*mumayyila*) orb enclosed within the encompasser … with the distance of its center from the center of the encompasser equal to the distance between the centers of the eccentric and the imagined deferent for the planet as you have learned in the Third Hypothesis.\(^\text{92}\)

While Shīrāzī's apparently reconsidered direction for the motion of the encompasser is certainly consistent (at long last) with ‘Urḍī's Lemma, it is not at first clear what to make of his reference to the Third Hypothesis. For one thing, unlike the *Nihāya/Limit* Shīrāzī does not number the hypotheses, i.e. the *uṣūl*, in his *Tuhfa/Offering* (*cf.* Appendix 4-F). A review of the chapter of the hypotheses clarifies Shīrāzī's confusing terminology, however:

And know that of the principles requiring the third inequality, and that is the uniformity of motion of a point together with its drawing near and moving away from it is that the moving body, and let this be an epicycle, is enclosed by another which we call the encompasser in the thickness of the eccentric and with its motion equal to the motion of the deferent in magnitude and direction in the upper half.\(^\text{93}\)

What Shīrāzī refers to as the “Third Hypothesis,” in the chapter on the upper planets is apparently the hypothesis associated with the third inequality, i.e., ‘Urḍī's Lemma (see Appendix 4-F). Given Shīrāzī's choosing of Apollonius's Theorem in the *Nihāya/Limit* and the *Ikhtīyārät/Selections*, the manner in which he chooses to emphasize the “correct” motion for the encompasser is telling:

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\(^{92}\) Quṭb al-Dīn Shīrāzī, *al-Tuhfa al-shāhīya*, BN Arabe MS 2516, 45v.

\(^{93}\) Ibid., 25v; Morrison, “Qutb al-Din al-Shirazi’s Hypotheses for Celestial Motions,” 50.
the center of the deferent if the center of the encompasser is at the apogee and lower than [the center of the deferent] if the center of the encompasser is at the perigee and in the second scheme the reverse is true.  

This paragraph is merely a description of what Shīrāzī has previously called the Conjectural-Inferior and the Conjectural-Superior hypotheses (see Figures 4.6 a and b). Cognizant of the earlier difficulties Shīrāzī adds:

If a circle is described, the desired [thing] – which is the drawing near and moving away from the point about which the motion is uniform – is not obtained... [Whereas] if the motions [i.e., of the encompasser and the deferent] are in agreement in the upper half a circle is not described, rather [this compels] the uniformity of the motion of the center of the epicycle, compounded of two motions, about a point that is separated from the center of the deferent also by the separation of the center of the epicycle from the center of the encompasser, however [this occurs] together with the drawing near to and the moving away from [the equant] as desired, regardless of the assumption of the initial location of the center of the epicycle in the apogee of the encompasser or in the perigee, the difference being that in one [scheme] the motion is uniform relative to a point above the center of the deferent and in the other [it is uniform relative to] a point below it, provided the aforementioned stipulations are met as described previously.

This paragraph is a description of the Deductive-Inferior and Deductive-Superior hypotheses in Shīrāzī's earlier works. Here, in the Tuḥfa/Offering, Shīrāzī's rejects the Conjectural hypothesis  


(of either the superior or inferior kind) for the motions of the planets.

The previous discussion unambiguously indicates, therefore, that Shīrāzī's views on his planetary models were not static in the period framed by the completion of the Nihāya/Limit and that of the Tuhfa/Offering. What lends this fact its special interest, however, is that the Nihāya/Limit has long been considered Shīrāzī's principal work. And, by the same token, the Ikhtiyārāt/Selections and the Tuhfa/Offering have been generally viewed as derivative works that essentially restated the material in the Nihāya/Limit. That Shīrāzī himself was aware of his difficulties on the use of ‘Urḍī's Lemma for his models of the upper planets is also seen in a section from the chapter on the hypotheses in the Tuhfa/Offering. Here, Shīrāzī appears to reject a configuration based on Apollonius's Theorem by questioning its agreement with observation, stating: “We say [this hypothesis] was too majestic to be hidden from [Ptolemy] … however he did not use this hypothesis because it entails matters that reality proves false.”96 After providing the reader with a list of observational inconsistencies Shīrāzī writes: “Knowing how this hypothesis necessitates these matters we have used [the hypothesis] in our books without referring to [these observations] as a test of the intellects of the intelligents: Do they pay attention to it or to some of it? And upon God is the straightness of the path and at Him the road ends.”97 Given the evidence presented in this chapter, it is difficult not to read in these lines further evidence of Shīrāzī's reconceptualization in regard to the use of his Conjectural Hypothesis for the upper planets.

H. Discussion

Not surprisingly a study such as this, based on the reading of a select chapter in three related but distinct works of medieval astronomy is bound to raise more questions than it

97 Ibid.
answers. What can be said, based upon the textual evidence in the *Nihāya/Limit*, the *Tuhfa/Offering*, and the *Ikhtīyārāt/Selections*, is that Shīrāzī's claims in his introductions as to the nature of each work are, in a general sense, affirmed. It is clear that of the three the *Nihāya/Limit* was meant, at least in part, as a reference work on astronomy for the practitioner much as the *Tadhkira/Memoir* of Shīrāzī's teacher, Ṭūsī. The evidence for this consists of the inclusion in the *Nihāya/Limit* of models which Shīrāzī considered incorrect or inadequate in treating the many “difficulties” that were brought against them. The *Tuhfa/Offering* appears to include a more limited collection of information, summarizing celestial models that Shīrāzī considered correct. Needless to say, as the chapter for the upper planets indicates, the newer book would have also provided an important opportunity for the re-evaluation and correction of earlier models. Another finding from our study is in regard to the *Ikhtīyārāt/Selections*. In the absence of the dating information in Köprülü 956 it would have possible to argue for the completion of the *Tuhfa/Offering* as providing an upper limit for the completion of the *Ikhtīyārāt/Selections* (*i.e.*, August, 1285, C. E.) for it is inconceivable that Shīrāzī would have included a model for the upper planets that he had already rejected in the *Tuhfa/Offering*. Indeed, the reference to the *Ikhtīyārāt/Selections* in the main body of the text in Köprülü 956 indicates that the *Ikhtīyārāt/Selections* must have been completed prior to the end of 1284 C. E. Furthermore, the *Ikhtīyārāt/Selections* must have predated the revisions in the *Nihāya/Limit* that affected how Shīrāzī meant to keep track of the inclinations of the various orbs for the upper planets, for as we saw the information presented in the *Ikhtīyārāt/Selections* was the same as the earliest surviving account of the inclination of these orbs. Unfortunately we don't know when the aforementioned corrections to the *Nihāya/Limit* were made, though it is reasonable to assume that the ones that contradict the *Tuhfa/Offering* were carried out prior to the completion of that book.
We should also note that our proposed close connection between the
*Ikhtiyārāt/Selections* and the *Nihāya/Limit* is strengthened by the existence of references to the
Conjectural Hypothesis, and the Deductive Hypothesis in the *Nihāya/Limit*. These hypotheses
are never properly defined other than in the *Ikhtiyārāt/Selections*, and though Shīrāzī is not
entirely consistent in how he refers to his hypotheses in each work, he, at any rate appears to
have abandoned any use of this nomenclature in the *Tuhfat/Offering*. Indeed the references to the
Conjectural and Deductive hypotheses in the *Nihāya/Limit* raise the possibility, at least, that
Shīrāzī's earlier bodies of work upon which he drew to create the *Nihāya/Limit* and the
*Ikhtiyārāt/Selections* could have been in Persian rather than in Arabic. Given the great prestige
of Arabic as the language of learning and scholarship in the Islamic world for most of its history
it is not surprising that Shīrāzī would have chosen to write what he intended to be his standard
work in Arabic rather than in Persian. Furthermore, the great influence of Ṭūsī’s
*Tadhkira/Memoir* written in Arabic would have made this choice even more natural.

Perhaps the most interesting part of the present study is Shīrāzī's unexpected handling of
‘Urḍī's Lemma. As we said, that Shīrāzī's model for the upper planets did not rely on this
formulation in the *Ikhtiyārāt/Selections* has been only revealed recently by scholarship.98 The
comparative work carried out in our study has been useful in allowing us to map the extent to
which Shīrāzī relied instead on Apollonius's theorem for his treatment of the upper planets
during the fateful period 1281 to 1284 C. E. In particular this study shows that even though
Shīrāzī recognized the merits of applying ‘Urḍī's Lemma to the orbs of the Moon in the
*Nihāya/Limit*, he only adopted this mathematical formulation in his models for the upper planet
in the *Tuhfat/Offering*, i.e., after trying and ultimately abandoning his implementation of
Apollonius's theorem.

98 See note 73.
Given the great importance attached by Shīrāzī to the Nihāya/Limit, it is important to note several issues that require further study. If, as Shīrāzī suggested, the Nihāya/Limit was the culmination of his astronomical productions, how is this to be reconciled with the revisions we have seen in the section on the latitudes? What compelled Shīrāzī to insert in his book that was the result of many years of study, a statement like, “The mystery was resolved as I was writing this?” Furthermore, why is the section on the latitudes organized in such a strange fashion? As we have noted Ṭūsī also proposes his most innovative models in the section of following his chapter on the planetary latitudes. Why, however, did Shīrāzī not choose to place this discussion, i.e., that of his proposed models in a section of its own, as Ṭūsī did? Finally what do our findings mean as far as Shīrāzī's reputation as a scientist? Shīrāzī is generally careful to not take credit for innovations not his own, such as the Ṭūsī couple and ʿUrḍī's Lemma. Why does he fail, then, to provide attributions to these innovations in his work? Why, indeed, is there a complete absence of the names of his predecessor's upon whose work he has based his own?

What is the source of Shīrāzī's confident and ringing self-promotion as evident particularly in the Nihāya/Limit and the Ikhtyārāt/Selections? With the benefit of hindsight we can say that what Shīrāzī seems to want to take credit for – the generalizations of the innovative work of ʿUrḍī and Ṭūsī, or the application of this work to new problems, was at best a mixed success. On the one hand there is the Shīrāzī's achievement in applying ʿUrḍī's Lemma to the configuration of the Moon, on the other hand the complicated history of the models for the upper planets in the Ikhtyārāt/Selections and the Nihāya/Limit; models that were subsequently rejected in favor of ʿUrḍī's Lemma in the Tuhfa/Offering.

The discussion in this chapter has perhaps demonstrated as well the particular utility of a comparative textual analysis of closely related works such as the three works of Shīrāzī's on astronomy. Though nearly credited at some point with devising ʿUrḍī's Lemma as a useful
formulation for planetary theories, it is now clear that the truth is considerably richer. Further study of these texts and a fourth extensive text on astronomy, belonging to the end of Shīrāzī's career – while no doubt raising questions of their own – should help answer some of the questions posed earlier thus improving our understanding of the life and work of Quṭb al-Dīn Shīrāzī.
Chapter Four Figures
The Model for the Moon in the *Nīhāya/Limit* (First Model):

![Diagram showing the model for the Moon's orbit with center of the Deferent and center of the World labeled.]

Fig. 4-1
The Model for the Moon in the *Ikhtīyārāt/Selections*:

![Diagram of the model]

- Center of Imaginary Defrent
- Shīrāzī’s Deferent
- Center of the World

Fig. 4-2
The Model for the Upper Planets in the *Nihāya/Limit* (First Model):

Fig. 4-3
The Model for the Upper Planets in the *Ikhtīyārāt/Selections*

Fig. 4-4
Presentation of ‘Urḍī’s Lemma in the *Ikhtīyārāt’s* Chapter on the Upper Planets:

Fig. 4-5
The Conjectural-Superior Hypothesis

Fig. 4-6 a
The Conjectural-Inferior Hypothesis

Fig. 4-6 b
The Deductive-Superior Hypothesis

Fig. 4-6 c
The Deductive-Inferior Hypothesis

Fig. 4-6 d
Evidence of textual revision. Similar revisions exist for the section on the Moon.

Fig. 4-7
Chapter 5: Persian vs. Arabic: Language as Determinant of Content in Shīrāzī’s Works on Hay’a

A. Introduction

As has been noted before, the vast preponderance of scientific works by scientists working in the medieval Islamic world was written in Arabic. This is true despite the appearance, in the centuries subsequent to the appearance of Islam, of other “classical” languages within the Islamic domains (most notably Persian and, somewhat later, Turkish).\(^1\) The primacy of the Arabic language as the language of scientific discourse held generally true regardless of the local cultural background of the scientists themselves. The illustrious Bīrūnī (973 – c. 1048 C. E.) who, as far as we can tell was born in Khwārazm, states his preference for Arabic in his book on pharmacy and materia medica, Kitāb al-ṣaydanah fī al-ṭibb, by describing what was his first-hand experience of writing a scientific treatise in Khwārazmian with inadvertently humorous results: The ill-fated work appears to have elicited astonishment as that of “a camel at the rain-gutter or a giraffe at the stream.”\(^2\)

Certainly, the prominence of Arabic as the language of revelation and of religious observance contributed to its authority as a language of science. Bīrūnī hints as much when he starts the same passage referenced above as follows:

\[
\text{Our religion and governance are Arabic and they are in harmony with each other, with Divine power pulsing upon one and the}
\]


\(^2\) وهى مطبوعة على لغة نو خلدون بهما علم لاستغراب الاعتزاب على الميزاب و الزرافة في الكراب.

“Heavenly Hand” upon the other. And how the tribes of followers, and of these I mean especially the people of the Jīl [i.e., Gilân, or perhaps al-Jabal, both regions in Persia] and Daylam, collectively [engaged] in the cloaking of the government with Persian dress! Yet as long as the adhān [i.e., the call to prayers] strikes their ears five times a day and the prayer is carried out in the clear Arabic of the Qur’an, [while they stand] row upon row behind the imams [i.e. prayer leaders] and as long as they are preached to in [Arabic, and enjoined] to reform they are in their words and in their deeds muslims and the cord of Islam is unbroken and its fort unbreached.3

In addition to its authority on religious grounds, the primacy of Arabic as a language of scientific discourse would no doubt also have derived from its status as a language over which every muslim scholar in the vast Islamic domains was expected to obtain mastery. By evoking the lack of readership of Persian texts in what is a statement on the inherent unsuitability of Persian for science, Bīrūnī may be hinting, at least, at this practical consideration, as well:

And he who has considered carefully a book of science that has been transcribed in Persian will know the test of my words: For he will observe the [dismal] manner in which the success of the book proceeds and how its state is eclipsed and its face darkened and how it ceases to be profitably read since this language is not suitable for anything except for the histories of the [Sassanian kings] and evening conversations.4

Closer to Shīrazi’s period, one reads in the Arabic translation of a Persian work on hay’a,

3 Bīrūnī, Al-Biruni’s Book on Pharmacy and Materia Medica, 12.

4 Ibid.

و سيعرف مصدق قولی: من تأمل كتاب علم قد نقل إلى الفارسی كيف ذهب رونقه و كصف بالله و أسود وجهه و زال الانتفاع به إذ لا تصلح هذه اللغة الا للؤخبار الكسرية و الأسمار الليثية. 555
the Zubdah-i hay'a by Ṭūsī, that it was precisely the desire for an increased readership that served as an impetus for the translation in to Arabic of this work, which “though of great usefulness, was not of general benefit since it was in the Persian language whose understanding is denied to the intelligent Arab.”

Bīrūnī claims in the same Kitāb al-ṣaydanah fī al-ṭibb, which appears to have been written c. 1048 C. E. near the time of his death,⁶ that his relationship to Arabic and Persian is that of “a foreign speaker or an intruder with regard to both, [yet] satire in Arabic is more dear to me than eulogy in Persian.”⁷ Given the linguistic affinity of Khwārazmian to Persian,⁸ Bīrūnī's persianate cultural background, and the increased prevalence of Persian as a language of high culture in Transoxiana, which was Bīrūnī's home for his early professional career, this is a rather unexpected statement that requires further consideration.

Certainly, Bīrūnī's claims to the skills of a foreign speaker with respect to Persian are belied by his own book on the principles of astrology, the Kitāb al-tafhīm li-awāʾil fī ṣināʿat al-tanjīm. Dating from 1029 C. E., this text appears to have been rendered nearly simultaneously by the author in both Persian and Arabic.⁹ The question of the precedence of the different versions of the Kitāb al-tafhīm is important, but not within the scope of the present study. Here we can only note that the erudition of the Persian text is such that Huma'i who is responsible for

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5 The quote is by a certain al-Qāshī who produced a translation of this work; Naṣīr al-Dīn Muḥammad ibn Muḥammad Ṭūsī, Naṣīr al-Dīn al-Ṭūsī’s Memoir on Astronomy, vol. 1, 70.
its excellent edition suggests that it be considered as one of the foremost texts from medieval Persia based on literary as well as scientific merit.\textsuperscript{10} Certainly, the existence of this work, the only known work of Bīrūnī composed in Persian, forces the reader to look at Bīrūnī's views the Persian language more critically: Could it be that written late in life, Bīrūnī's stated distaste for Persian represents the religious fervor of an aging man approaching his death? Is Bīrūnī reflecting on the fate of the Perisan and Arabic versions of his \textit{al-Tafhīm}, in his assessment of the unsuitability of Persian as a language of science quoted above? Is his apathy for his former employer Mahmūd of Ghazna (971 – 1030 C. E.), who is mentioned by name in the section from the \textit{Kitāb al-ṣaydanah fī al-ṭibb} referenced above, to blame for his critical tone with regard to Persian as a language of scholarship?\textsuperscript{11} Is Bīrūnī perhaps reacting against cultural pressures exerted by the Persian as a language of high culture, \textit{adab} and courtliness at the expense of local languages and cultures such as Khwārazmian? Though it is not at present possible to answer these questions in a satisfactory manner, it is important to note that any reasonable interpretation

\begin{itemize}
\item \textsuperscript{10} Bīrūnī, \textit{Kitāb al-tafhīm li-awāʿil ṣināʿat al-ṭanājīn}, كر.
\item \textsuperscript{11} Bīrūnī writes: And the Prince of the Believers Yamīn al-daula [i.e., Mahmud of Ghazna] (may the Lord have mercy upon him) according to his hatred of the Arabic language had asked one of his courtiers about the state of his physicians and their ranks. And his interlocutor had responded that to each of his beneficial teachers and to each student who benefits from them there [exist specific] books, upon which they draw and to which they refer and in which they take refuge. And these books had been in Greek or Syriac with no one following them rightly except for the Christians so they have been translated into Arabic so that muslims [could enjoy them] and they have become well-versed in them. So the foremost among [the physicians] is he who has the most mature direction with regard to language for [it is he who] has the most absolute mastery over that which is in the books, and in his [absolute knowledge of what is in the books, he is distinguished] from he who dreams … and who imagines that which is not in [the books].
\end{itemize}

of Biruni's stated views on Persian as a language of scientific discourse would have to proceed with circumspection and caution. Certainly, whatever the underlying reasons for Biruni's negative views on the suitability of Persian for his scientific works may have been, we must note here, that the Kitāb al-tafhīm offers proof as to the viability of Persian as a medium for scientific discourse as early as the eleventh century, demonstrating that the author's quip about the use of Persian being limited to the stories of the pre-Islamic Persian kings was contradicted by an example, albeit a solitary one, from within his own vast scientific output.

Before we conclude our introductory remarks on the prevalence of Arabic in the scientific literature of Islam, we should highlight three additional points that bear directly on our discussion of Shīrāzī. The first: Biruni's complex views in regard to the Persian language were hardly unique. As an example of another prominent scholar holding similar views we could cite the slightly later Zamakhsharī (1074-1144 C. E.), whose Qur'anic commentary, al-Kashshāf 'an ḥaqā'iq al-tanzīl (“Unveiler of the Realities of Revelations,”) figured, according to al-Dhahabi, among the texts taught by Shīrāzī (see Chapter 3.D). Zamakhsharī was also a born in Khwarazm and was similarly dismissive of Persian as a language of scholarly discourse, this despite the fact that he taught Persian and composed, as well, an Arabic-Persian lexicon.12

The second point to be made is that the primacy of Arabic as a language of scholarship

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existed simultaneously in the mind of Bīrūnī and of others with a prevalent view of the Arabic culture, at least as it existed until the Abbasid period, as underdeveloped relative to those of the peoples they had conquered on the way to the forging of the vibrant world civilization known as the Islamic empire. Among the most notable of these subject peoples were the Persians as well as the Syriac-speaking inhabitants of the Levant. In the Kitāb al-ṣaydanah quoted heavily above we have the rather strange juxtaposition of sentiments; reading on the one hand Bīrūnī's contention that “knowledge is carried into Arabic from the four corners of the world,” and on the other hand encountering the assumption of the essential illiteracy of Arabic culture (at least as it existed in the Arabian peninsula):

And the Arabs in their desert homeland are an illiterate people [memorizing their oral traditions] and for this reason their poetic anthologies became [repositories] of knowledge, and of the reminiscences of their days and genealogies and perhaps for this reason we have returned for information … to their poems and scrutinize them [in regard to our] queries.14

Though it is certainly probable that Bīrūnī’s views refer primarily to the jāhilīya, or the pre-Islamic “age of ignorance,” this distinction is not always expressed (as can be seen by the fragment cited above). Indeed, looking at Bīrūnī’s works it is difficult to not be struck by the prevalence of similar statements. In Bīrūnī's celebrated Athār al-bāqīya (from c. 1000 C. E., henceforth the Chronology) we read:


14 Ibid.
But the Arabs, being illiterate people, could not recognize Lunar Stations except by certain marks, visible to the eye. Therefore they marked the Stations by those fixed stars which lie within them. And the rising of the fixed stars in the east early after the rise of dawn they considered as a sign of the Sun's entering some one of the Stations, and so they could do, since the stars do not recede from their places except after the lapse of long spaces of time, and, besides, the Arabs were not educated enough to notice such a variation.\(^{15}\)

The theme of the illiteracy of the Bedouin appears earlier in a discussion of the intercalation of Lunar months, though the reference here is more clearly than before to the \textit{jāhiliya} and Bīrūnī admits to having a limited knowledge of traditions that have been obliterated by time:

As regard the years of the Arabs and their months, how they intercalated them, and in what order they arranged them in pagan times, this is a subject that has been utterly neglected. The Arabs were totally illiterate, and as the means for the perpetuation of their traditions they relied solely upon memory and poetry. But afterwards, when the generation of those who practiced these things had died out, there was no further mention of them. There is no possibility of finding out such matters.\(^{16}\)

Other instances of the same “Arab as illiterate” rhetoric appear in Bīrūnī's \textit{Kitāb fi tahuqīq mā li al-Hind} (India, 1030 C. E.) and in the \textit{Kitāb al-Qānūn al-Ma'sūdi} (Canon Masudicus, 1030 C. E.) that are essentially the same as we have seen in the \textit{Chronology}.\(^{17}\) A final instance of Bīrūnī's dismissive attitude towards astronomy as practiced by the Arabs (in the \textit{Chronology}) is reproduced below for it demonstrates, among other things, the existence of a tradition

\(^{15}\) Muḥammad ibn Aḥmad Bīrūnī, \textit{Chronology of ancient nations; an english version of the Arabic text of the Athār-ul-Bākiya of Albīrūnī, or “Vestiges of the past”}, (Leipzig: F. A. Brockhaus, 1878), 336. C. Eduard Sachau's translation was used here.

\(^{16}\) Ibid., 138.

contradictory to Bīrūnī's views in regard to the history of astronomy in Arabia:

If you, likewise, inquire into the names of the Arabs for the fixed stars, you will see that they were very far from an accurate knowledge of the Zodiacal signs and the star-figures, although Abū Muhammad ʿAbdallāh b. Muslim b. Qutaiba al-Jabalī used to make a great to-do and to be very verbose in all his books, and specially in his book on the superiority of the Arabs over the Persians, maintaing that the Arabs were the best-informed nation regarding the stars and the times of their rising and setting. I do not know whether he was really ignorant, or only pretended to be ignorant, of what the agriculturists and peasants in every place and district have got in the way of knowledge regarding the beginning of the agricultural works and other things, and of knowledge of the proper times for similar subjects. For he whose roof is heaven, who has no other cover, over whom the stars continually rise and set in one and the same course, makes the beginnings of his affairs and his knowledge of time depend upon them. But the Arabs had, moreover, one advantage in which others did not share; this is the perpetuation of what they knew or believed, right or wrong, praise or blame, by means of their poetry (qasīdas), by rajaz poems, and by compositions in rhymed prose.\(^{18}\)

This fragment again highlights the debate in regard to the identity politics centered on the question of Arab vs. ʿajam (i.e., non-Arab, and – generally speaking – Persian) in Bīrūnī's era. It emphasizes as well the nuanced manner in which Bīrūnī (and no doubt many of his colleagues) negotiated a perceived Arab vs. ʿajam dichotomy. Indeed, Bīrūnī's rebuttal to Abū Muḥammad's claims of Arabic superiority depends for its coherence on a reconstruction of what the claims for Arabic superiority over the ʿajam were based upon. It is not unreasonable to assume that Abū Muḥammad's claims for a superior knowledge of the sky by the Arabs hinged on the fact that the putative bedouin tribesmen of the Arabian peninsula lived under an open sky and thus would have had a particularly intricate knowledge of it (relying, no doubt on the stars and constellations

for navigating their way across unpopulated expanses of land). Bīrūnī, on the other hand, appears to be highlighting the knowledge of the calendar based on the importance of the planting seasons to an agrarian culture. Thus to the list of broad binary opposites that populate the debate that Bīrūnī was commenting on, the concepts of Arab vs. ʻajam, literate vs. illiterate, oral vs. textual transmission of culture, should thus be added settled vs. unsettled. This fragment repeats the insistent theme of the importance of the oral and poetic lore to Arab culture that we have seen. In addition it is especially noteworthy among Bīrūnī’s observations regarding the Arab vs. the ʻajam (i.e., non-Arab, and – generally speaking – Persian) in offering sedentary agricultural life (vs. the purported nomadism of the Arabs) as a pre-requisite to the development of astronomy.  

The theme of sedentary vs. nomadic life is significant, because we see it taken up by the celebrated historian Ibn Khaldūn (1332-1406 C. E.) who relies heavily on the opposition between the sedentary vs. the nomadic to develop a theory of the cultural productivity of the ʻajam within the Islamic realms. In a chapter entitled “On the fact that the majority of the bearers of knowledge in Islam were ʻajam” he writes:

Of the strangest incidents is that within the Islamic [lands] the majority of the bearers of knowledge, whether in the religious sciences or the transmissible sciences have been ʻajam, except for a negligible few. And if among them there are ethnic Arabs, these are ʻajam in their language, and instruction and in terms of their teachers. This is so despite the fact that as far as religion is concerned the people are Arab, and the founder of their religion is an Arab.  

19 This is so, even though it must have been as clear to Bīrūnī as it is to us that the heavens formed just as much a roof for the inhabitants of the Arabian peninsula -- whether the nomads of the Najd and the “Empty Quarter” or the settled people of the Hijaz -- as for the purportedly sedentary inhabitants of Persia.  
20 Ibn Khaldūn, The Muqadimma (Cairo: Matba’at Mustafa Muhammad, 1945), 543.
This fragment is noteworthy because it echoes Bīrūnī rather closely: to both thinkers, whatever could be said about the historical background of the ‘ajam, they were – “as far as religion is concerned” – Arab with an Arab prophet. Ibn Khaldūn continues by specifying the nomadic nature of Arab society as a cause for the near absence of Arab presence amongst the “bearers of knowledge”:

And the reason for this is that the religious community at its beginning did not have within it knowledge or crafts, as befitted the situation of simplicity and the bedouin life. And verily the religious injunctions, that are the decrees of the Lord and his prohibitions, were transmitted [orally] by men who were aware of their [attribution] in the Qur’an and the sunna [i.e., pre-Islamic tribal traditions] through that which they had encountered from the [Prophet] and his companions. At that time the people were Arabs and did not know [about] instruction and books and were not driven to these nor was there a need that induced them to [seek these crafts].

How is it possible, then, for the prophetic lore, consisting of revelation and tribal customs, practices, and histories to survive in an illiterate environment? In answering this question Ibn Khaldūn emphasizes, among other things, the central importance of the Qur’anic revelation as the cornerstone of Islamic civilization:

من الغريب الواقع أن حملة العلم في الملّة الإسلامية أكثرهم العجم، لا من العلوم الشرعية ولا من العلوم النقليّة، إلا في الفليل النادر. و إن كان منهم العربي في نسبه، فهو أعجمٌ في لغته ومراه و مشيخته. مع أن الملّة عربية، و صاحب شريعتها عربي.

٢١ Ibid.

و السبب في ذلك أن الملّة في أصلها لم يكن فيها علم ولا صناعة لمقتضى أحوال السدامة والبداوة. وإنما أحكام الشريعة، التي هي أوامر الله و نواهيه، كان الرجال يتقذونها في صدورهم وقد عرفوا ما نصدهما من الكتب و السنة بما تلقىهم من صاحب الشرع و أصحابه. القول ومنذ عرب لم يعرفوا أمر التعليم والتأليف والتدوين ولا دفعوا إليه ولا دعتهم إليه حاجة.
And the period of the companions and those who followed [them] passed along in this manner. And those who specialized in the carrying of this knowledge and its transmission were called the reciters, meaning those who could recite the Qur’an, and they weren’t illiterate despite the fact that illiteracy was at that time the general condition of the companions by virtue of their being Arabs. So the bearers of the Qur’an are called the reciters as an indication of this state. For they were the reciters of the book of the Lord and the traditions that were transmitted from God, for they did not understand religious injunctions except [as they originated] from Him and from the accounts of the Prophet that are in most cases an exposition of [the religious injunctions from God]. And the Prophet [may the prayers of the Lord be upon him] said: “I have left for you two things; those of you who hold fast to them will not go astray: the book of God and my sunna.”

It is also through these words of Ibn Khaldūn that we can finally appreciate Bīrūnī’s emphasis, rather unexpected, on the poetic lore and the orally-transmitted traditions of what he considered an illiterate culture. To the muslim scholars of the medieval period (much as to present day muslims) this exceptional capacity of Arab culture was key to understanding cultural transmission during the early centuries of Islam (a transmission which would be in need of explanation otherwise).

In order to explain the productive role of scholars from among the ‘ajam in Islamic culture Ibn Khaldūn evokes a purported decline of this all-important oral tradition in Arab culture. To him, the primary impetus for the enterprise of knowledge was a linguistic or lexical one, designed to counteract this decline of the oral tradition. The reign of the fifth Abbasid

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22 Ibid.
caliph, Hārūn al-Rashīd (c. 766 – 809 C. E.) was, to Ibn Khaldūn, a watershed in this regard:

When the transmission died away during the reign of Hārūn al-Rashīd ... the need appeared for the fixing of the Qur’anic interpretations and the fixing of the accounts of the Prophet [due to the] fear of their getting lost. There then developed the need for the knowledge of the authority [upon which the accounts were based] and [also for] the judging of the transmitters in order to distinguish between the proper authorities and those that were inferior. There then occurred an increase in the extraction of necessary injunctions from the Book [i.e., the Qur’an] and the sunna and along with it there occurred a corruption of the language, so there arose the need to put in place syntactical rules with the religious laws becoming the criteria for [these] inductions, extractions, and [analogical procedures]. So there arose the need for other branches of knowledge to serve as tools for understanding the rules of the Arabic language and the rules of such inductions and analogies [as well as for the] protection of religious belief through proofs [and this latter was due to] the increase in “innovation” and heterodoxy. So all of these [procedures] evolved into branches of knowledge with [their own] criteria which required instruction, and [these processes became widespread] in all of the crafts. And we had said in our introduction that the crafts were the [products] of sedentary life and that the Arabs were the farthest people from this, so for this reason the sciences became [the domain] of settled peoples, and [also] because of the distance of the Arab peoples from them [i.e., crafts] and of their [marketplace of ideas]. And at the time [i.e., during al-Rashīd's reign] the sedentary folks were ‘ajam or those who were among the ‘ajam captives from among the clients [of the Arab tribes] as well as the sedentary people who at the time were the followers of the ‘ajam, in terms of culture and their crafts and trades for they had striven for this since the time of the governance of the [Sassanian] Persians.23

23 Ibid.
Ibn Khaldūn then proceeds to provide a long list of the various fields of knowledge in which
the ‘ajam played a signicant role:

So the master of Arabic syntax was Sībawayh [c. 760 – c. 797 C. E.,
known as Sībūya in Persian,] and after him al-Fārisī [900 – 987 C.
E.], and al-ZajāJ [d. 923 C. E.]. And they were all of ‘ajam stock,
but verily educated in the Arabic language, having [learnt it]
through instruction by Arabs and interaction with Arabs. [And they
were then able to] render rules … [for the Arabic language] to those
who came after them. And likewise the bearers of the [accounts of
the life of the Prophet], those who preserved [this lore] for the
muslims were primarily ‘ajam or [‘ajam in language] or trained by
‘ajam by virtue of the spreading of this art to Iraq and [elsewhere].
And the scholars of the principles of jurisprudence were, all of
them, ‘ajam, as you know, and likewise the bearers of the science of
kalām [i.e., theology]; and similarly the preponderance of the
exegetes [were ‘ajam]. And no one but the ‘ajam strove for the
preservation and recording of knowledge. And the [truth of the
Prophets words] became apparent: “If knowledge were to hang
from the [high] heavens it will be a party of Persians [who retrieve
it].”

The subsequent text of the Muqaddimah suggests Ibn Khaldūn's desire to account for a
prevalence of ‘ajam scholars even after the sedentarization of the bedouin:

And as for the Arabs who reached this civilization [i.e., sedentary
life] and its [marketplace of ideas] and left the bedouin life-style for
it, they were occupied in leadership positions in the Abassid

| فصارت العلوم لذلك حضارية، و بعد العرب عنها وعن سوقها. و الحضر لذلك العهد هم العجم أو من في معناهم من |
| الموالي و أهل الحواضر الذين هم يفندون للعجم في الحضارة و أحوالها من الصنائع و الحرف، لأنهم أقوم على ذلك |
| للحضارة منذ دولة الفرس. | ٥٥٥ |

24 Ibid., 544.
government, and that which they were driven to was … a striving for [political power] rather than a striving for knowledge and [the opportunity to reflect upon that knowledge]. For they were people of government and its defenders and they managed its policies [together with a certain disdain] in regard to the bounty of knowledge in the period through what was happening in all the crafts. For leaders [are forever] too proud in regard to crafts and professions and all that [is associated with these things]. And they compelled those among the ‘ajam and [persons with an Arab father and a non-Arab mother] to [engage in these things]. So [the ‘ajam and persons of mixed ancestry] still consider it their right to strive for [the crafts and professions] for verily this is as a religion to them and their knowledge [system] and they do not disdain [knowledge] with the full disdain [felt by the Arabs for non-political pursuits?]. [This has ultimately resulted] in the [disappearance] of [the aforementioned skills] from the Arabs in general and the [association of these skills] with the ‘ajam. And the people in power grew strangers to the religious sciences [due to their drawing distant from the roots of these sciences]. They relegated the bearing [of knowledge and of the crafts] to those to whom they observed as being neglectful of [the people in power?] preoccupied [as these (non-Arabs) were] with what was of no avail to them as far as government and politics, as we described in the section on the religious hierarchies. So this [then] is that which we have [determined] to be the reason … that the bearers of [religion], or the vast preponderance of them, were ‘ajam.25

Having rooted his entire system of knowledge-production in the linguistic and religious sciences and the early history of Islam, Ibn Khaldūn re-emphasizes the formation religious sciences as a prerequisite to that of the other, intellectual, sciences (such as astronomy) in his subsequent

25 Ibid.
And as for the intellectual sciences, they do not appear in a religious community until after the bearers of knowledge and its authors are distinguished, and the crafts have ensconced themselves in all of the sciences. So this too was specific to the ‘ajam, with the Arabs having left it, and having refused its gifts, for no one bore [knowledge] except the Arabic speakers from amongst the ‘ajam with regard to crafts, as we said in the beginning.\textsuperscript{26}

A detailed historical analysis of the question of Arab vs. ‘ajam falls outside the scope of the present study. However, worth noting here is the unmistakeable identification or near-identification of ‘ajam with Persian-speakers as far as Ibn Khaldūn was concerned: This can be seen in the quote from the Prophet, the reference to the Sassanian dynasty, and the list of Persian-speaking scholars Sībawayh, al-Fārisī and al-Zajāj. Noting this remarkable identification it is indeed difficult not to marvel at the complex cultural background for these scholars as well as scientists such as Birūnī (and in subsequent centuries Ṭūsī and Shīrāzī), working in a largely Persian-speaking world but reliant on Arabic not only as a language of scholarly discourse, but as an important element of their self-identity as muslim scholars. This complex cultural background of medieval scientists from Persian-speaking regions of the Islamic world has often been ignored in modern treatments of the subject. Bulliet notes that “specialists on matters Arabian frequently forget to mention how many of the most prominent authors of medieval works in Arabic grew up in Persian-speaking homes.”\textsuperscript{27} As the fragments from Bīrūnī and Ibn Khaldūn suggest, by failing to recognize the cultural background of the Persian-speaking

\textsuperscript{26} Ibid.

\textsuperscript{27} Richard Bulliet, \textit{Cotton, Climate, and Camels in Early Islamic Iran}, 128.
scholars of the medieval period who wrote in Arabic, we risk the exclusion of a great deal of pertinent historical information from our discussion.28

As rich and compelling as the texts from Ibn Khaldūn and Birūnī seen here are, the goal is certainly not to provide these texts as proof for a comprehensive account of the history of the sciences (religious and otherwise) in the early centuries of Islam. For these discussions one would do best to refer to studies that have been carried out,29 and that will no doubt be carried out in the future. Leaving the broad implications of the Arab vs. ‘ajam discussion aside and focusing instead on the choice of language in the composition of scholarly tracts we should ask ourselves: If the Persian language was not used in the intellectual or religious sciences, what cultural role did it serve in the intellectual community of scholars working in the eastern Islamic domains, i.e., the so-called ‘ajam? While the emergence of New Persian (which occurred roughly during the 7th - 9th centuries C. E.) is not fully understood and falls outside the scope of this study, here we note that by the tenth century Persian had spread from its birthplace in historical Khurāsān and occupied much of the lands that had formerly belonged to the Sassanian empire (with the exception of ‘Iraq-i ‘Arab).30 In addition, upon its appearance, Persian was able to transform itself quickly into the language of high culture for the minor dynasties in

28 It should be also perhaps be noted here that embedded within both Birūnī's text and Ibn Khaldūn's are to be found the germs for a thorough questioning of the concepts of Arab and ‘ajam as binary opposites. This is seen, for instance, by the claims that the ‘ajam who were central to Islamic culture were nonetheless Arab in their language and religion (likely, with many sharing Birūnī's antipathy towards the Persian language as a language of scientific discourse), as well as the fact that the category of people of mixed ethnic identity was large enough to warrant its own name.


Khurāsan, and Transoxiana which, while subject to the rule of the Abbasid court in Baghdad were geographically distant enough to develop a distinct cultural identity (as can be seen in the efflorescence of Persian poetry and prose in these cultural centers). It should finally be noted that this process of the ascendance of Modern Persian came at the expense of the local Iranian languages such as Soghdian and Bactrian.\footnote{31} (Khwārazmian, which was Bīrūnī’s choice for his ill-fated and unnamed manuscript, appears to have held out into the 14\textsuperscript{th} century, only to ultimately yield to Turkish, but would presumably have been under pressure from the encroachment of New Persian, as well.\footnote{32})

Discussing the rise of Persian as a “new dominant literary language” in his Early Middle Period (i.e., c. 1111 – 1274 C. E.) Hodgeson states that its cultural ascendance

had more than purely literary consequences: it served to carry a new overall cultural orientation within Islamdom. Henceforth while Arabic held its own as the primary language of the religious disciplines and even, largely, of natural sciences and philosophy, Persian became, in an increasingly large part of Islamdom, the language of polite culture; it even invaded the realm of scholarship with increasing effect.\footnote{33}

Therein lies the final point that should be made with respect to linguistic history of the period we are examining: the Persianization of culture in the realms of eastern Islam was likely an ongoing process that, though well underway during Bīrūnī’s time, continued on, with fits and starts into subsequent eras.\footnote{34} The result of this process was a situation in which scholars working in the lands we denote today as Iran, and Central Asia were able to avail themselves of two languages

\footnote{31} MacKenzie, “Iran iii. Languages.”
\footnote{32} Ibid.
\footnote{33} Hodgson, The Venture of Islam, vols. 2, 293.
\footnote{34} It is interesting in this regard to note the presence in Bīrūnī’s Kitāb al-ṣaydanah the presence of Persian words (e.g., mīzāb, kārāb, and raunaq) that would presumably have raised eyebrows in Baghdad, and would have likely been incomprehensible in Cairo.
of high culture, i.e., Arabic and Persian, while the language of high culture in the Islamized regions to the west remained, almost exclusively, Arabic.

It is not surprising that the boundary between these two cultural would have become less porous by the advent of the Mongols and the political rivalry with their arch-enemies, the Mamluks. Hinting at what could only have been the mayhem wrought by the Mongols, Ibn Khaldūn concludes his chapter as follows:

And this [exclusive Persian involvement in the religious and intellectual sciences] remained the case in the Islamic lands so long as civilization was in Persia and its regions in Iraq and Khurasan and Transoxiana. And when these regions were destroyed and civilization (which is the divine secret for the obtaining of knowledge and crafts) left them, knowledge left all of the ‘ajam for they were surrounded by nomadism, and knowledge is specific to the countries that are abundant in civilization/settled-living. And today no [country] has more abundant civilization than Egypt. So she is the mother of the world, the īwān of Islam and the well-spring of the sciences and the crafts. And there remains some civilization/settled life in Transoxiana due to [the government that is there], and it can not be denied that through it they [i.e., the people of Transoxiana] have a bit of the sciences and the crafts. And what has led us to this [belief] are the words of one of their scholars written works that have reached was from those lands, and this scholar is Sa’d al-Dīn al-Taftazānī [1332-1390 C. E.]. As for the other ‘ajam we have not seen after the Imam Ibn al-Khatīb [i.e., Fakhr al-Dīn Rāzī, (1149 – 1209 C. E.)] and Naṣīr al-Dīn al-Ṭūsī any [works that would indicate excellence].

The tense political border that sprang into place after the defeat at ‘Ayn Jalūt, and that was due to the mortal enmity of the Mongols and the rulers of the Levant – the Ayyubids and subsequently the Mamluks) may have affected the diffusion of ideas and so may be partly responsible for Ibn Khaldūn's observations in regard to the virtual disappearance of scholarship from Persian-speaking lands. Still, as we look at the works of Shīrāzī and his colleagues, we

would do well to recognize the severity of the blows suffered by what Ibn Khaldūn refers to as civilization or sedentary life in the Persian-speaking land from which our author hailed. That the wholesale destruction of the cities of Transoxiana, Khorasan, and other regions in Persia, would have affected the intellectual productivity of the region should not be surprising. Ibn Khaldūn's observations must therefore be interpreted as well as a measure of the magnitude of the trauma dealt by the Mongols and their military conquests to a historian who lived less than a century and a half after the “catastrophe.”

B. Persian vs. Arabic in the Chapter on the Upper Planets

Having looked at the quoted fragments on the question of the Arab vs. the ʿajam in Islamic culture we are now better equipped to examine Shīrāzī's books on hayʿa, and to the discuss these with regard to the language in which their author chose to write them. As Shīrāzī's hayʿa book written in Persian Ikhtīyārāt/Selections has been variously described as an “abridgement of the author's Arabic [Nihāya/Limit],” 36 as well as the “Persian version of the [Tuḥfa/Offering].” 37 Our work in Chapter Four, however, indicates that the latter characterization is invalid, and the former problematic. We will now cast a fresh eye at some of this evidence as well as looking at additional passages within these works that are relevant to the question of Shīrāzī's choice of language.

As far as the Tuḥfa/Offering is concerned, we saw that it must have been written after the Ikhtīyārāt/Selections and that it contains planetary models for the upper planets that are notably different from those that appear in the Ikhtīyārāt/Selections. In addition, unlike the other two

works of Shīrāzī that we examined in Chapter Four, Shīrāzī does not include in the
*Tuhfa/Offering* a preliminary list of planetary models that he considered obsolete, limiting
himself instead to a presentation of the models that were accepted (i.e., “preferred”) by him, so
the *Tuhfa/Offering* is a generally more compact book than either the *Ikhtīyārāt/Selections* or the
*Nihāya/Limit*, so that even had it been written prior to the *Ikhtīyārāt/Selections* it could not
serve as a viable source for a putative summary regardless of the language in which each book
was rendered.

The characterization of *Ikhtīyārāt/Selections* a Persian version of the *Tuhfa/Offering*
appears in Saliba's essay, “Persian Scientists in the Islamic World,” as part of the discussion
touching on the dearth of Persian texts on *hay’a*, and the fact that those that do exist are “either
translations of Arabic texts or definitely mediocre popularized versions of the same.” Since
we have established that the *Ikhtīyārāt/Selections* could not have been based on the
*Tuhfa/Offering*, and since the *Ikhtīyārāt/Selections* and *Nihāya/Limit* are generally more closely
related, we could ask, instead: Is the *Ikhtīyārāt/Selections* perhaps a translation (or a mediocre
popularized version) of the *Nihāya/Limit*? In considering this question it is important to recall
that we have previously discussed how the *Nihāya/Limit* likely predates the *Ikhtīyārāt/Selections*
by perhaps several years, and also that Shīrāzī claims in his introduction to the
*Ikhtīyārāt/Selections* that this work is an “adorning” of the text of the *Nihāya/Limit* by the
Persian language. However, our work in the same chapter (i.e., Chapter Four) renders both
speculations (i.e., the *Ikhtīyārāt/Selections* as translation or bowdlerization) as, *prima facie*,
dubious. In Chapter Four we touched upon the differences between these two works. Here we
look at the same evidence in further detail.

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38 Ibid., 135.
Based on the analysis in Chapter Four we saw that the two books differ in Shīrāzī's organizational treatment of the hypotheses (see section 4-E, and Appendix 4-F). For example, the material systematically presented in the section on the hypotheses in the Nihāya/Limit, appears scattered about, partly in the analogous section in the Iktiyarat/Selections, and partly in the Chapters on the Sun (e.g., the Hypothesis of the Dirigent), the Moon (e.g., the Conjectural Hypothesis, and the Ṭūṣī Couple) and the Upper Planets (e.g., variants of the Conjectural and Deductive hypotheses). Also, as we noted in Chapter Four, Shīrāzī changed his labels for some of his hypotheses prior to writing the Iktiyārāt/Selections (note in particular the Nihāya/Limit hypotheses labled 5 and 8 in Appendix 4-F).

As far as the changes that affected the organizational scheme of the chapter on the upper planets, Shīrāzī chose to include the discussion of Venus's longitudinal motion in the chapter on the upper planets (loosely following Ptolemy's scheme in the Almagest) in the Nihāya/Limit, but, in the Iktiyārāt/Selections, he moved this material to a subsequent chapter that also includes the longitudinal models for Mercury. An even more notable difference in the chapters on the upper planets as they appear in the two works, however, is the fact that in the Nihāya/Limit Shīrāzī proposed his planetary models after presenting the discussion on the planetary latitudes, whereas for the Iktiyarat/Selections these were moved each to a properly designated chapter. As a result of these changes the outline for the chapter on the upper planets quite notably different (See Appendix 4-D, section 2).

As we have noted that the models themselves, though not identical (see Chapter 4, Sections F and G), correspond fairly well to each other in these two works.39 If we were to

39 So, for example the description of the "encompasser" in the Iktiyārāt/Selections (Ayasofya MS 2575, 106v) is clearly related to the text in the Nihāya/Limit (Köprülü MS 956, 77v and, though barely legible, Köprülü MS 957, 98v). The same is the case for the "dirigent" (Ayasofya MS 2575, 106v; Köprülü 956, 77v) and the "maintainer" (Ayasofya MS 2575, 106v; Köprülü MS 956, 78r). We have already commented in Chapter Four
ignore the differences listed in the previous paragraph, and look only at the differences in the models for the upper planets, then we could begin to speculate about a relational scheme between these two works other than one based on a presumed “translation from Arabic to Persian.” If, rather than taking Shīrāzī's words as to the nature of the Nihāya/Limit as a book containing his mature and fully-developed thinking relative to his models, we look at it as a work in progress, containing his views on hay’ā at the beginning of a period of intellectual ferment and productivity, then the fact that he wrote two books in close succession (three, if you count the Tuhfa/Offering of 1284 C. E.) could perhaps more accurately be described as a process by which the author consigned to paper his evolving theories with respect to astronomy at three closely separated instances in time. In this view which is lent some credence by the heavy revisions that appear in Köprülü 956 and Köprülü 957, as well as the grossly different model for the upper planets that was to subsequently appear in the Tuhfa/Offering, each of the three books in question would serve as a “snapshot” of Shīrāzī's thinking relative to his astronomical models over a four year period.

Furthermore, if this view is accepted, the assumption that the middle book in the sequence (i.e., the Iktiyarat/Selections) must somehow be considered as a translation of a primary work in Arabic, or that it is second-rate in some manner, becomes difficult to maintain. To provide a rationale for the choice of language in the Ikhtiyārāt/Selections, we would, of course, have to speculate, and ask if this couldn't have been driven, perhaps, by practical considerations such as the desire to locate a patron who was conversant in (or at least familiar with) the language of the text. As is self-evident, Shīrāzī was capable of writing in both Persian

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on how the differences in the two books are primarily in the relative orientation of the various axes of rotation for the orbs of the upper planets.
and Arabic, and he may very well have taken the opportunity afforded by a sponsor who did not understand Arabic to compose his work instead in Persian.40

So far in our discussion we have focused somewhat on the difference in the organization of the material within the two books, i.e., on material that ended up at a different chapter or location for each. A look at Appendix 4-D indicates that there are more substantial differences in the two texts, as can be seen by the existence of sections that appear in one text but that are partially or completely omitted in the other. An example of this appears as 1.b.iii in Appendix 4-D. This is a fragment text that provides an alternative explanation for the necessity of existence of an epicycle, and appears in the *Nihāya/Limit* but not in the *Ikhtīyārāt/Selections*.41 As this fragment is a short elaboration of a point that Shīrāzī had already made it is not very interesting, however. Of the more notable examples of omission in the *Ikhtīyārāt/Selections* or the *Nihāya/Limit*, I have selected three, that we will examine in the following section of this essay.

1. The Eccentricity of the Equant and of the Deferent.

The *Nihāya/Limit* and the *Ikhtīyārāt/Selections* both contain an extended section in which Shīrāzī discusses his ill-fated Conjectural Hypothesis (recall that Shīrāzī abandons the Conjectural Hypothesis subsequently, and instead provides a list of its observational inconsistencies in the *Tuḥfa/Offering* chapter on the hypotheses). The context for this

40 Needless to say, in the absence of actual data on the proficiency of Muẓaffar al-Dīn's facility in Arabic (and in Persian, for that matter), this reasoning remains speculative. If it is accepted for the sake of argument, however, then the language in the *Ikhtīyārāt/Selections* becomes almost incidental.

41 “And as for the [possibility] of retrograde motion and all that it entails, without the presence of an epicycle, though [referred to previously] in the Fourth Hypothesis, we will [nonetheless describe it in a different manner, which will include benefits that the aforementioned [discussion] lacked.” Köprülü MS 956, 54r.
arguments in favor of the Conjectural Hypothesis (see Appendix 4-D, item 8 in the columns corresponding to the Nihāya/Limit and the Ikhīyārāt/Selections) is Ptolemy's discussion of the eccentricities of the equant and the deferent orbs. In the Almagest, Ptolemy posits the eccentricity of the deferent (i.e., the distance of the center of the deferent orb with respect to the center of the World) to be one-half the eccentricity of the equant (i.e., the separation of the equant point form the center of the World). Ptolemy is not clear as to his reasoning for this, and scholars have speculated as to the rationale for his assumption ever since.\textsuperscript{42} Rather than provide an explicit reasoning for his choice in the Almagest, Ptolemy states cryptically that, for the motions of Mars, Jupiter, and Saturn, and “using rough estimation, the eccentricity one finds from the greatest equation of ecliptic anomaly turns out to be about twice that derived from the size of the retrograde arcs at greatest and least distances of the epicycle.”\textsuperscript{43} Evans suggests that Ptolemy must therefore have calculated the eccentricity needed to provide a reasonable prediction of the motion of the epicyclic center about the center of the world (the so-called zodiacal anomaly, or, as Ptolemy states “greatest equation of ecliptic anomaly”) as well as calculating an eccentricity required to properly predict the synodic behavior of the planet as characterized by the “size of the retrograde arcs.”\textsuperscript{44} According to Evans, the fact that these two quantities were related by a factor roughly of two is likely what led Ptolemy to specify the 1:2 ratio as an exact ratio for his models of Venus, Mars, Jupiter, and Saturn.\textsuperscript{45}

In his defense of the Conjectural Hypothesis, which like ʻUrḍī's Lemma relies on an eccentric deferent that is centered not where Ptolemy has placed it, but half-way between

\begin{footnotesize}
\begin{itemize}
  \item \textsuperscript{42} Olaf Pedersen, \textit{A Survey of the Almagest} (Odense: Odense Universitetsforslag, 1974), 266-267; James Evans, \textit{The History & Practice of Ancient Astronomy} (New York: Oxford University Press, 1998), 357.
  \item \textsuperscript{43} Ptolemy, \textit{The Almagest}, 480.
  \item \textsuperscript{44} James Evans, \textit{The History & Practice of Ancient Astronomy} (New York: Oxford University Press, 1998), 358.
  \item \textsuperscript{45} Ibid.
\end{itemize}
\end{footnotesize}
Ptolemy's center (for the deferent) and the equant point, Shīrāzī includes a passage in the
*Ikhtiyārāt/Selections* that appears to be a paraphrase of the view of other astronomers who (with
Evans) suspected Ptolemy's choice for the eccentricity of the deferent to be based on some sort
of calculation and who reproached Shīrāzī (and likely al-ʻUrdī, as well) for moving the center of
the deferent from were Ptolemy had placed it. Appearing to follow a formal medieval
disputational scheme Shīrāzī paraphrases the criticism as follows:

“Even though it is generally accepted that Ptolemy determined the
distance of the center of the deferent for these planets by guessing
… unlike his derivation for the location of the equant [which is
based on proof], this is … false, for his reasoning there was also
based on [geometrical] proof and observation. However since the
proof was not listed in the *Almagest* people assumed falsely that he
had determined the aforementioned distance by conjecture and by
guessing, whereas this is not the case. And just as one shouldn't
alter the distance between the equant from the center of the world
[from that which Ptolemy has determined], one should also not
change the distance of the center of the deferent [from the center of
the world] for the basis of both is [a geometrical] proof.”

Shīrāzī's response to this criticism appears as follows:

We reply that the proof indicates that the distance between the mid-
point between the furthest and the closest distance of the center of
the epicycle from the center of the world that was determined from
the largest and smallest arcs of the retrograde in the ecliptic was half
that between the center of the world and the equant, and we have not
moved this point from its place, but we changed the distance of the

center of the embodied deferent from that which the moderns [!] had set, and there is no problem with that since their basis in this [choice] was not observation or proof, nor was the basis of Ptolemy in [assuming that the center of the epicycle was always moving along a circle centered at the point that was the bisector of the farthest or nearest distance].

What is remarkable about this passage (that also appears with some variations in the *Nihāya/Limit*) is that it both highlights the existence of a current within the Islamic tradition that explained Ptolemy's choice for the eccentricity of the deferent sphere based on a measurement of retrograde arcs (as Ptolemy himself had hinted), as well as providing an insight into Shīrāzī's critique (and no doubt al-ʻUrdī's before him) of Ptolemy. If Ptolemy's derivation of the eccentricity of the deferent was based on the observation of the arcs of retrograde, then this does not automatically imply his claim of a deferent sphere with a prescribed eccentricity, (which, to Shīrāzī, remained unsupported). In other words, if one were to posit another configuration (as had al-ʻUrdī) that could predict the same behavior as far as the length of the arcs of retrograde were concerned, then this configuration was at least as valid as Ptolemy's, and eccentricities different from Ptolemy's could therefore be allowed.

As we have said the quoted text of the *Ikhtīyārāt/Selections* follows, with variations, that of the *Nihāya/Limit*. The *Nihāya/Limit* develops this idea further, however, explaining Ptolemy's methodology for extracting the eccentricity of the deferent from observations of the retrograde

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Ibid.
arcs of the planet (This occurs in section 8.2 A, Appendix 4-D):

So we say, and [to God we look for success], that Ptolemy obtained through observations of successive years the amount of retrograde, meaning the degrees by which the planets retrograded from first station to second station until he found from the amount of the retrogrades the smallest and the largest and he inferred from the smallest that the center of the epicycle was at the apogee [i.e., of the deferent] at the midpoint of the retrograde and from the largest that it was at the perigee [likewise], relying on the fact that – upon the limiting of the distance from both directions – should there [exist the least bit of discrepancy] that there should not befall the calculation a noticeable error due to this. He then started from the knowledge of these two quantities to seek the desired quantity in the manner which I will follow.\(^{48}\)

The “desired quantity” referenced in the quote is the eccentricity of the deferent orb mentioned above. Shīrāzī subsequently proceeds with a mathematical derivation in which he extracts the eccentricity of the equant, and that of the deferent based on the measure of the largest and smallest arcs of retrograde, and a single observation of the planet, in opposition, at ninety degrees from the apsidal line.\(^{49}\) Shīrāzī's derivation is related to the material in the *Almagest* X6, and X7, in which, Ptolemy derives the eccentricity of the equant and its location relative to the equinox for Mars based on observations of the planet at three solar oppositions. The focus of this section is the differences between the *Nihāya/Limit* and the *Ikhtīyārāt/Selections* and so we merely note here, that this derivation and its accompanying figure are missing from the


\(^{49}\) Ibid.
And know that [relying] on the measures of the retrogrades ... Ptolemy extracted the distance of aforementioned bisector [of the nearest and farthest distance of the epicyclical center from the center of the world] and assumed an imaginary circle centered upon it, and imagined that the center of the epicycle was always moving upon this circle, and then he observed the center of the epicycle in the mean distance relative to motion and from the angle [between] the two apogees [i.e., the mean and the visible], which is at its maximum at that point, and which he determined by observation he extracted the distance between the center of the world, and the [eccentric], ... and it [was] twice the original quantity. 50

The fact that the actual proof was omitted in the Ikhtiyārāt/Selection would tend to strengthen the view of this book as a secondary work derived from the Nihāya/Limit. We should bear in mind, however, that Shīrāzī's derivation in the Nihāya/Limit is rather general – in that it does not refer to actual values or planetary parameters – and that the text that appears in the Ikhtiyārat/Selection and that we reproduced above, provides a fair outline of the text as it appears in the Nihāya/Limit. Also worth noting in this regard is that one could as easily find sections within the Ikhtiyārat/Selections that have no counterpart in the Nihāya/Limit. We will look at two such sections from the chapter on the upper planets, subsequently.

50  Quṭb al-Dīn Shīrāzī, Ikhtiyārat-i Muẓaffarī, Ayasofya MS 2575, 116v.
2. The Conjectural and Deductive Hypotheses

After concluding his discussion of the various anomalies for the upper planets, in the *Nihāya/Limit* Shīrāzī provides a brief discussion of the equant before stating: “And should a problem arise, we respond [in providing a solution for it, that] the reason for the motion of a [moving body] about a point that is not the center of its mover is one of three hypotheses.”51 He then proceeds to describe 1. The Ṭūsī couple, 2. his own ill-fated “Hypothesis of the Maintainer and the Encompasser,” (which is a close affiliate of his own Conjectural hypothesis) and 3. the hypothesis based on ʻUrdī's Lemma.52 Since he does not present his own views on what the “preferred” model is until later in the book, Shīrāzī doesn't make an indication of which of these is his choice for the configuration of the upper planets.

While the presentation of the corresponding material in the *Ikhtiyārāt/Selections* is generally similar, it differs in important ways. In this chapter, Shīrāzī has already committed to the “Conjectural Hypothesis” (i.e., the second hypothesis in the aforementioned list) as his preferred model. So he does not include the “Hypothesis of the Maintainer and the Encompasser” in the list of three hypotheses and limits himself instead to the other two hypotheses. He, furthermore, adds a preface to the presentation of Ṭūsī’s Couple and ʻUrdī's Lemma hinting that they each suffer from shortcomings:

And since [we have reached this point and you are already aware] that these planets don't have an equant problem or an alignment problem, thanks to [an interpretation that is uniquely ours] and


52 Ibid.
likewise in the refutation of the issue of the equant as was described in the conjectural principle it is time [now] to mention that which has reached us from the [experts] in this art as far as the refutation of the issue of the equant in these planets [i.e., Saturn, Jupiter, and Mars], so that beginner's don't consider [these discussions by the experts] as complete and so they don't come to believe in them [as the final truth].

It is worth reiterating here that even though the presentation of the material in the *Ikhtiyārāt/Selections* is based loosely on the structural outline of the *Nihāya/Limit*, it is also rather different in that the hypotheses based on Ṭūsī and al-ʿUrḍī are presented here as expressly flawed, unlike the presentation in the *Nihāya/Limit* in which no judgement is made on the viability of each hypothesis.

The discussion of this material as it appears in these two books is different in other important ways as well. In his presentation of Ṭūsī's Lemma in the *Nihāya/Limit* Shīrāzī states:

> "And the Third Hypothesis is what I promised to you I'd explain when needed, and that is the Hypothesis of the Maintainer and the Dirigent, that is one of the four hypotheses that are apparent from the words of Ptolemy." 54

Nowhere in the *Nihāya/Limit* does Shīrāzī subsequently explain his cryptic reference to the “four hypotheses” of Ptolemy. To solve the mystery of the four hypotheses, one has to refer, instead, to the *Ikhtiyārāt/Selections*. The four hypothesis are, of course, none other than the Deductive-Superior/Inferior, Conjectural Superior/Inferior, and

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that I have described in Chapter Four. They are presented at the conclusion of the the presentation of ‘Urḍī's Lemma in the chapter on the upper planets in the *Ikhtīyārāt/Selections*.

We have already examined this text in Chapter Four and so here merely present Shīrāzī's concluding remarks which echo his remark in the *Nihāya/Limit* quoted earlier, as well as highlighting the importance of this four-fold scheme to the author:

> And it is obvious that these four hypotheses are as four branches belonging to Ptolemy. And though this is apparent to some, for most it will not become clear unless [full consideration] is given to it. This [then] is the heart of this matter and from it our [mediatory] actions, our conjecture, and the [excellent] quality of our reasoning become apparent.55

Shīrāzī then proceeds with his rather striking criticism of al-‘Urḍī for the failure to recognize the applicability of his hypothesis to the case of the Moon that we saw in Chapter Four. He then provides the only clue, rather cryptic, as to why he rejected the use of ‘Urḍī's Lemma for the upper planets, despite his success in generalizing it to the case of the Moon:

> And the difference [between these hypotheses] is that the Conjectural Hypothesis results in [points on the trajectory of the planet] to be equidistant from the equant point … and the center of the epicycle to have a true [i.e., circular] trajectory whereas the other two [i.e., the ‘Urḍī's Lemma and the Ṭūsī Couple] do neither of these things, and for this reason [the Conjectural] hypothesis is closer to the truth.56


56 Ibid., 115v.
The deviation of the planet's trajectory from a circular path, then, appears to be that with which Shīrāzī faults the other two principles, and is the reason why he decides upon using the
Conjectural Hypothesis for the upper planets in his two earlier works: the Nihāya/Limit and the
Ikhṭyārāt/Selections. The context in which this discussion is presented, the four-fold hypotheses
of the Conjectural-Superior/Inferior and the Deductive-Superior/Inferior is absent from Shīrāzī's
earlier work, the Nihāya/Limit, and is instead to be found in his slightly later work in Persian, the
Ikhṭyārāt/Selections.

3. The Question of “Alignment”

In concluding his discussion on the anomalies of the upper planets in the Nihāya/Limit
Shīrāzī states:

And the issue mentioned in the chapter on the Moon, caused by the
uniformity of motion of the center of the epicycle about a point
distinct from the center of its deferent is [applicable exactly] to
these four planets [i.e., Saturn, Jupiter, Mars, and Venus], as well.
But, as for that which was mentioned [in regard] to the anomaly of
the alignment, that is not applicable, by virtue of the alignment [for
these four planets] being relative to a point [about which] the
uniformity of motion is reckoned.57

The details of how Shīrāzī reckons the various planetary anomalies need not concern us here.
Of relevance to the present discussion, rather, is that Shīrāzī states that the “equant” issue as
observed for the upper planets and Venus is the same as that for the Moon (for the solution of
which he has relied on ‘Urḍī's Lemma), but that the issue of alignment is different for the Moon
(at least, as commonly understood) than the other planets mentioned. Shīrāzī continues:

57 Quṭb al-Dīn Shīrāzī, Nihāyat al-idrāk fī dirāyat al-aflāk, Köprülü MS 956, 58r.
And this too is apparent [though latent?] and we will clarify it further should we [encounter] it in the future, God willing. And its true reason is uniformity [of motion], since: for every sphere, the center of which is moving uniformly about a point, [there exists by necessity] a diameter that is aligned to that point, regardless of whether that point is the center of its orbit or not. And we have explained this in detail in the *Ikhtiyārāt/Selections* and you should pay heed to it, if you would like to be informed of it.  

We have already encountered this remarkable passage in Chapter Four, where we used the reference to the *Ikhtiyārāt/Selections* to provide a rough date for the completion of this work and to demonstrate that it was written shortly after the *Nihāya/Limit*. In Chapter Four we, also, commented on how the *Nihāya/Limit* gives the appearance at times of being a work in progress, particularly with a view to the heavy emendations that appear in the chapter on planetary latitudes. The fragment quoted above reinforces this impression by virtue of Shīrāzī's somewhat disjointed presentation: he first appears to promise to provide a discussion at some future point, and then provides a reason (in summary) on the spot, before referring the reader to a different work entirely, for the details. The most interesting aspect of this fragment by far, however, is the fact that the material that Shīrāzī views as relevant to the question of “alignment” does not appear in the *Nihāya/Limit* and that he urges the reader to refer to the *Ikhtiyārāt/Selections*, instead. Indeed, the discussion that Shīrāzī is apparently referencing appears in the chapter on the “hypotheses” in the *Ikhtiyārāt/Selections*. In that section Shīrāzī proceeds from a criticism of the Ptolemaic model for the upper planets and its reliance on the equant to what amounts to a description of the physics of solid bodies:

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58 Ibid.
However, the fact that the desired cannot be achieved through it [i.e., the Ptolemaic model] is [for the reason that]: It is [a given, and sound minds would also vouch for it] that [for] every circle, the circumference of which carries the center of another circle and that moves with a simple and uniform [rotational] motion, moving the circle that is carried with the same motion, the center [of the carrying circle] must possess three characteristics: first, the equality of angles resulting from equal motion about it [i.e., about the center of the deferent]; second, the equality of the distance of the center of the carried circle from [the center of the deferent in every instance]; and, third, the alignment of a specific diameter on the carried circle [with the center of the deferent circle]. This is because if the first characteristic is absent, either the circle is not a true circle or the center of the circle not a true center. And if the second characteristic is absent the motion is not uniform. And if the third characteristic is absent, then a line passing through the point of intersection of the carried circle with one of the tangent circles and the center of the epicycle … will not necessarily pass through the center of the other and this is necessary as Euclid has expressed.\(^59\)

Shīrāzī continues by noting that the proposed hayʿa of the Moon, and of the other planets, can not be correct since it fails to satisfy the physical requirements laid out above:

And since [the behavior of the planets] that has been determined through observation does not result from their [proposed] configurations [i.e., once the physical constraints that have been outlined are taken into account] their configuration [can not be correct] and the effort [of the proponents of these models] is fruitless and their endeavor futile.\(^60\)

Referencing the issue of the equant and what he terms the “issue of alignment” Shīrāzī adds:

\(^{59}\) Quṭb al-Dīn Shīrāzī, *Ikhtīyārāt-i Muẓaffarī*, Ayasofya MS 2575, 69r.

\(^{60}\) Ibid., 70r.
And it is [commonly accepted] by the practitioners of this craft that in these five planets [i.e., the Saturn, Jupiter, Mars, Venus, and the Moon] there exists an issue with the equant but not one of alignment, and they justify this by [stating] that alignment is with a point about which motion is uniform. [Yet] this claim [is only valid] if they explain [how it would be] that whenever the motion of the center of the moved circle is uniform about a point it is necessary that a specified diameter from the moved circle be aligned with that point. [Yet] none of the practitioners of this craft [have expressed this] or if they have it hasn't reached us, and the master of this craft [i.e., Ptolemy] [merely assumed this based on conjecture] since in the Almagest he said: “What is necessary is that the point that is the origin for the motion of the epicycle be a prescribed point which we assumed to be the apogee. The assumption that the apogee and perigee that is opposite to it are always upon a line from the center of the epicycle to the point about which the motion is uniform [is also speculative], and we found this was as we had supposed in the [upper planets and Venus] but not so in the Moon since [for the Moon] the uniformity is relative to the center of the World [but] the alignment is with the prosneusis point.” This is the exact rendition of what Ptolemy says and what he meant with this is clear.  

The related material in the Almagest appears in section V.5, in the discussion of the “direction” of the diameter of the Moon's epicycle in which Ptolemy says: “Every epicycle must, in general, possess a single, unchanging point defining the position of return of revolution on that epicycle. We call this point the 'mean apogee', and establish it as the beginning from which we

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61 Ibid.
count motion on the epicycle.”

According to Ptolemy's discussion in this section the mean apogee for all hypotheses, save the Moon's, is always aligned with the center of the deferent. It is only in the case of the Moon in which the “mean apogee” is configured such that it aligns with a point that is neither the center of the ecliptic, nor the center of the deferent, but “a point removed from [the center of the deferent] towards the perigee of the [deferent] by an amount equal to the [eccentricity of the deferent],” i.e., the so-called \textit{prosneusis} point.\footnote{Ptolemy, \textit{The Almagest}, 227.}

It is clear based on Shīrāzī's earlier comments that he considered the \textit{prosneusis} point for the Moon as troubling as the point “about which the motion of the epicycle center was uniform,” i.e., the equant for the upper planets and Venus, and the center of the Moon's deferent for the Moon. In his critique of Ptolemy's description of a \textit{prosneusis} point he states:

\textit{We say [i.e., in response to Ptolemy] that whatever is chosen as the origin of the motion of the moving body must be stationary relative to the moving body so that the distance of the moved body and its proximity be [confined] to that which is caused by its motion [i.e., the motion of the moved body and so the motions remain orderly]. So the point that is chosen as the origin for the motion of the epicycle must be stationary relative to the planets [!], and this is the import of Ptolemy's words: “It is necessary that the point be specified” meaning that it does not vary or change. However, the specified point [in this account] is nothing but the two endpoints of the diameter that is aligned with a point about which the motion is uniform, and the existence of this diameter is, in this case, necessary, since whenever the motion of the center of the epicycle is uniform about a point it is necessary that a prescribed diameter of the epicycle be always aligned with that point … and from this it becomes apparent that that which is commonly [accepted] as far as the [uniformity of the distance [of the epicyclic center] from the center of the eccentric is a falsehood, [for it is also necessary?] that a specified point of the epicycle be at all times aligned with the center of the world[!].\footnote{Quṭb al-Dīn Shīrāzī, \textit{Ikhtīyārāt-i Muẓaffarī}, Ayasofya MS 2575, 70v.}
Shihrâzî then proceeds to heuristically “prove” the claims he has made about the behavior of the epicycle and its alignment to the center of the motion, aided by a diagram. Subsequently, he re-emphasizes his contention that “the [statement] that it is always the same specified diameter from the epicycle that is aligned with the prosneusis point is a well-accepted falsehood,” and he responds to those of his critics who evoke Ptolemy's attempts to reconcile his models of the Moon with observations made by Hipparchus as the source of his configuration of the prosneusis point by citing errors arising from “observational factors.” He then concludes by stating:

So for this reason [i.e., observational factors] it is impossible, once the origin is [chosen as the] visible apogee, for observation to match [numerical prediction], but this is not due to the [variability of the visible apogee, just as] the agreement between [prediction and observation when the origin is chosen as the mean apogee] is not due to the fact that this [mean apogee] is fixed, rather it is [in principle] fixed, even though it is truly variable. And the origin of the motion of the mean apogee, which is the visible apogee, is fixed, even though it [i.e., the mean apogee] is variable. And for

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65 Ibid., 72 v.
67 Qutb al-Dîn Shîrâzî, Ikhtiyârât-i Mu'azzafarî, Ayasofya MS 2575, 72v.
this reason it doesn't result in a discrepancy and the [motion] remains accurate and the computed [parameters] are in accord with observation …. So based on this discussion it is apparent that the situation with the Moon is as that of the five wandering planets, by virtue of the fact they all have an “equant” problem [but none] have an alignment problem, since for each the alignment is with the point about which the motion is uniform, and the alignment with a [separate] alignment point an impossibility.68

Shīrāzī’s argument is admittedly rather confusing. It is, for example, difficult to know what to make of his allowance that the point of reference for the rotation of the epicycle be “virtually fixed” rather than “absolutely fixed.”69 In addition the citing of “observational factors,” at the end of his argument suggest that (perhaps somewhat like his Conjectural Hypothesis) he did not use his model to actually make a prediction of the Moon position, but that rather he was argued for it heuristically, based on the physical principles that he adhered to. What can be said about Shīrāzī's preceding discussion, without going into the details of a lunar model that is based on any new “alignment” schemes, is that it is clear that to Shīrāzī Ptolemy's proposed model of the Moon was as flawed as that of his model for the upper planets, for it relied on a non-physical behavior of a solid object moving through space, namely that it rotates about a point such as the center of its deferent, while also moving in a manner by which a given diameter would have to adjust its orientation to align with a point that was its “alignment point.” According to Shīrāzī’s

68 Ibid., 73r.

Ps azin jehit mahal basht ke chon maida doroo mo ray ba basht mursod ba mhosob rast ast. Ayn ne az an jehit ke mitfiger ast o moawafqat o matabag mursod ba mhosob br teqdir. Maida biyt o eshtfe ne az jehit ayn ast ke thabit ast bl az jehit anke d hurkat thabit ast che maida hurkat doroo o eshtfe ke az doroo mo ray ast thabit ast hejje jend o mitfiger ast o azin roveri d hurkat ehtlafigi ninfat o mifubab mando o mhosob ba mursod moawafqem. Che ayn amor o qo fi azam nyaid ke mida mitfiger ra mida thabit nisad ps muelom shke mida ya thabit baib ya az hurkat thabit ne thabit melata jehan ke mesher ast o biyt azin neq klname o ayn soval o jowab az asemar o gowamish ayn fen ast o qo jehan ast ke kesi biyt az ma berin muelom shke ast o ager shede ast bari ba mardise ast. Ps azin bnh shke muelom shke ke hurkat qore mitfiger hejje ast ba anek d aishan heme asekal meelal misir hejje o asekal mahadah nisest che d hrme mahadah ba an qo jehit ke hurkat bnsbta ba an mshbhe ast o mahadah nqota mahadah az mahalates. 555.

69 Ibid.
belief the alignment point was only physically coherent when it coincided with the point about
which the motion was uniform (e.g., the well-known equant point for the upper planets). In
addition Shīrāzī's attempt to come up with a physical description which covers both the
configuration of the Moon and the planets (save Mercury) is certainly consistent with his
adoption of ‘Urḍī's Lemma, which had been applied to the upper planets previously, for the case
of the Moon as well. In each case the overriding goal appears to have been to provide a general
description of the configuration of the planets that would explain the orbits of as many of the
planets as possible. A final note in regard to the question of alignment is that it does not effect
Shīrāzī's adaptation of ‘Urḍī's Lemma for the Moon, as that calculation is meant to predict the
position of the center of the Moon's epicycle rather than the position of the Moon itself.

The details of what Shīrāzī's interpretation of the “alignment” meant for his full model
remains to be worked out for now, and will have to await future studies. For the purposes of our
discussion of scientific texts written in Arabic and in Persian, this section of the
\textit{Ikhtīyārāt/Selections} is important, however, because it contains Shīrāzī's thoughts on
“alignment” during the period, roughly, of the composition of the \textit{Nihāya/Limit} and the
\textit{Ikhtīyārāt/Selections}. This text appears in the \textit{Ikhtīyārāt/Selections} and not the \textit{Nihāya/Limit};
with the author referring the reader of the \textit{Nihāya/Limit} to the \textit{Ikhtīyārāt/Selections} for his full
exposition of the subject.

\textbf{C. Discussion}

A comparison of the text of the \textit{Nihāya/Limit} and the \textit{Ikhtīyārāt/Selections} as these
appear in the chapters on the upper planets, reveal an involved relationship between these books
that almost defies our attempts at categorizing. Certainly our work indicates that the
*Ikhtiyārāt/Selections* can not be viewed as a translation of the *Nihāya/Limit* (i.e., from Arabic to Persian) in any recognized sense of the word; the texts in this single chapter are simply too
different from one another. Nor can the *Ikhtiyārāt/Selections* be viewed as a popularization of
the *Nihāya/Limit*; as we have seen from the fragments of text the Persian of the
*Ikhtiyārāt/Selections* cited in this chapter does suggest simplification; in fact it matches well the
tone and technical level of the Arabic of the *Nihāya/Limit*. As we have also seen each book
contains sections of a technical nature (in which the author develops his ideas, or expands on
them) that do not appear in the companion work. In addition we have the rather remarkable case
of cross-referencing in which each work mentions the other by name. How, then, are we to
characterize the relationship between these two *hay’a* works by Shīrāzī?

Certainly, one aspect of the relationship between these *hay’a* works has already been
mentioned: the fact that these works were a record of Shīrāzī's changing views on the
configuration of the heavens during the course of a short but particularly productive period. If
nothing, else the fact that *Nihāya/Limit* and the *Ikhtiyārāt/Selections* were completed in such
close succession allows us to conclude that Shīrāzī's views on *hay’a* were unsettled and subject
to considerable revision during the period in question (i.e., 1281 C. E. - 1284 C. E.). In addition
what we have seen of the *Nihāya/Limit* and the *Ikhtiyārāt/Selections* brings to mind one of
Ragep's comments in his discussion of the tradition of commentary on Ṭūsī's *Tadhkira/Memoir*.
Noting the ubiquity of these commentaries Ragep also notes the often high quality of the
members of this tradition that “provide new solutions to the *ishkālāt* (difficulties) of astronomy
as well as very interesting passages concerning the status of astronomy, the relation of theory
and observation, the role of physics in astronomy, and other theoretical concerns.\textsuperscript{70} Even though the text that we have studied in each work has been culled from one or two chapters at most (and thus represents a small fraction of each work) what we have seen indicates that Shīrāzī’s purpose was consistent with the goals that Ragep lists. Indeed, these feature are shared to varying degrees by all three of the works that were the subject of this study. As we noted in Chapter Four the \textit{Nihāya/Limit} can be viewed as a commentary of the \textit{Tadhkira/Memoir}. Yet, the same characteristics that allow us to label the \textit{Nihāya/Limit} a commentary on the \textit{Tadhkira/Memoir} apply equally well to the \textit{Ikhtīyārāt/Selections}. Hence, given the affinity of the \textit{Ikhtīyārāt/Selections} to the author's slightly earlier text on \textit{hay‘a}, the \textit{Nihāya/Limit}, perhaps the best way to characterize this work is as a commentary; a commentary in Persian, that is – not on the popular \textit{Tadhkira/Memoir} by Ṭūsī, but rather on Shīrāzī's own \textit{hay‘a} text in Arabic, the \textit{Nihāya/Limit}. Perhaps it bears pointing out again that in calling the \textit{Ikhtīyārāt/Selections} a commentary I do so while emphasizing that it matches the \textit{Nihāya/Limit} in the technical level of its language, and its overall scope. In other words, if, in the final analysis, the \textit{Nihāya/Limit} can be considered “one of the most elaborate Arabic \textit{Hay‘a} texts,”\textsuperscript{71} then our study so far indicates that this quality is one which it shares with its Persian companion, the \textit{Ikhtīyārāt/Selections}. Ultimately, it is by viewing the \textit{Ikhtīyārāt/Selections} in this manner, i.e., as a serious work in its own right, that the difficulties arising from its characterization as a translation or abridgment can be avoided.

The scarcity of Persian texts on \textit{hay‘a}, relative to those published in Arabic, has been commented upon by Saliba in his essay “Persian scientists in the Islamic world.”\textsuperscript{72} It is

\textsuperscript{70} Ṭūsī, \textit{Naṣīr al-Dīn al-Ṭūsī’s Memoir}, 59.
\textsuperscript{71} Saliba, “Persian scientists in the Islamic world,” 141.
\textsuperscript{72} Ibid., 126 - 146.
important to bear in mind however, that, if anything, our work in this chapter and in Chapter Four suggests, that as far as scholarly circles in the Persian-speaking world the division of the hay’a tradition (and other scientific traditions) into Persian and Arabic genres tends to obscure the fact that the authors (and the preponderance of the readers) of the Persian works on hay’a had a high proficiency in Arabic. Given this bilingualism, a work written in Arabic would have not posed a problem to serious scholars working in Persian. At the same time, however, any scientific work that was written in Persian would have been immediately incomprehensible to the vast preponderance of scholars working in ‘Irāq-i ‘Arab, the Levant, and Egypt. The question then is: why bother composing a book of hay’a in Persian at all, when this would effectively remove all of the Arabic-speaking scholars of ‘Irāq-i ‘Arab, the Levant, and Egypt from the pool of potential readers? Factors that would have been involved in the decision to write in Persian would no doubt have included the ever-increasing presence of New Persian of Persian as a language of culture (in the lands occupying the Iranian plateau and central asia), as well as the linguistic abilities of the patrons, who would have been expected to be conversant at least in the language in which these technical works were written (if not expected to fully understand the discussions contained therein). Ultimately, however, with our present state of knowledge with respect to the scientific texts in Persian (on hay’a as well as on other subjects), the best we can do is to say that the authors of technical works written in Persian were likely mindful of reducing their potential readership but that they chose (or felt compelled) to do so anyway.73

Of the astronomical and astrological titles that Storey lists in his reference work “Persian

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73 Ibid., 144 - 146.
Literature,” many are marked as translations, abridgments, or commentaries of Arabic texts.\footnote{Storey, *Persian Literature, A Bio-Bibliographical Survey*, 1:35 - 117.} It is a sobering fact in regard to the status of the field of “Islamic Science” that most of these works, whether commentaries or paraphrases or seemingly independent works such the *Gaihān-shinākh*\footnote{Ibid., 1:46; Birūnī, *Kitāb al-tafhīm li-awā‘īl shinā‘at al-tanjīm*, مب.} and the *Ikhtiyārat-i Sanjari*\footnote{Storey, *Persian Literature, A Bio-Bibliographical Survey*, 1:46.} remain unknown and unstudied except in rare instances. It is therefore impossible to form a coherent picture of the linguistic significance of the Persian language to the works which relied on it as their language of discourse. Here we can only emphasize that the paradigm “Arabic equals sophisticated technical work on *hay‘a*, whereas Persian equals derivative” should be questioned, as indicated by the comparison of the *Ikhtiyārat/Selections* and the *Nihāya/Limit*.

Also indicative of the developmental state of the field is the fact that even works (in Arabic and Persian) by well-known authors remain unpublished and unstudied, and that it is not surprising to encounter disagreements by modern scholars as to their nature and significance. A case in point is Ṭūsī's early Persian work on *hay‘a*, the *Risāla-i Mu‘īniya*. Noting the absence of certain features such as a list of the *ishkālāt* (i.e., the criticisms of Ptolemy) and a discussion of the “Tusi Couple” in the *Risāla-i Mu‘īniya* Saliba characterizes this texts as an “elementary text” relative to the *Tadhkira/Memoir.*\footnote{Saliba, “Persian scientists in the Islamic world,” 140.} Ragep, on the other hand characterizes the *Risāla-i Mu‘īniya* as a text “anticipating” Ṭūsī's *Tadhkira/Memoir* “in both structure and content”\footnote{Ṭūsī, *Naṣīr al-Dīn al-Ṭūsī’s Memoir*, 65.} implying a closer affinity for these two works. Though a comparative study of the *Risāla-i Mu‘īniya* is certainly not possible here, we merely point out that a range of characterizations appears to exist for this work. Indeed, given our experience *Ikhtiyārat/Selections* it is probably safe to say that
any conclusions made in regard to the *Risāla-i Muʿīnīya* at present would have to be modified once the work is studied further and edited.

Though a Shīrāzī's choice of Persian as a language scientific discourse is an interesting topic of inquiry, especially given the ubiquity of Arabic as the lingua franca of religious and scientific discourse across the vast Islamic realms, (and the fact that the preponderance of scholars working in the Islamic world wrote and read these works in Arabic), one must pay heed to the pitfalls of modern nationalism and the central importance of language in the nationalistic discourse with its myriad distorting and deceptive qualities. It is perhaps with a view to these confounding tendencies of nationalism that the term Persian has been problematized as an ethnic qualifier when used in the studies dealing with the history of science. Noting the impracticality of obtaining ethnic information in regard to the scholars of the medieval period Saliba notes that if Persian were to be relied upon as an ethnic term “then the history of Persian science will become totally chaotic.”

However, while it is critical to recognize the hazards of relying on a concept such as ethnicity (with its lack of precision and its host of distressing racial valences) for historical studies, we should not dismiss out of hand the value of the term Persian, at least as a cultural and historical signifier. Ultimately Khwārazmī (fl. 830), Rāzī (d. 932), and Būzjānī (d. 997) – to use Saliba's examples for the pitfalls of using Persian as an ethnic term – can be usefully thought of as Persian and should be. If for nothing else this is true for the reason that their lore as it has reached us associates them with a certain historical (and as the names themselves suggest) geographical context. It is certainly true that we have no way of saying anything useful about the ethnic make-up of these scientists. But, by ignoring the fact that these scientists were culturally and linguistically Persian we risk hobbling our historical analysis by

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79 Saliba, “Persian scientists in the Islamic world,” 126.
ignoring an important aspect of what Hodgson terms the "Perso-Islamic" culture. It should also be noted that we face the identical challenge in identifying the ethnicity of other medieval scientists, say Adelard of Bath or Ibn Khaldūn. Khwārazmī, Rāzī, and Būzjānī can only be said to be Persian that is, in the same sense that Ibn Khaldūn can be said to be Arab, or Adelard of Bath can be said to be English. It would be foolish, and certainly pointless to wonder about the racial or ethnic make-up of any of the scholars listed. Instead what can be said with reasonable certainty about the three Islamic scholars in question – Khwārazmī, Rāzī, and Būzjānī – is that each hailed from a Persian-speaking region in the eastern reaches of the Islamic world, and was fluent in Persian as well as Arabic. It is very likely, as was the case with Bīrūnī, that each would identify himself primarily as a member of the Islamic umma, rather than attaching great importance to his vernacular language, or to a recently ascendant language of high culture, for that matter. Given what we have learned in our study in regard to the cataclysm that befell the regions which are associated with these three scientists (i.e., Khwārazm, Ray, and Khurāsān) in the 13th century, a proper study of the Persian scientists in the Islamic world, would have to include both a discussion of the historical and cultural significance of Khurāsān, Transoxiana and Khwārazm in the first seven centuries of Islam, as well as discussing the monumental repercussions of the Mongol invasion in the 13th century; repercussions that were so dimly sensed in the account presented by Ibn Khaldūn. If this chapter manages to convey the fact that is yet to be written, and – that given the present state of scholarship and the vast store of unstudied manuscripts – it remains presently an impractical project, it will have realized one of its goals.

Restricting ourselves to the findings in this chapter and the previous ones, we can say
that *Nihāya/Limit* and the *Ikhtīyārāt/Selections* are a pair of closely related works composed during a period in which the author was rethinking and revising his models for the configurations of the universe. These books form a distinctive pair, as one is written in Arabic and the other, in close succession, in Persian, yet they share many of the same aims and the same scope, and they assume the same level of proficiency in their readers. The reputation of the *Ikhtīyārāt/Selections* as an abridgment or a translation of the *Nihāya/Limit* is undeserved. Based on the evidence from the chapter on the upper planets this work should more properly be thought of as an exposition or commentary of the author's *Nihāya/Limit*. 
Chapter 6: Conclusion

A. The taxonomy of Shīrāzī's three works on hay’a

One of the first things we noted in looking at Shīrāzī's works was the rather unusual collection of three books on the same topic (i.e., hay’a) and in the same general format; two of which were written in the relatively short time period of four years. One of the questions that our study hoped to answer at the outset was: What compelled Shīrāzī to write three closely related works, two of which were written with quick succession? Though a definitive answer to this question remains out of reach, this study has highlighted an unexpected variability of the three texts so that, at the very least, each of these works can be viewed as having afforded Shīrāzī an opportunity to present his changing theories on the configuration of the heavens. Though limited to a small section in each of these books, our study has also demonstrated that the situation with Shīrāzī and his prolific astronomical output is in many ways even more remarkable than originally imagined.

There are three reasons for this. The first has to do with the date of the Ikhtīyārāt/Selections. It is clear based on evidence from the works themselves that the date for the Ikhtīyārāt/Selections is sandwiched between the date for the other two works studied here. Thus, rather than having written two books in close succession, Shīrāzī appears to have completed all three of his major works on astronomy in this same period of (a little under) four years. As we saw in Chapter Three, this period of productivity (which involved several works on topics other than astronomy) was followed by what the author considered a fallow period that lasted for more than a decade. The second remarkable fact in regard to Shīrāzī's works and their dates of publication is the clear evidence for the close proximity of the Ikhtīyārāt/Selections and
the *Nihāya/Limit* in terms of content and date of completion. Not only do the books contain closely related astronomical theories (specifically with respect to the upper planets), but they appear to have been written virtually at the same time. The evidence for this lies in the fact that the astronomical models for the upper planets that appear in the *Ikhtīyārāt/Selections* correspond to the earliest versions of these as they appear in the *Nihāya/Limit*. We have seen that while the text of the *Nihāya/Limit* was subsequently amended these changes did not end up in the *Ikhtīyārāt/Selections*.\(^1\)

The corrections themselves are, of course, the third remarkable fact with respect to the chronology of these works and their relationship with each other. These appear primarily in the *Nihāya/Limit* and they are visible in the earliest manuscript that we know of, i.e., Köprülü 957. Many of these emendations appear in Shīrāzī's discussion regarding the orientation (or the tilt relative to the ecliptic) of the orbs for the upper planets, but are not limited to this section. Indeed Köprülü 956 contains many corrections, as we noted above, even though it was transcribed shortly before the *Tuhfa/Offering*. The corrections make it abundantly clear that, unlike Shīrāzī's claim as to the status of the *Nihāya/Limit* as a seminal and mature work, the astronomical theory that was included in the *Nihāya/Limit* was considered unsatisfactory by the author and was therefore heavily revised. As we have seen some of these revisions were almost certainly due to the fact that Shīrāzī viewed his proposals in the *Nihāya/Limit* (and the *Ikhtīyārāt/Selections*) as problematic, and was therefore forced ultimately to abandon some of his earlier theories in his third work, the *Tuhfa/Offering*. A major difference in the outline of this

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1 The reasons for why the heavy emendations did not find their way into the *Ikhtīyārāt/Selections* are not clear, but are perhaps related Shīrāzī's claims as to the status of the *Nihāya/Limit* as his seminal work (i.e., one in which he was willing to lavish time and effort upon subsequent to its publication). The fact that these emendations do not appear in the *Ikhtīyārāt/Selections* in my mind strengthen the theory that this work existed in some form prior to the *Nihāya/Limit*. 
work relative to Shīrāzī's two earlier works, is that (with exceptions, e.g., in the case of Mercury) the *Tuhfa/Offering* shuns a discussion of models that Shīrāzī considered incomplete or inadequate. As a result the great interest with which Shīrāzī refutes the astronomical models of his predecessors is lacking in this work, as far as I can tell. Indeed, the work may have been conceived, at least in part, as an opportunity to redress inadequacies in the earlier works, i.e., the *Nihāya/Limit* and the *Ikhtīyārāt/Selections*. As we saw, the only reference in the *Tuhfa/Offering* to Shīrāzī's earlier models of the upper planet occurs in the chapter on the hypothesis, where the author appears to depict these earlier models as untenable and as a test of the intelligence of the reader.

**B. Physical and mathematical principles in Shīrāzī's *hay’a***

As far as Shīrāzī's theoretical approach, our work in Chapters Four and Five has highlighted two underlying but ever-present themes. One is the central importance of the "hypotheses." To Shīrāzī these hypotheses were mathematical formulations representing what was in effect a sum of vectors moving with uniform angular motions (i.e., the system referred to commonly as "wheels upon wheels"). Not surprisingly Shīrāzī's title for his chapter dealing with the hypotheses echoes what Tūsī used for his corresponding chapter in his *Tadhkira/Memoir*, i.e., "On basing some of the apparently irregular motions upon models that bring about their uniformity." As we saw in the *Nihāya/Limit*, however, the material in Shīrāzī's chapter is greatly expanded relative to the material in Tūsī's *Tadhkira/Memoir*. The presentation of the hypotheses in the *Tuhfa/Offering* is similar in structure to the *Nihāya/Limit*, though modified in its details (see Appendix 4-F). One of the striking features in the

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corresponding chapter in the *Ikhtīyārāt/Selections*, however, is that organizationally it departs from that of the other two. (see Chapter 4-E). Rather than provide a full list of the hypotheses as in the *Nihāya/Limit* Shīrāzī only includes four in the *Ikhtīyārāt/Selections*, consigning the presentation for the remainder of the hypotheses to other parts of his book (see Appendix 4-F). The four hypotheses that Shīrāzī does include are precisely the ones included by Ṭūsī in his chapter on the hypotheses. The reason for this is not clear, though this arrangement may be the reflection of an earlier organizational scheme for the hypotheses, i.e., one predating the *Nihāya/Limit*. If we recall that the *Nihāya/Limit* was a commentary on the *Tadhkira/Memoir* in its conception and that (based on our work in Chapter Five) the *Ikhtīyārāt/Selections* could similarly be viewed as a commentary on the *Nihāya/Limit*, then the fact that Shīrāzī's fully elaborated scheme on the hypothesis does not appear in the *Ikhtīyārāt/Selections* suggests that what is preserved in the *Ikhtīyārāt/Selections* may be an earlier version of Shīrāzī's thinking with respect to the hypotheses predating both the *Ikhtīyārāt/Selections* and the *Nihāya/Limit*. We may perhaps speculate and wonder if this text had been written in Persian, and that for this chapter Shīrāzī decided to use what was available to him rather than carrying out the additional work of translating the *Nihāya/Limit* into Persian. The names that Shīrāzī gives to the hypotheses due to Ṭūsī and al-‘Urḍī may also be indicative of the existence of an earlier text in Persian as well (see note 52, Chapter 4).

A sense of how Shīrāzī viewed these hypotheses can be seen in the presentation of these hypotheses in the *Nihāya/Limit*, where each hypothesis is connected with an anomaly which it is meant to address (see Appendix 4 – F). If the hypotheses themselves introduced undesirable features, these could be addressed by relying on other hypotheses, as can be seen in a fragment
from the *Ikhtīyārāt/Selections*: “[We insert a] maintainer orb between the [planetary] epicycle and the dirigent, [so that this maintainer is] centered on the center of the epicycle and its motion is equal to that of the dirigent [in magnitude but] in the opposite direction so that the motion of the dirigent is decoupled from the motion of the epicycle and the motion of the epicycle remains simple and [that it does not include a contribution from other motions].” Here the motion of a dirigent (or encompasser) orb has rotated the enclosed epicycle in addition to (its desired effect of) moving the center of the epicycle along a desired path, so Shīrāzī relies on another hypothesis consisting of a single orb (i.e., the maintainer) to counter this undesired rotation. In its most general scheme, Shīrāzī’s hypotheses were therefore meant to rectify the non-physical behavior exhibited by the Ptolemaic models of the planets, with each non-physical behavior being addressed by a single hypothesis or by a judiciously chosen combination of hypotheses.

The second underlying theme of Shīrāzī’s astronomical theory is one that it shares with other works of *hay’a* in general and this consists of the fundamental importance of the laws of physics and the importance of consistency between the “hypotheses” and these laws. As we have seen, one of the most important of these laws was the requirement that celestial motion be circular and uniform.3 At the beginning of his chapter on the hypotheses Shīrāzī states: “So we say that motions that are non-uniform, as apparent from observation – and which may not issue from the celestial orbs except due to a displacement [i.e., of the observer from the center as in an eccentric orb] or a combination of uniform motions [that in turn necessitate non-uniformity with respect to us, i.e., the observer] – [occur in several varieties].”4 This stipulation of uniform

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circular motion, which was effectively a cornerstone of the hay'a genre as a whole, echoes – not
surprisingly – one appearing in the introduction to Tūsī’s chapter on the usūl in the
Tadhkira/Memoire: “If a celestial motion is irregular from our perspective, we must require that
it have a [hypothesis] according to which that motion is uniform; this [hypothesis] should also
bring about its irregularity with respect to us. For irregular [motion] does not arise from the
celestial bodies.”5 In the chapter on the hypotheses in the Ikhtiyārāt/Shīrāzī states:

So it is incumbent upon the group of moderns, who talk about [the
corporeality] of the orbs and the descriptions of the principles of the
motions that they have obtained through observation [while?] they
establish an orb that acts as mover for each motion – [and this group
of moderns includes] Abū ‘Alī ibn al-Haytham who was a
prominent mathematician, whose words and words of others like
him have greatly [influenced] the configuration of the orbs as three-
dimensional bodies – to describe the [configuration of the] orbs in a
manner such that which is desired is obtained from it, while at
the same time it is consistent with the principles [of hay’a]. And
should [the account] add or subtract from the number of orbs it will
not be [an issue] but if it is inconsistent with what is found through
observation or if is not [consistent] with some of the rules and
[principles] then it will have [missed its mark].6

5 Tūsī, Naṣīr al-Dīn al-Ṭūsī’s Memoir, 130; Ptolemy, The Almagest, 141.
6 Quṭb al-Dīn Shīrāzī, Ikhtiyārāt-i Muzaffarī, Ayasofya MS 2575, 67v.; Naṣīr al-Dīn Muḥammad ibn Muḥammad
Ṭūsī, Ḥall mushkilāt-i mu‘īyāh (Teheran: Chāpkhānah-i Dānishgāh, 1335).

Ultimately these concerns stem from The Almagest. In the discussion on the hypotheses for uniform circular
motion in III.3 Ptolemy states: “The apparent irregularity [anomaly] in their motions is the result of the position
and order of those circles in the sphere of each by means of which they carry out their movements, and in reality
there is in essence nothing alien to their eternal nature in the ‘disorder’ which the phenomena are supposed to
exhibit. The reason for the appearance of irregularity can be explained by two hypotheses, which are the most
basic and simple. When their motion is viewed with respect to a circle imagined to be in the plane of the
ecliptic, the center of which coincides with the center of the universe (thus its center can be considered to
coincide with our point of view), then we can suppose, either that the uniform motion of each [body] takes place
on a circle which is not concentric with the universe, or that they have such a concentric circle, but their uniform
motion takes place, not actually on that circle, but on another circle, which is carried by the first circle, and
With these words Shīrāzī underscores his commitment to one of the basic principles of celestial physics (i.e. the physical existence of spherical orbs) as well as positing the existence of theoretical hypotheses capable of describing the motion of the planets as they are carried about by these orbs. The correlation between the physics of the celestial realm and the hypotheses (consisting of “compounded” circular motions) is expressed in the language of solid geometry.

In a text that appears subsequently and that we have already examined in Chapter Five (see Chapter Five, note 55) and partially reproduced here for convenience: “It is [a given, and sound minds would also vouch for it] that [for] every circle, the circumference of which carries the center of another circle and that moves with a simple and uniform [rotational] motion, moving the circle that is carried with the same motion, the center [of the carrying circle] must possess three characteristics....” 7 It is important to note that Shīrāzī’s discussion of circles as it appears here follows shortly after his explicit criticism of Ptolemy: “But as far as Ptolemy – who is the founder of the principles (qawā‘id) and the master of observation – is concerned, since he doesn't [conceive] of solid bodies and [instead] is content with [planar figures], he is [unable to meet this challenge, (i.e., to provide a coherent explanation of the configuration of the orbs while remaining in agreement with observation and the principles of astronomy)].” 8

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7 This criticism is interesting for in it Shīrāzī appears to be criticizing Ptolemy's Almagest, rather than the Planetary Hypothesis. It is not clear therefore if Shīrāzī knew of the Planetary Hypothesis, a work, for example.

8 The description of Ibn al-Haythm is quoted directly from Hall-i mushkilāt-i muʿīnīyah. See Naṣīr al-Dīn Muḥammad ibn Muḥammad Ṭūsī, Hall-i mushkilāt-i muʿīnīyah (Teheran: Chāpkhānah-‘i Dānishgāh, 1335), 14. (Note I have used the consecutive numbering scheme for the pages that appears in this work.)
discussion of circles only made sense if the underlying reality of the orbs was understood (and thus features such as the equant rejected outright). What can be seen in the preceding fragments, therefore, is Shīrāzī's commitment both to the physics of solid spheres and to their abstraction in the realm of the hypotheses consisting of circles moving with uniform angular motions.

As we have seen, the fact that Shīrāzī opted not to use ‘Urḍī's Lemma in the model for the upper planets for the Ikhtīyārāt/Selections has only recently been brought to light.\(^9\) One of the important findings of the present study is that Shīrāzī decides against the use of ‘Urḍī's Lemma in the Nihāya/Limit, as well; favoring instead – as he did in the Ikhtīyārāt/Selections – his own rendition of Apollonius's theorem, the Conjectural Hypothesis. As we saw in Chapter Five the reason for this may have been Shīrāzī's desire to maintain a perfectly circular path for the center of the epicycle, and thus maintain better consistency with celestial physics.\(^10\) At any rate, as we stated in Chapter Four, it is clear that Shīrāzī's choice to not use ‘Urḍī's Lemma was not due to his ignorance of this formulation, for he used the very same lemma in the model for the Moon in both of the aforementioned works. This choice could very well have been due rather to Shīrāzī's confidence in his own ability to do better. Indeed, the choice of model for the upper planets in the Nihāya/Limit and the Ikhtīyārāt/Selections, raises interesting questions with regard to his familiarity with al-‘Urḍī's work. What was Shīrāzī's history with respect to ‘Urḍī's formulation? When would he have learned of this important innovation? As we have seen Ibn al-Fuwaṭī who knew Shīrāzī personally wrote that Shīrāzī was a student of al-‘Urḍī and was taught astronomy by him (see Chapter 3-C). This bit of biographical data does not survive in

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10 See note 25, Chapter Five.
any other of the biographies that we examined in Chapter 3. It should also be noted that Ibn al-Fuwaṭī's information with respect to Shīrāzī is not always entirely reliable; as we saw in Ibn al-Fuwaṭī's biography of Mujīr al-Dīn, he lists him as the dedicatee of the *Nihāya/Limit* rather than recognizing him as the dedicatee of the *Tuhfa/Offering*. Shīrāzī himself doesn't seem to mention his tutelage under al-ʿUrḍī anywhere. This fact is certainly missing in his autobiography for instance, though perhaps it is not reasonable to expect Shīrāzī to mention al-ʿUrḍī in his biography as the scholars listed in that work are those who were connected in some way with Shīrāzī's quest for medical knowledge. Also, Shīrāzī's praise for, al-ʿUrḍī as the foremost astronomer of his age in the late work the *Durra/Pearl*, is the only mention of ʿUrḍī's name that I have encountered in Shīrāzī's works. That Shīrāzī had access to a copy of ʿUrḍī's Kitāb al-*hay'a* is clear, however, because this book is quoted verbatim in Shīrāzī's discussion of ʿUrḍī's Lemma in the *Nihāya/Limit* as we saw in Chapter Four. Given this rather spotty collection of evidence it is, in the final analysis, impossible to know how and when Shīrāzī came upon ʿUrḍī's work on the upper planets. What we can say is at the time of the writing of the *Nihāya/Limit*, he was aware of it, yet failed to note one of the central features of the formulation which was its ability to circumvent the problem of the equant while maintaining a planetary trajectory that was essentially that stipulated by Ptolemy.

Given of Shīrāzī reputation as a 13th century astronomer in the tradition of Ṭūsī and al-ʿUrḍī it is perhaps time to offer a new look at his contributions to the *hay'a* tradition. This assessment will perforce be preliminary and provisional, for as we have seen, the vast majority of Shīrāzī's astronomical works (to say nothing of his scholarly works in general) remain

11 In the *Nihāya/Limit* Shīrāzī refers to his predecessor as “ba'd al-afāḍil al-muta’akharīn” (i.e., one of the excellent moderns) but does not mention him by name.
unpublished. Looking to past Shīrāzī's models on the upper planets as this appears in the Nihāya/Limit and the Ikhtīyārāt/Selections it is important to note Shīrāzī's successful application of 'Urḍī's formulation to the configuration of the Moon. This model, which has been discussed by Saliba in his essay “Arabic Planetary Models After the 11th Century AD,” successfully addressed one of the issues with Ptolemy's proposed configuration, in that it allowed the motion of the center of the Moon's epicycle to be described as a combination of circular motions about the center of the universe.\textsuperscript{12} It is worth repeating here that the present study has shown that the use of 'Urḍī's Lemma for the configuration of the Moon should not be considered an innovation that appears in the Tuhfa/Offering only, but that it was already included by Shīrāzī in the Nihāya/Limit.\textsuperscript{13} In Chapter Four we saw a quote from the Ikhtīyārāt/Selections in which Shīrāzī took al-'Urḍī to task for failing to recognize the importance of his own invention for the configuration of the Moon. In the Nihāya/Limit he states similarly: “And the master of this principle did not [recognize its (i.e., the principle's) application] in proving the uniformity of the motion of the center of the Moon's epicycle about the center of the universe as [we have recognized] and for this reason he [took refuge] in proving this via [reversing] the directions of motion [i.e., of the deferent and the encompasser spheres].”\textsuperscript{14}

While looking at questions related to the concept of “contributions” to hay’a, at least as important as Shīrāzī's application of 'Urḍī's Lemma to the case of the Moon, which can be

\begin{itemize}
  \item \textsuperscript{13} Quṭb al-Dīn Shīrāzī, Nihāyat al-idrāk fī dirāyat al-aflāk, Köprüli MS 957, 95r.; Saliba, “Arabic Planetary Theories after the 11th Century AD,” 97-98.
  \item \textsuperscript{14} Quṭb al-Dīn Shīrāzī, Nihāyat al-idrāk fī dirāyat al-aflāk, Köprüli MS 957, 95r.; For a discussion of Shīrāzī's claim to having solved the alignment issue see Saliba, “Arabic Planetary Theories after the 11th Century AD,” 99.
\end{itemize}
characterized roughly as the generalization of an established mathematical formulation, is his recognition of the importance of the works of his predecessors (especially in regard to a slew of recently developed “hypotheses” that were able to coherently challenge the models of Ptolemy) and the compilation of these models. It is for instance important to note that ‘Urḍī's Lemma did not appear in the works of Ṭūsī, nor did the Ṭūsī couple make an appearance in ‘Urḍī's Kitāb al-hay’a. In compiling these techniques (together with his own ill-fated “Hypothesis of the Encompasser”) Shīrāzī was advocating the treatment of the perceived issues with Ptolemy's astronomical theories via mathematical objects that were consistent with the laws of physics. It is true that in championing this approach to astronomy he was supporting what had been a basic tradition of the hay’a, but in his attempts at the compilation and the tabulation of these hypotheses, he seems to have been adding a new impetus for the treatment of the non-physical features within the Ptolemaic system that had preoccupied the authors of the hay’a tradition for so long with formulations relying on “compounded” circular motions.

In looking at Shīrāzī's relationship with ‘Urḍī's Lemma (a formulation that he was originally thought of as potentially the inventor\(^\text{15}\)) one can not but be struck by the richness of the evidence as it emerges upon a closer study of the primary sources. In reading the chapters on the configuration of the planets in Shīrāzī's three works one at first sees his adoption of ‘Urḍī's Lemma for the configuration of the Moon, followed by the rejection of it for the purpose that it was originally used (i.e., the upper planets), and, finally, the capitulation as it appears in the Ṭuḥfa/Offering. Ultimately, it is this richness and complexity that must serve as justification for the detailed study of the texts of Shīrāzī and his fellow scientists in the pre-modern world.

C. Alchemy at Marāgha

It should be noted here that even the non-astronomical sources that have been studied can offer surprises when viewed from a slightly different vantage point. The case in point for our study is the rather intriguing association of the Marāgha observatory with alchemy. This was remarked upon in Chapter Two, and as was pointed this association was already noted by Sayili in his excellent survey “The Islamic Observatory.” Sayili's remarks on alchemy are somewhat perfunctory, however, and don't appear to register the full import of Rashīd al-Dīn's comments on Marāgha. In discussing the same text that we reviewed in Chapter Two Sayili states:

The same author [i.e., Rashīd al-Dīn] tells us that Hulagu allotted salaries and pensions to the scientists and philosophers and had his royal residence embellished with their presence. The emphasis here seems to be on pseudo-sciences such as astrology and alchemy. Indeed, there is ample evidence concerning the astrological side of that interest, and Rashid al-Dīn informs us that Hulagu had a special inclination toward alchemy and dwells at some length on his wasted confidence on the alchemists. He says that they kindled much fire, constructed many a vessel, employed bellows of various sizes and consumed immeasurable amounts of materials but that although they caused the expenditure of immense sums of money they did not produce a particle of silver or gold and it all came to naught and resulted in no benefit to anyone except that these impostors thereby secured a livelihood for themselves. It seems probable therefore that Marāgha was also the scene of alchemical activities of considerable extent.16

This passage in Sayili follows a discussion of Marāgha as a locus of contact between “Islam and the Fareast [sic].” Sayili's main concern remains, however, with the interaction between the two astronomical traditions, rather than with alchemy.17 At any rate, his reference to astrology and alchemy as “pseudo-sciences,” as it appears in the fragment quoted above, is somewhat

17 Ibid., 192.
anachronistic: to the Ilkhanid ruler and to his subjects these activities were as sound and authoritative (at least as far as their epistemological validity) as many of the other technical and scholarly activities within the culture. What Sayılı fails to pick up on, and which is clarified only upon a comparison of the narrative of Hülegü's demise with that of his grandson Arghūn is that while the alchemy at Marāgha was perhaps driven in part by the desire to create wealth in the from of precious metals, its main purpose could very well have been to grant longevity or immortality to the Ilkhanid ruler. This is suggested, at least, in the fragment of Rashīd al-Dīn describing Arghūn's death (see Chapter 2.C.4). If we accept this then it follows that – rather than belonging to the Islamic tradition of alchemy with its primary focus on the transmutation of gold – the alchemy practiced at Marāgha may have had a closer affinity to a Taoist or other “eastern” tradition with a strong interest in the elixir of immortality.¹⁸

According to Rashīd al-Dīn the adept who prepared and administered this elixir to Arghūn “came from India.”¹⁹ As can be seen in the chapter in Birūnī's *India* entitled “في ذكر علوم لهم كاسرة الأجنحة على أفق الجهل” – translated as “Of Hindu Sciences Which Prey on the Ignorance of People” by Sachau – Indian alchemy indeed appears to have included a tradition called the *Rasayana*, which, like alchemy in the Taoist tradition, was principally concerned with the rejuvenation of the vital spirit.²⁰ However, this tradition was primarily based on herbal preparations rather than metallic ones (e.g., ones dependent on Mercury and ores and minerals in

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¹⁹ Rashīd al-Dīn Ṭābih, *Jāmi’ al-tawārīkh* (Tehrān: Iqšāl, 1338), 824. See Chapter Two, section C.4 for an English translation of this passage. See also note 131 in the same section.
a general sense), at least according to Birüni.\textsuperscript{21} That Rashīd al-Dīn's account (which was written several decades after the events the describe) may have been slightly garbled and that the adept in question may have belonged to a tradition more intimately connected with Taoist belief is suggested, at least, by the fact the text describing Arghūn's seclusion, and his partaking of the draught closely resembles a description of the “Potable Gold elixir” in Needham's “Science and Civilization in China.” This elixir was apparently based on minerals and metals, rather than herbal potions, and commenting on the difficulties in obtaining it the fourth century Taoist author Ko Hung (283 – 343 C. E., pinyin: Gě Hóng) includes the following as its prerequisite components: “money, seclusion in some famous mountain-range, isolation from profane unbelievers and critics, religious ceremonies, purificatory rites; abstention from pungent flavours and fish, to say nothing of the fasting; long heating under exact condition of temperature, needing taxing watch; and finally the indispensability of oral instruction from a genuine adept, as teacher.”\textsuperscript{22} As can be seen many of these elements occur in Rashīd al-Dīn's account of Arghūn's death: most notable among them the need for seclusion, the purificatory rites, and the constant accompaniment of the adept. In the final analysis, however, the exact tradition upon which Arghūn relied in his quest for immortality is less important than the implication that at least for part of its existence Marāgha was involved with alchemical technology meant to prolong the Ilkhanid ruler's life.\textsuperscript{23} Certainly the very possibility should allow us to view the strategic importance of Marāgha to the well-being of the Ilkhanid polity in a different light.

\textsuperscript{21} Birüni, Kitāb fi tahqīq mā lil-Hind min maqūlah maqūlah fi al-ʻaqīl aw mardūlah, 150.
\textsuperscript{22} Joseph Needham, Science and Civilisation in China (Cambridge [Eng.]: University Press, 1954), vols. 5, part 2, 68.
\textsuperscript{23} Li, The Travels of an Alchemist; the Journey of the Taoist, Ch'ang-Ch'un, from China to the Hindukush at the Summons of Chingiz Khan, Recorded by His Disciple, Li Chih-Ch'ang, 113.
D. Persian vs. Arabic in the Scientific Works of Islam in the East

The observations presented in Chapters Four and Five of the present study in regard to the *Ikhtīyārāt/Selections*, indicate that this book was a sophisticated commentary on the *Nihāya/Limit* and so does not fit the paradigm of an inferior or simplified *hay’a* work written in Persian. 24 Indeed, in our discussion of language as a determinant of content we should be ever mindful to not obscure the fact that the scientists working in Persia were able to write in at least two of the classical languages of Islam, Arabic, and Persian, and that at least some chose to render their scientific tracts in Persian. An interesting frame of inquiry, as far as the language of the *hay’a* texts is concerned, is the degree to which scientific works written in Persian reflected the social and historical forces of their era, such as the ascendance of the Persian language as a language of literary culture in the era up to the advent of the Mongols in the thirteenth century, and the its adoption by the Mongols as a language of high culture (which appears to have lent it even further prominence as can be seen by the heavy reliance on Persian in the major historical works listed in Chapters One and Two). Certainly, no firm conclusions should be made with respect to the role of language in the scientific works of Persian-speaking lands (as far as *hay’a* or any other fields are concerned), until something resembling a representative sample of the books of the scientists of the Persian-speaking world – whether in Persian or Arabic – are studied and published. A look at Storey’s bibliography demonstrates that the Persian works alone represent a long list of manuscripts that have been languishing for lack of attention, and that will require a considerable amount of scholarly attention, before we can make dependable

24 Saliba, “Persian scientists in the Islamic world,” 141.
conclusions about the interplay of language and the content of these scientific works.  

Once this rather extensive project is carried out, the additional benefit will be that it will help us in better understanding of the Mongol invasions and their cultural ramifications in the lands of eastern Islam. While historians of Islam generally recognize the Mongol invasions of the 13th century as ushering a new period in Islamic history, little work has been done, to my knowledge on the effect of these invasions on the scientific production emanating from the lands that were overrun by the Mongol armies. As we saw, the great fourteenth century historian Ibn Khaldūn viewed the invasions as having essentially snuffed out the cultural productivity of Persian-speaking lands. In what is surely a remarkable correlation with Juwaynī and Kolbas as to the extent of the damage early in the 13th century and the subsequent revival of the areas north of the Oxus river, Ibn Khaldūn singles out the region of Transoxiana as having retained something of a cultural pulse in the era leading to his own. Is this singling out warranted from the texts themselves? How much of the perceived negative impact of the political events of the 13th century on the cultural production of the Persian-speaking lands due to a cessation of this activity and how much was due to other factors (such as transmission)? How do the presence of Ṭūsī, Shīrāzī, and other luminaries of the era correlate with the perceived cultural dark age as perceived by Ibn Khaldūn? These questions and others like them remain the impetus for future work on Shīrāzī and his colleagues.

At the beginning of this study we pointed out that Shīrāzī's works remain largely unstudied. Due to its limited scope our study cannot claim to have improved the situation with respect to the unstudied manuscript by Shīrāzī and others, but it can be viewed at least as an indication of the importance of carrying out this work in order to obtain a better grasp of the

history of science in Persia and in other Islamic domains, during the late pre-modern era.
Bibliography


entry=islam_SIM-1438>.


Hartner, Willy. “The Astronomical Instruments of Cha-ma-lu-ting, Their Identification, and
Their Relations to the Instruments of the Observatory of Marāgha." *Isis* 41, no. 2 (July 1950): 184-194.


Li, Zhichang. *The Travels of an Alchemist; the Journey of the Taoist, Ch’ang-Ch’un, from China to the Hindukush at the Summons of Chingiz Khan, Recorded by His Disciple, Li Chih-Ch’ang*. London: G. Routledge & sons, ltd, 1931.


ʻIlmiyyah, 1997.


———. The Islamic Intellectual Tradition in Persia. Richmond, Surrey [England]: Curzon


———. *Ikhtiyārāt-i Muṣaffārī, Ayasofya MS 2575,* Istanbul.


———. *Mukatabat-e Rashidi.* Panjab University oriental publications; Lahore: Panjab University oriental publications, 1947.


Sarton, George. Introduction to the History of Science ... Baltimore, Pub. for the Carnegie Institution of Washington, by the Williams & Wilkins Co., 1962.


Tūsī, Naṣīr al-Dīn Muhammad ibn Muḥammad. Ḥall mushkilāt-i mu ‘īnīyah. Teheran: Chāpkhānah-‘i Dānishgāh, 1335.


Waṣṣāf al-Ḥazrat, `Abd Allāh ibn Ḍafāl Allāh. Geschichte Wassaf’s. Wien: Verlag der
Österreichischen Akademie der Wissenschaften, 2010.


Appendix 4-A

From the introduction to the Ikhtiyārāt/Selections (Ayasofya MS 2575, 1v):

بسم الله الرحمن الرحيم

رب اعمنت فرز

سباس و ستایش به قیاس و مدح و حمد به حد و عد لایق حضرت عزت صانعی باشد که حقه این شفه می‌نیا را

بدرر غر کواکب ثواب و جواهر زواره سیارات و ثوابت مرصع گردانیده

حکیمی که نیام (یتیج) انتقام عمل در قبیله زحل نهاده

علیمی که مشتری را در مسند سیادت قبای سعادت در میزانیده

قاری که مرتخ را در خطه پنجم شحنه انجم گردانیده

قادیری که بی‌قصر زر اندوز افتاب که بنمزلت حدقه اک افروینج است شیب و بالای عالم مجازی را منور کرد

لطفی که ارغون فنون در کنار زهور شهره نهاد تا ماه قرندری از نغمات آن ذراعه نو خرده کرد

مدیری که کلک تبیین بست تبر که بیبر کشدار دوم است داده

مقدری که مروک کواکب را در زین زرین پروسون کشیده

پادشاهی که مشهد قربان هنف کتیبگان زر اندوز دری مارس کپاه غلتان کرده و چندین هزار مهره بلور در

dوارزه خانه این رنگ کشی کردن کرده که با داده آن حکمت واحده که مره اعمال و اعمال مهره

اعمال و اعمال کاتانات عالم گاه در کشیشی حدوث و وجود متحرک کرده و گاه در ششدر اج ل و عدم

ساقن

الله خلق و الامر فتبارک الادین الحاقین

و صلوات و تحف تعبیرات سراور نتار و وجود مقدس و ثروت مطهر سرور راه نمازیان دین و مهرب پیشوابان

یقین محمد مصطفی و رسول مجتبی باشد که خلائی خلائی از ظلمات حیرت و جهالت بناز ارشاد و هدایت

اوست. و امان اهل ابان از وراثات غفلت و ضلال از اعتقاد بحبل عصمت او صلی الله علیه و علیه و

اصحابه خلفایه (و خلافه‌های؟) صلوا دانه زانکی؟ مبارکه (نامه‌های؟) و سلم تسنیما کهیرا

جنین قوید محرر این رسالت و مقرر این مقالات احوج خلق الله الیه محروم بن مسعود الشیرازی ختم الله

بالحسنی که بحکم اکناب شریف‌نامه نوع از انواز علم ربانی از جزئی حکمت نظری علم‌یست که

نفس انسانی را از اقتین اش شرف اطلاع و هبیده (مهمان) انسان و زمان و عد افلاک و مقام ادین و کبید

ایجار و اجرای و اقدام اضداد بسانت احسان که اجزاء این عالم اند به اقتین حاصل شدی پررفت صاحب

عمر در کن و الموت و جست و جوی آن مصرف کرده شد و چون آن علم بر ویکیه که استاد صناعت صاحب
وجوهين ساعد توقيع بوز بس عصا اتيني رابيي زينيت كفرت وهو جهرة امني يغوص مواهب قضاي (ايشان) يذى حليتى بانتجع وحن تائنز و تعبست يبئرت چچر محاير اين سوارتود بودا شتى تاج حل اين مياكات كما يبتغي يرو آسان كشت چى بوسليت استعداد از كتب اسئان صناعت و چى بيوستلت استنباط و استعمال فكر و روبت خواست كه اژيجت احزان فضيلات و سماحت دينك طلاب و بحث و فيضود هرى(بر؟؟؟) مفت كرده قضايا را بر سكندن مرايع طبايع و مشطانان مسدس كييى بمشى ؟؟ ظهر باز نمايد و متل مجم؟؟ زواياى فكرت را بر شكل تروس جله دهد و انزا بر معرض انتشوار و استنثار بر و از افت اندرس و تبدى صيانت كند و بر مسترشجان و مستفيدان كه مامت بر تحقيق حق متصور كردنده باشند عرضه كد پس يحكم اين تسبيب كتاب نظام الادراك في درآم الانفعال يستحى و بسب ان كاتب مشتغل بر تجهيزات افاق انفعال و غيابات انظار متىئرات و تغى و تزيفي هر یكي بر مينى و تميزى انجى مذهب متىئرات أتى ان ذمارت مي تومي بنا براین مقدمة تردى خاطرى مي بود كه انجى مذهب متىئرات و خلاصه اين اسرار در متىئرات شت فایکورد.

في أثناء اين تفكر و بيدا اين تتحيى از حضرت علیا و بارکه ولا يم خذوى و خدوان لى الإبادة والإعماج منع الافعال و الاكرام نحمى الفدوات المتعة اسئان يشير الشفيف محيى فضاءى السلف ملك الإعراة العبع و الأعجم قوة زعامة جييش الإمبراطور Odin و الدين حيال الإسلام و المسلمين و نخر سنهج جيدة غيره دارد الاكابر الاخلاص في العالمين سكارم ابطال الافاق انسى العالم انفجارا جهل كفر و كفر این إيران و يوق البرانين بن لامير السيد الشهيد فدوى اكله و سلطان الغزاة؟ حساس الملة (نسله جيده الدوله دارد) و الدين البريك ادام الله عاله (علاله) و ضاغع اقتداره كه صيت يزغورى و منشانى در افاق اقتران سارينس و حقيقات (من اشبة طاهى فما ظلم) بر جميع مبيع أو وضيح و ظاهرى انشانيين دعا دفعى مخلص و هو خواى يجي انشاى نفاى ؟؟ يبتى كه فصلى بحى ذكر شرح الانفعال و ارجى و حيدانى في حبى تتعيى ان ابى كر معاى را بالفاعل بالموسى طارى تا عياى قوالي او خاص و حاى شالى شوى و قوالي عوارى او ناقص و كامال را كان.

پس بحکم أن خاطر و انت امتثال فرمان آن لوازم خدمت و شرایط مطابقت. کس این اوراق اتفاق افتاد و انت را انطباقی در تام کرده تا باعثت انسبام بان جناب مقیم الی لگت و مظالم جهانی گرد. انتظام بعید که انجبان چنان است که جهن منظر همایونی مشترک گردگر بر خلیل يا ژاله اطلاع یابند بعد از تشریف اصلاح عفو را که از عادات سادات و سادات عادات استعمال فرامیند.

اورد سیگناتو تعلیلی دولت و رفعت این خاندان مجد و کرم در تراکم داراد و جاه و خشم دنیا‌ و این دومان حسن شیم در تصاعد انتهای الجمب اللافت... و وضع و اساس این کتاب بر چهار مقاله لایح افتاد.
Appendix 4-B

Table of Contents, The Nihāya/Limit

Book I: Concerning that which must be presented by way of introduction
   Chapter One: Concerning the definition of hay’a, its subject, principles, issues, and benefits in summary.
   Chapter Two: An account of what must be presented from geometry
   Chapter Three: An account of what must be presented from natural philosophy.

Book II: Concerning the configuration of the celestial bodies.
   Chapter One: On the sphericity of the apparent surface of the earth, and water and the sphericity of the sky according to the senses.
   Chapter Two: On the arrangement and order of the bodies.
   Chapter Three: On the well-known circles, great and small.
   Chapter Four: On the circumstances occurring due to the two primary motions, and the situation of the fixed stars.
   Chapter Five: On accounting for apparently irregular motions as determined from observation by hypotheses (uṣul) that would allow their issuing from the orbs or for the regularity of their motion [despite their] irregularity with respect to us.
   Chapter Six: On the orbs and motions of the Sun.
   Chapter Seven: On the orbs and the longitudinal and latitudinal motions of the Moon.
   Chapter Eight: On the upper planets and venus and orbs and their longitudinal motions.
   Chapter Nine: On the orbs of Mercury and its longitudinal motion.
   Chapter Ten: On the latitudes of the five wanderers.
   Chapter Eleven: On parallax.
   Chapter Twelve: On the variation in the moon’s illumination and on lunar and solar eclipses, and the time period between two lunar or solar eclipses.
   Chapter Thirteen: On sectors and the situation of visibility and invisibility and conjunctions.

Book III: On the configuration of the earth and its populated and desolated sectors and the [consequences] accruing to it due to the changing positions of the celestial bodies.
   Chapter One: A general summary of the configuration and circumstances of the Earth.
   Chapter Two: On the characteristics of the equator.
   Chapter Three: On the characteristics of locations having latitude which are called the oblique horizons, and on the extent of east and west and the equation of daylight.
   Chapter Four: On the characteristics of locations whose latitude does not exceed the complement of the obliquity.
   Chapter Five: On the characteristics of locations whose latitude exceeds the complement of the obliquity but does not reach one-quarter revolution.
   Chapter Six: On the characteristics of locations whose latitude is exactly one-quarter revolution.
   Chapter Seven: On the co-ascensions of the ecliptic.
   Chapter Eight: On the lengths of the nychthemerons.
   Chapter Nine: On dawn and dusk.
   Chapter Ten: On understanding the units of the day, namely hours.
   Chapter Eleven: On the degrees of transit of the stars on the meridian and on their [degrees] of rising and setting.
Chapter Twelve: On shadows.
Chapter Thirteen: On the meridian line and the direction of the qibla.

**Book IV: On finding the measurements of the distances and the bodies.**

Chapter One: Introduction
Chapter Two: On the measure of the Earth, and on the knowledge of the height of the sphere of air.
Chapter Two: On finding the distances of the Moon from the center of the world
Chapter Three: On the sizes of the diameters of the Moon.
Chapter Four: On the measure of the diameters of the Moon and the circle of its shadow and the size of the Sun, and the [distance] of the apex of the cone of the shadow from the Earth.
Chapter Five: On the measure of the diameter of the Sun and the ratio of the sizes of the two luminaries and the Earth.
Chapter Six: On the other dimensions of the Sun and the dimensions of the two lower bodies [and their size].
Chapter Five: On the rest of the distances of the sun and the distances and body [sizes] of the two lower planets.
Chapter Six: On the distances of the upper planets and their body [sizes] and a concluding discussion regarding this section.
Chapter Seven: On the measure of the upper planets.
Chapter Eight: On the distance of the fixed stars and their bodies.
Chapter Nine: On the erroneous distances and sizes due to early and late astronomers without exception
Chapter Ten: On the correct method for extracting distances and sizes.

**Table of Contents, The *Tuḥfa/Offering***

**Book I:** On introductory remarks that need to be made prior to commencing on our desired discussions and that is in three chapters.

Chapter 1. Definition of the science of planetary configurations, its subject matter, its foundations and issues.

Chapter 2. On introductory statements that belong to geometry, and consists of two articles; the first one devoted to definitions and the second one containing geometric theorems that are needed.

Chapter 3. On introductory remarks pertaining to the natural sciences in two chapters. The first on the classes of solid bodies and their motion in summary fashion and the second chapter on issues pertaining to the natural sciences and the configuration of the planets and these are seven.

**Book II:** On the configuration of the celestial bodies and related topics, of the relationships between some of the bodies in thirteen subsections.
Chapter 1. On the sphericity of the visible surface of the earth and water.

Chapter 2. On the sphericity of the heavens as perceived by the senses.

Chapter 3. On how the earth relative to the heavens is as the center of a sphere to its surface.

Chapter 4. On how the earth is stationary at the center.

Chapter 5. On the arrangement and order of the bodies.

Chapter 6. On the well-known circles great and small.

Chapter 7. On the situation due to the two primary motion and that of the fixed stars.

Chapter 8. On accounting for (isnâd) the irregular motions by hypotheses (usûl) that require their occurrence based upon the orbs, or hypotheses that require their motion to be regular at the same time as they appear irregular to us, for irregularity does not issue from the orbs.


Chapter 10. On the spheres of the Moon and its motion in longitude and latitude.

Chapter 11. On the spheres of Saturn, Jupiter, Mars and their longitudinal motions.

Chapter 12. On the spheres of Venus and Mercury and their longitudinal motions.

Chapter 13. On the latitudes of the five planets who are called the wandering planets.

Chapter 14. On parallax.

Chapter 15. Includes an introduction and conclusion and four sections on the variation in the light from the Moon and solar and lunar eclipses and the period between two subsequent solar eclipses or lunar eclipses.

Chapter 16. On the planetary sectors, and visibility and invisibility and conjunctions.

Book III. On the configurations of the Earth generally [lit. whether filled or empty] and all that is properly related to it, in view of the differences with those of the superior planets. This is in thirteen chapters.

Chapter 1. On the configuration of the Earth.
Chapter 2. On the properties of the equator.

Chapter 3. On the properties of locations with finite latitude and these are called oblique horizons, and on the extent of east and the west and the equation of daylight.

Chapter 4. On the properties of locations where the latitude does not cross total obliquity.

Chapter 5. On the properties of locations where the latitude crosses total obliquity but does not reach a quarter of revolution.

Chapter 6. On the properties of locations where the latitude is a quarter of revolution.

Chapter 7. On the zodiacal co-ascensions.

Chapter 8. On the angles of the planetary transits and the angles of their rising and setting.

Chapter 9. On the length of day and night and the day and night equations.

Chapter 10. On morning and dawn.

Chapter 11. On the divisions of the day, i.e., the hours, and on what are composed of days such as months, years and related topics such as leap years and dating.

Chapter 12. On shadows.

Chapter 13. On the meridian line and on the direction of the qibla.

Book IV. On the distance and size of the planets in three chapters.

Chapter 1. On distances and sizes as they are commonly understood and this is in three articles and two principles, the first article on introductory remarks that are needed prior to commencing on our desired discussion, the second article on the area of the earth and what is properly related to it, the third article on the determination of the unknown sides/angles in a triangle? from the known.

Chapter 2. On the demonstration of the error of the ancients and the moderns in the determination of sizes and distances

Chapter 3. On the proper way to determine distances and sizes.
Table of Contents, *Ikhtīyārāt*/selections

**Book I:** On introductory remarks that need to be made prior to commencing on our desired discussions and that is in three chapters.

Chapter 1. Definition of the science of planetary configurations, its subject matter, its foundations and issues in summary fashion.

Chapter 2. On introductory statements that belong to geometry, and consists of two articles; the first one devoted to definitions and the second one containing geometric theorems that are needed.

Chapter 3. On introductory remarks pertaining to the natural sciences in two chapters. The first on the classes of solid bodies and their motion in summary fashion and the second chapter on matters pertaining to the natural sciences.

**Book II:** On the configuration of the celestial bodies and related topics, of the relationships between some of the bodies in thirteen subsections.

Chapter 1. On the sphericity of the visible surface of the earth and the sphericity of the heavens as perceived by the senses and how the earth relative to the heavens is as the center of a sphere to its surface and how the earth is stationary at the center and this is in four sections. The first is the sphericity of the visible portion of the earth and water, the second on the sphericity of the heavens as perceived by the senses, the third on how the earth is unto the sky as is the center of the sphere to its surface and fourth on how the earth is stationary at the center.

Chapter 2. On the description of the simple bodies.

Chapter 3. On the well-known circles great and small.

Chapter 4. On the causes of the primary and secondary motions and the fixed stars.

Chapter 5. On accounting for (*isnād*) the motions that appear forbidden by the motion of the spheres such as fastest speed and slowest speed and retrograde motion and station based on hypotheses (*usūl*) that would permit their occurrence and on the configuration of the planetary spheres in summary fashion and a brief mention of the existing difficulties and it consists of four sections; first on a description of the cause of fastest and slowest speeds, second on a description of the cause of retrograde motion and station and direct motion, third on the ways in which the solid spheres can be envisioned and its mapping onto a planar surface and the realization of the flat figure, on the configuration
of the spheres in the well-known manner and a brief mention of the difficulties that lie therein.

Chapter 6. On the spheres and the motions of the Sun.

Chapter 7. On the spheres of the Moon and its motion in longitude and latitude.

Chapter 8. On the spheres of the superior planets.

Chapter 9. On the spheres of Venus and Mercury and their motions in longitude.

Chapter 10. On the latitudes of the five planets who are called the wandering planets and this includes the purpose an introduction and a conclusion. As for the introduction it is an explanation of the situation of the apogees and nodes of these planets and the conclusion is an exposition of the spheres for the seven planets and in our reckoning these come out to forty-five, etc.

Chapter 11. On parallax.

Chapter 12. On the variation in the light from the Moon and solar and lunar eclipses and the period between two subsequent solar eclipses or lunar eclipses; and this includes an introduction and four articles and a conclusion. The introduction on conjunctions expresses how the position of the two luminaries is the same point on the ecliptic and its ascendant corresponds to the ascendant of the conjunction. The first article is on the variation of the luminosity of the moon; the second on the lunar eclipse; the third on the solar eclipse; the fourth on the period between successive lunar eclipses and solar eclipses, the conclusion on the planetary sectors, conjunctions, tashrīq, taghrīb, and visibility and invisibility (khafā’).

Book III. On the configurations of the Earth generally and all that is properly related to it, in view of the differences with those of the superior planets. This too is in thirteen chapters.

Chapter 1. On the configuration of the Earth, and a brief bit on its condition or state.

Chapter 2. On the properties of the equator.

Chapter 3. On the properties of locations with finite latitude and these are called oblique horizons, and on the extent of east and the west and the equation of daylight.

Chapter 4. On the properties of locations where the latitude does not cross total obliquity.

Chapter 5. On the properties of locations where the latitude crosses total obliquity but does not reach a quarter of revolution.
Chapter 6. On the properties of locations where the latitude is a quarter of revolution.

Chapter 7. On the zodiacal co-ascensions.

Chapter 8. On the angles of the planetary transits and the angles of their rising and setting.

Chapter 9. On the length of day and night and the day and night equations.

Chapter 10. On morning and dawn.

Chapter 11. On the divisions of the day, i.e., the hours, and on what are composed of days such as months, years and related topics such as leap years and dating.

Chapter 12. On shadows.

Chapter 13. On the meridian line which is also called the vanishing line and on the azimuth of cities.

Book IV. On the distance and size of the planets in three chapters.

Chapter 1. On distances and sizes as they are commonly understood and this is in three articles and two principles, the first article on parallel lines and introductory remarks that are needed prior to commencing on our desired discussion, the second article on the area of the earth and what is properly related to it, the third article on the determination of the unknown sides/angles in a triangle from the known, the first principle on the determination of a more optimum method for the determination of sizes and distances and includes six rules, the second principle on the better-known method for the determination of sizes and distances which includes an introduction and five rules.

Chapter 2. On the demonstration of the error of the ancients and the moderns in the determination of sizes and distances

Chapter 3. On the proper way to determine distances and sizes.
Appendix 4-C

Table of Contents, Tadhkira/Memoir (From Ṭūsī: al-Tadhkira fi ʻilm al-hay' a, p. x-xiii.)

**Book I. Concerning that which must be presented by way of introduction**

Chapter One: An account of what needs to be known that pertains to the geometry [corpus]

Chapter Two: An account of what needs to be accepted from natural philosophy in this science.

**Book II. The configuration of the celestial bodies.**

Chapter One: On the sphericity of the sky and the earth; on the earth being in relation to the sky as the center of a sphere to its circumference; and on [the Earth] being completely stationary.

Chapter Two: On the arrangement and order of the bodies.

Chapter Three: On the well-known great circles.

Chapter Four: On the circumstances occurring due to the two primary motions, and the situation of the fixed stars.

Chapter Five: On basing some of the apparently irregular motions upon models that bring about their uniformity.

Chapter Six: On the orbs and motions of the Sun.

Chapter Seven: On the orbs and motions of the Moon.

Chapter Eight: The orbs and longitudinal motions of Mercury.

Chapter Nine: On the orbs and longitudinal motions of the remaining planets.

Chapter Ten: On the latitudes of the Five Planets

Chapter Eleven: An indication of the solution -- of the difficulties referred to previously that arise from the aforementioned motions of the planets.

Chapter Twelve: On parallax.

Chapter Thirteen: On the variation in the moon’s illumination and on lunar and solar eclipses.

Chapter Fourteen: On sectors and conjunctions and the situation of visibility and invisibility.

**Book III: On the configuration of the earth and the [consequences] accruing to it due to the changing positions of the celestial bodies.**

Chapter One: A general summary of the configuration and circumstances of the Earth.

Chapter Two: On the characteristics of the equator.

Chapter Three: On the characteristics of locations having latitude which are called the oblique horizons.

Chapter Four: On the characteristics of locations whose latitude does not exceed the complement of the obliquity.

Chapter Five: On the characteristics of locations whose latitude exceeds the complement of the obliquity but does not reach one-quarter revolution.

Chapter Six: On the characteristics of locations whose latitude is exactly one-quarter revolution.

Chapter Seven: On the co-ascensions of the ecliptic.

Chapter Eight: On the lengths of the nychthemerons.

Chapter Nine: On dawn and dusk.

Chapter Ten: On understanding the units of the day, namely hours, and what is composed of days, namely months and years.

Chapter Eleven: On the degrees of transit of the stars on the meridian and on their
[degrees] of rising and setting.

Chapter Twelve: On finding the meridian line and the qibla bearing.

Book IV: On finding the measurements of the distances and the bodies.
Chapter One: On the measure of the earth.
Chapter Two: On finding the distances of the moon from the center of the world
Chapter Three: On the sizes of the diameters of the moon, the sun and the shadow, and
the distances of the sun and the shadow from the earth.
Chapter Four: On the volume of the two luminaries.
Chapter Five: On the rest of the distances of the sun and the distances and body [sizes]
of the two lower planets.
Chapter Six: On the distances of the upper planets and their body [sizes] and a
concluding discussion regarding this section.
### Appendix 4-D Table of Contents for the Chapter on the Upper Planets.

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2. The Orbs (this has three orbs appended to Ṭūsī's three orbs.)

2.a. The parecliptic.
2.a.1. Statement of nested parecliptics starting from the sphere of the fixed stars. Order is fixed stars-Saturn-Jupiter-Mars-Venus-Mercury. (cf. the Tuḥfa/Offering 2.b.1)

2.b. The Eccentric Deferent.
2.b.1. Clarification in regards to the naming of this orb: the deferent does not carry the center of the epicycle as though. Rather the epicycle is one of "the parts of this orb."
2.b.2. The inclination (which is fixed) of this orb relative to the parecliptic. (cf. the Tuḥfa/Offering 2.b.1)
2.b.2.a. results in the occurrence of a large circle: the ma'īl. (cf. Nihāya/Limit 2d.)
2.b.2.b. A definition of the "head" and "tail" of the planet.

2.c. The Encompasser
2.c.1. Inclination relative to the deferent.

2.d. The Dirigent
2.d.1. Centered on the center of Encompasser and [enclosed within it], but with its equator in the plane of the deferent with its axis intersecting the axis of the encompasser a the center of this orb.

2. The Orbs (number of orbs reduced from six to five here).

2.a. The parecliptic.

2.b. The Eccentric Deferent.
2.b.1. The inclination (which is fixed) of this orb relative to the parecliptic (cf. "The Chosen" 2.b.2).
2.b.2. A definition of the "head" and "tail" of the planet.

2.c. The Encompasser
2.c.1. Aligned with the Encompasser (no inclination).

2.d. The Inclined Orb
2.d.1. Aligned with the encompasser.
2.c. The Epicycle of the Planet.
   2.c.1. It is in the thickness of the Eccentric and the Planet is embedded in it.

2.d. The ma‘il:
   2.d.1. Due to the inclination of the deferent relative to the parecliptic there occurs a great circle. (cf. Ikhtiyārāt/Selections, 2.b.2.a)

   2.d.2. Definition of head and tail of planet. (cf. Ikhtiyārāt/Selections 2.b.2.b)

   2.d.2.a. The position of the head relative to the apogee of the deferent for Saturn, Jupiter and Mars.

   2.d.2.b. The position of the head for Venus.

   2.d.2.c. Naming convention: the meaning of al-taqaddum.

3. The Motions
   3.a. The parecliptic (How manifest, how discovered, how computed).
      3.a.1. calculation of the

2.e. The Maintainer.
   2.e.1. It is enclosed within the encompasser in a manner so that its equator is in the plane of the equator of the encompasser, with its center removed from the center of the encompasser at a distance equal to the distance between teh deferent and the center of the world.

2.f. The Epicycle of the Planet
   2.f.1. It is within the maintainer, in a manner such that they are in agreement as far as center and equator and diameter, and such that its equator is always superimposed on the equator of the maintainer and the planet is [affixed] to the epicycle and moves by the motion of its equator.

   2.f.2. Definition of head and tail of planet. (cf. Ikhtiyārāt/Selections, 2.b.2.b)

   2.f.2.a. The position of the head relative to the apogee of the deferent for Saturn, Jupiter and Mars.

   2.f.2.b. Naming convention: the meaning of al-taqaddum.

3. The Motions
   3.a. The parecliptic (How manifest, how discovered, how computed).
      3.a.1. calculation of the
3.a.2. Subsequent calculations indicated drift of apogee (see 3.b.3, below).

3.b. The Eccentric
3.b.1. Values for the planets.

3.b.2. Manifest as the motion of the center of the epicycle.
3.b.3. If the drift of the apogee is added to the motion of the epicycle the mean planetary motion results.

3.b.4. On the order and coherence of the motion of the epicyclic center for the upper and lower planets and the Moon (relative to the mean solar motion).

3.b.5. The manifestation of this motion (is that similar phenomena occurring at different parts of the zodiac are dissimilar).

3.b.6. The method by which this motion was computed. "They saw the Sun moving away from the planet ... and then returning to it -- the anomaly also returned to its original value. Except that now it was occurring in a different part of the ecliptic. It thus became known that the Sun in one period of the anomaly had traversed an arc, that the planet had traversed? The mean motion of the planet was thus extracted."
3.b.7. The Equant
3.b.7.a. Its value for Saturn, Jupiter, Mars, and Venus. [cf. The Gift, 3.c.2]
3.b.7.b. Derivation of its location. "Measured its anomaly when it was ninety degrees from the apogee."
The difference of mean Sun and mean planet = proper motion provided the planet moves uniformly around the center of the world, etc. Once derived the point was called "the center of the equant orb since they [falsely] imagined [an orb centered upon it]. It is also called the center of the dirigent as well... Yet it does not trace a circle."

3.b.7.b.1. A discussion of what it is that draws a circle touching on the hypotheses.

3.c. The Encompasser:
equal to the motion of the eccentric, countersequential.

3.b.7. The Equant
3.b.7.a. It's value for Saturn, Jupiter, Mars. [cf. The Gift, 3.c.2]
3.b.7.b. Derivation of its location. "Measured its anomaly when it was ninety degrees from the apogee."
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3.b.7.b.1. A discussion of what it is that draws a circle touching on the hypotheses. (Note this is different in the two books.)

3.c. The Encompasser:
equal to the motion of the eccentric, sequential.

3.c.1. "As you have learned in the third hypothesis," the reference here the hypothesis of the epicycle and the deferent. And so if we assume the epicycle of the planet to be in the perigee of the encompasser rather than at the apogee [cf. Ikhtiyārāt/Selections "istikbati faqānī" this doesn't look like it is the right one as the epicycle will move on lowest of the three circles in the ‘Urḍī scheme? "if this were not case it uniform motion would happen relative
3.d. **The Dirigent**, equal to the motion of the encompasser in both magnitude and direction [i.e., countersequential].

3.e. **The Maintainer**, twice the motion of the encompasser and sequential.

3.e.1. So due to the equality of the encompasser and the motion of the

to the center of the imagined deferent????]  
3.c.2 list of the location of the equant for various planets [cf. The Limit and The Ikhtyārāt/Selections 3.b.7.a]  
3.c.3 The alignment of the diameter follows, as well, from this scheme.  
3.c.4 discussion of the observational basis for the equant loosely paralleling 3.b.7.b in Nihāya/Limit and The Ikhtyārāt/Selections. Note the proof is not explicitly stated in the Tuhfa/Offering. In the other two books it is more explicit. In the Tuhfa/Offering we read: "They then tested the individual [juz’i] motions that were computed based on uniformity of motion and alignment being about this point and they found them to match the observations and there did not exist another point that was in agreement with their observed locations. So he decided that these point are the equants and further he found the distance between the equant and the imagined deferent as the distance between the imagined deferent and the center of the world."

3.c.5 Ptolemy's method for finding the location of the equant.

3.d. **The Motion of the Inclined Orb**, twice the motion of the encompasser and is countersequential.
deferent and the opposite sense of their motion in the upper half, despite [or together with] the fact that we assumed the distance of the center of the epicycle from the center of the encompasser to be equal to the difference between the center of the world and of the [imaginary] deferent, through the compound motion of these two the center of the epicycle traces an orbit equal to the equator of the eccentric, meaning the orbit/mover of the center of the encompasser in the eccentric (!). And its center is the center of the equant, and the motion of the encompasser and the dirigent do not cause the mean apogee which is the origin of the proper motion to be aligned with the equant. And the motion of the encompasser and the dirigent do not cause the nearness and farness of the center of the epicycle to be equal to twice the distance between the center of the world and the center of the deferent, and the motion of the encompasser and the dirigent do not cause the distance between the nearness and farness of the center of the epicycle to be equal to twice the distance between the center of the world and the center of the deferent.
3.c. The Epicycle
   3.c.1 The method for determining this.
   3.c.2. The motions are such as to allow for retrograde motion.
   3.c.3. A discussion of the dimensions; with Saturn used as an example. The third hypothesis is evoked.

3.d. The Epicycle
   3.d.1 The method for determining this.
   3.d.2. The motions are such as to allow for retrograde motion.
   3.d.3. A discussion of the dimensions; with Saturn used as an example. The second hypothesis is evoked.

transfromed into the perigee (or vice versa), since the motion of the Maintainer is in the opposite direction and equal to them in magnitude and returns the diameter [in question] to its [original] state.

3.e.2. The heirarchy of significance of these orbs:
"So the problem of the equant and the alignement of the mean apogee is removed through the addition of these orbs. However you should know that the effective [orb] in the equant [phenomenon] is none but the encompasser. And we [introduced] the Maintainer [only] to avoid the corruption of the transformation of the apogee to the perige. But the addition[relative increase]?? of the motion of the maintainer relative to the encompasser and the the ithbat?? the proof, or stationariness or constancy of the motion of the dirigent is due to the inclination of the apogee as shall be presented in the chapter on the latitudes.

3.f. The Epicycle
   3.f.1 The method for determining this.
   3.f.2. The motions are such as to allow for retrograde motion.
   3.f.3. A discussion of the dimensions; with Saturn used as an example. The third hypothesis is evoked.
| **3.c.4.** The upper planets are always in the apogee of their mean epicycles relative to the mean Sun. | as an example. |
| **3.f.4.** The upper planets are always in the apogee of their mean epicycles relative to the mean Sun. | incorrectly]. |

| **3.c.4.a.** And since their motion in the epicycle is by the excess of the mean Sun motion relative to their respective mean motions, their [angular] separation from their apogees is as much as the separation of the mean Sun relative to the center of their epicycle, in orbs that include/surround the earth. So the mean Sun is in opposition to them in the mean apogees in the middle of the time of retrograde and it returns to conjunction in the apogees. | **3.e.4.** The upper planets are always in the visible apogee of their epicylce _not_ the mean apogee!!!!! |
| **3.f.4.a.** And since their motion in the epicycle is by the excess of the mean Sun motion relative to their respective mean motions, their [angular] separation from their apogees is as much as the separation of the mean Sun relative to the center of their epicycle, in orbs that include/surround the earth. So the mean Sun is in opposition to them in the mean apogees in the middle of the time of retrograde and it returns to conjunction in the apogees. | **3.e.4.a.** And since their motion in the epicycle is by the excess of the mean Sun motion relative to their respective mean motions, their [angular] separation from their apogees is as much as the separation of the mean Sun relative to the center of their epicycle, in orbs that include/surround the earth. So the mean Sun is in opposition to them in the visible apogees in the middle of the time of retrograde and it returns to conjunction in the visible apogees. |

| **3.e.4.b.** And in situations other than these two, meaning if the planet is not at the visible apogee or perigee it is on the line between it and the center of the epicycle parallel to the line passing through the center of the world and the mean Sun. | **3.e.4.c.** And this does not become apparent except in opposition to the members of this craft and through the intermediary of geometrical proofs. |
3.c.4.b. This is the manner which this [topic] is commonly expressed, [but] they have [mistakenly] assumed what needs to be proven to be the proof as is apparent from the observations that we have cited.

3.c.4.c. The case of Venus.

3.c.4.d. The measure of the radii of Saturn, Jupiter, Mars, and Venus.

3.c.4.e. The case of Mars and Venus. "Know that the epicycle of Mars and Venus are much greater than the others."

3.c.4.f. In the section on distances and bodies it will become clear that the epicycle of Mars is much greater than the parecliptic orb of the Sun.

3.c.4.g. For this reason some may question this.

3.c.4.h. The well-known response to the cricism.

3.c.4.i. The well-known response is insufficient since it does not account for all

3.f.4.b. This is how this topic is commonly expressed. In truth [however] they have taken as proof what requires proving. And this can be seen from considering the observations that we have cited.

3.f.4.c. The measure of the radii of Saturn, Jupiter, and Mars.

3.f.4.d. The case of Mars and Venus. "Know that the epicycle of Mars and also that of Venus is much greater than the others."

3.f.4.e. In the section on distances and bodies it will become apparent that the epicycle of Mars is much greater than the parecliptic orb of the Sun.

3.f.4.g. For this reason some may question this.

3.f.4.h. The well known response to the cricism.

3.f.4.i. The well-known response is insufficient since it does not account for all
| 3.c.4.j. | A rephrasing? of the objection. | 3.f.4.i. | The well-known response is insufficient since it does not account for all possible conditions. |
| 3.c.4.k. | The comprehensive answer by the author. | 3.f.4.j. | A rephrasing? of the objection. |
| 3.e.4.j. | A rephrasing? of the objection. | 3.e.4.k. | The comprehensive answer by the author. |

4. **The Three Anomalies of motion.**

4.a. The radius of the epicycle.

4.b. The excess of the radius in appearance.??

4.b.1. This anomaly is joined to the first one.

4.b.2. A distinction relative to the case of the Moon.

4.b.2.a. This distinction is caused by the coordinate system chosen by Ptolemy.

4.b.2.b. introductory comments? in regards to the case of the Moon.

4.b.2.c. An example comparing the behavior of these anomalies as far as the Moon and the upper planets are concerned.

4.c. The anomaly due to the equant.

4.c.1. definition.

4.d. A fourth anomaly. Which is included in the third anomaly. Due to the difference in the visible and mean apogee.

4.d.1. It is additive when the center is ascending and subtractive when the center is...
descending.

4.d.2. Furthermore the addition and subtraction are as in the case of the Moon.

4.e. These two anomalies refer back to the same object.

5. A discussion of the equant.

6. The solutions involve:
6. a. The Tusi couple

6. b. The Conjectural Hypothesis (based on Appolonius's Theorem)

6. c. Hypothesis based on ‘Urḍi’s Lemma.

8. A discussion of the merits of the Conjectural Hypothesis

8.1 Invalid criticism of the Conjectural Hypothesis is based upon a common misunderstanding of Ptolemy's methodology.

4.d.1. It is additive when the center is ascending and subtractive when the center is descending.

4.d.2. Furthermore the addition and subtraction are as in the case of the Moon.

5. A discussion of the equant.

6. The solutions involve:
6. a. The Ṭūsī couple

(Note: Hypothesis has already been utilized in this chapter for the orbs of the upper planets)


7. A discussion involving the Conjectural Hypothesis and of the Hypothesis based on the ‘Urḍi’s Lemma (see 6.c) each with two "initial" positions for the center of the epicycle.

8. A discussion of the merits of the Conjectural Hypothesis

4.d.2. Furthermore the addition and subtraction are as in the case of the Moon.

4.e. These two anomalies refer back to the same object.
8.2 An illustration of Ptolemy's methodology in fixing the center of the deferent based on observation.

8.3 In conclusion: while it is not permissible to move the bisector of the nearest and farthest distances of the center of the epicycle from a point halfway between the equant point and the center of the world, since this was based on observation, it is permissible to move the center of the embodied deferent.


8.1 Invalid criticism of the Conjectural Hypothesis is based upon a common misunderstanding of Ptolemy's methodology.

(This material has already been presented in Chapter 2.5, on the Hypotheses)

8.3 In conclusion: while it is not permissible to move the bisector of the nearest and farthest distances of the center of the epicycle from a point halfway between the equant point and the center of the world, since this was based on observation, it is permissible to move the center of the embodied deferent.

8.3.1. A defense of the Conjectural Principle.

8.3.2. A discussion of Ptolemy's methodology, and of his confusion between the orbit of the epicycle and the orbit of the "encompasser."

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<td><strong>The Tadhkira/Memoir</strong>, (from Ṭūsī, al-Tadhkira fī ʿilm al-hay'a) <strong>The Nihāya/Limit</strong> <strong>The Ikhtīyārāt/Selections</strong></td>
</tr>
</tbody>
</table>
| **الفصل التاسع في علم الكواكب الباقية** **باب هفتم در افلاک کواكب علیٰ**  
**و حركاتها الطولية** **وجدوا الكواكب الثلاثة العلوية ابطا سيراً من الشمس**  
**الزهرة و حركاتها الطولية** **لما** **و جدوا الكواكب الثلاثة العلوية ابطا سيرا من الشمس** |
| **فإذا قارنتها الشمس** **بجاون أقتاب مقارن ایشان می شد**  
**و بقتها فظهرت مشرقة** **ایشان در بعدی ابد می بودند و مستقيم و سريع السیر و با سرعت سیر ایشان** |
| **و تكون في اسرع سیرها** **مشرق ظاهر می گشتند**  
**ثم تأخذ** **آنگاه سیرشان متوسط می شد**  
**بعد المتوسط في الحركة** |
في البطء حتى إذا صارت الشمس إلى قرب من نيليتها الأولى أو بعدة بقليل وقبلت ثم رحبت وتقبلت الشمس في واسط رجوعاتها ثم تلقف ثانية بقرب وصول الشمس إلى نيليتها الثانية

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</tr>
</thead>
<tbody>
<tr>
<td>أو بعدة بقليل</td>
</tr>
<tr>
<td>ثم تسبق وتأخذ من البطء</td>
</tr>
<tr>
<td>إلى التوست</td>
</tr>
<tr>
<td>ثم إلى السرعة التي إن تقرب الشمس منها تخفى مغرباً</td>
</tr>
<tr>
<td>و تقارنها الشمس في واسط استقامتاتها</td>
</tr>
<tr>
<td>حكموا بان لكل منها تدويراً</td>
</tr>
</tbody>
</table>

لاستحالة وجود هذه الأحوال بدونه

| لا إن مقارنتها للشمس في الإبعاد البعيدة و مقابلتها لها في القريبة و أن ممكن |

بسش از أن بانكد

| بان مستقيم مي گشتنت |

باز مقارن أفتاب مي شندن در أواسط استقامتاتها

| حكم كردن كى هر يه را فلك تدويرست |

باز طلی چا چون أفتاب نژدیک تثلیث

اول ایشان می رسید یا بعد از آن بانکدی واقف می شندن اگه راجع و در اواسط رجوعات مقابل أفتاب می بودند و در بعید اقرب باز دوم بر واقف می گشتنت نژدیکی رسیدن أفتاب بتلیث دوم ایشان یا
<table>
<thead>
<tr>
<th>ممكن است كه به دو فلك خارج ي ناقش</th>
<th>يا بيك خارج كه حركت أو همین</th>
</tr>
</thead>
<tbody>
<tr>
<td>جر و موافق</td>
<td>مقدار باشد</td>
</tr>
<tr>
<td>متحركين الى التوالى حركتين مجموعهما</td>
<td>و ان امكن ان يكون بخارج و موافق</td>
</tr>
<tr>
<td>مسار لنصف وسط الشمس</td>
<td>لكن رجوع و توابع ان و أنك در</td>
</tr>
<tr>
<td></td>
<td>مقارنة في اسرع نسر مي بودند</td>
</tr>
<tr>
<td></td>
<td>دافع اين</td>
</tr>
<tr>
<td></td>
<td>و رجوع و توابع ان اگر جه ممكن</td>
</tr>
</tbody>
</table>

چنانک در فصل دوم از باب بينم | 
| بيان ان کرده شد لکن اختلاف غایبت | 
| تعلیم ایشان چه برو تغیر بسبب | 
| أنک بصب أن بودی که ما بین | 
| المركزین اقطبا کردی و أن یک | 
| مقدار معین است مشاوی بودی | 

و أنک مقارنات ایشان با افتاب در | 
| ابعاد بعدی است و مقابلات او در | 
| قریبه مبطل این امکان بود | 

ازین تقریب یاد که معلوم کنی که | 
| استدلال یسیز این دو حکم | 
| اعی مقارنة و مقابلة بر و جه مذكور | 

چنانکه بعضی استدلال کرده اند باطل | 
| است | 

و من هذا یعلم ان الاستدلال باحدهما على | 
| وجود التدویر | 

علی ما استدل به بعضهم باطل | 
| جرح هر یکی بین تدوری صورت می | 
| بندد آلی مجموع ی objectives یست |
و بدانك ابعادى كه كواكب را بود أز
أفتاب كه غون بانجا رسن وافق شوند
للرجوع يأ للاستقامة ايشان را
رابطات خواند و آن درين سه كوكب
نزيكرست بثبتين تكير دن تشاك گنتم
و در زهره و عطارد بحسب أك
نصف قطر تدوير ايشان اقتضا كند
تقربا خانك بعد أزين بيايد ان شاء الله

و اما امكن حصول الريحون وما يتبعه
بدون الدوور و ان سبقت الاشاره بيه في
الاضل الربع لكننا نذكره هاهنا نمطا آخر
يشتمل على فوائد خلا عنها المذكور ثمة

فنقول متي كانت حركتا الخارج و
الموافق مختلفي الجبه و كانت التي هي
إلى التوالي اعظم قدما لليم للكوكب
دوره في البروج و مقهورة عن التي
إلى خلاف التوالي في ابعد البعد و قاهره
اياها في اقربه و انما يتهابا هذا بكثرة
خروج المركز يلزم منها المطلوب

اما الريحون فحبنا تكون زاوية الحركة
المرنيه إلى خلاف التوالي اعظم من
المرنيه إلى التوالي. و اما الاستقامة
فعلى العكس و هو أن تكون
7.0 المرنيه إلى التوالي اعظم من
المرنيه إلى خلافه. ثم المرنيه العظمى
إلى التوالي اما ان تكون أصغر من
زاوية الوسطية فيكون مستقيما بطنا و
وان كانت اعظم منها كان مستقيما سريعا
و اما الوقوف فبعد تكافؤ الحركتين
 لتكون المرنيه إلى التوالي كهي الى
خلافه.

لكن يدفعهما بعد ما مر ژروم كون جرم
الكوكب في الريحون تكون في الاوج
صغر منه في الاستقامة لكونها في جانب
الحضيض و كون زمان البطوط و الرجوع
لكونه مقدار ما يقطع الكوکب ما بين
البعدين الأوسطين بحسب الحركة من
جانب الآخر اكبر من زمان السرعة و
الاستقامة لكونه مقدار ما يقطع بينهما من
جانب الحضيض و كون ما بين اسرع
السیر و اوسطه اقل من زمان ما بين
اوسطه واقله و كون مقابله مع
الشمس في ابعد البعيد لأنها تقابلها راجعة
و كون غايتها تعدلها متساويين لتعين
موضعهما و هو البعد الأوسط بحسب
الحركة

و الوجود بخلاف الكل هذا ان كانت
الحركة التي الى التي همزة من التي
التي الى البعيد و قاهرة اباها في
اقربه و ان فرصة تدسر حيث يكون مفهورة
التي الى التي همزة من التي الى
خلافها في اقرب القرن و قاهرة اباها
ها في ابعده فلا يرد عليه بعد ما مر
لا خير

و القد ثبت التدوير و علم

ان له حماما و الا لما تكملت دورة
الكوکب في الربع

كه اولا حاملي باشد و الا كوكب تمام
دور بروج را قطع يندر

جنانك هز فصل اول از باب بنجم
تقرير كرده شد

معظم شد كه حاملي او خارج مركز
است

بلغ جه

من الكه يختلاف غاية تعدل

باختلاف غاية التعدل
ومختلفة لها

و اختلاف زمان احتفاء كل منها تحت
الشاعر في اجزاء بأعيانها من البرج مع
ان الاحتفاء يكون في الذري فلا يلبث
من جهة التدريب اختلاف بل من جهة
الخارج فهي زمانية الاحتفاء عند يبعده من
الأرض ويكثر عند قربها لأن
الشمس التي تسبق مركز التدريب فإذا
كان بعيد عن الأرض كانت حركته أبطأ
فتسق الشمس أسرع فيل زمان الاحتفاء
و بعمد إذا كان أقرب

و إذا قيس حال من أحوالها
تلك الحالة
و باختلاف أي حال من أحوالها
إذا قيس الى نظير تلك الحالة

و هواز زوجة
وجاز زوجة
و اكبر قلرا و اقل زمانا و بالعكس كما
في زحل و المشتري

دواء باختلاف زمان احتفاء هر يرك
ابو ايا في تحت الشاعر في اجزاء
من نل الاحتفاء مع أن الايا بك احضا
تدريب لمية باشد با دير احضا
اختلفي لحق او نشود بل از راه
خارج زون دوز باشد زمان
احتفاء اناكه شود و بون نرنيك باشد
بهية كود تي أتبا راص كان زا سوق
مي كيفر بر مركز تدبرر باز
دور باشد از زيم سير او باشا تود و
سون اسرع و زمان احتفاء أقل و أوتر
نزديك باشد بعكس بود

سوم

اختلاف في حال از احوال ايا
جون قياس مي كرادا با نظير ان حال

وروع زوجي با روعي يا استقابتي
با استقابتي يا باشت با بطني با
سرعتي با سرعتي ين مشاء
ياني باز في بعض اجزاء البحرة اكبر قلرا و زمانا
و في بعضها اقل قلرا و زمانا كما في
المريخ

يا دو بعضي قدر بيتشر مي باشد و
زمان كتير و دو بعضي بر عكس
جنانك دو زحل و مشترين

اين معنى از جداولي كه بجيحت قوس
رجوع و استقابتي و ايا ايا باشت و ضع
كرده ان ظاهرات
لا يوجد نص يمكن قراءته بشكل طبيعي من الصورة المقدمة.
الشمس إذا انتهت الكواكب إلى حدودها
وقفت اما للرجوع أو للاستقامة
و هو في العلية قريب من ثلث دائرة كما قلنا، وفي السفليين قريب من نصف قطر تدويرهما كما سيجيء أن شاء الله تعالى
ثم وجدوا الزهرة متحركأة في الطول
لا على نفس منطقه النجوم بل حولتها
تقرب منها تارةً في شمالها و تارةً في جنوبها و تبعد كذلك لا إلى حدود عينهما
فعلم أن لها عرض مختصها
وميلاً غير ثابت
وجدوا الزهرة شبيهة الاحوال بعطارد طولاً و عرضاء إلا أن أقرب ابعادها
مقابل إلا أن أقرب أبعادها مقابل لأبعدها
كما في العلية
وعادةً بعدها في الطول عن الشمس قداماً
و خلفاً لا تتجاوز سبعاً و أربعين درجة
ثم وجدوا شرحاً في سيرها فتسبق
الشمس بعد مقترحتها و تظهر مغرباً ثم
بعد التوسط ت treeNode في القطب مترجاً إلى أن
تقف ثم ترجح و تخفى و تقرر الشمس و تؤثر قصيفها الشمس
و تظهر مشرقة ثم تقف وتستقا من بطرف
الي توسط ثم سرعه إلى ان تخفى قدر
الشمس و تقررها فتكون معاً في
منتصف زمنها استقامتها و رجوعها
و لا تبعد في الطول عنها من قدمها
و خلفها أكثر من سبع و أربعين درجة
علي الجليل من النظر
فحسناً أنها لمحمدتها على فلك تدوير و ان
حركة مركزه مواقة لوسط الشمس و ان
التقدم والاختلاف لحركة التدوير

وأنا حكم يان حاملي التدوير خارج لما مر و الاختلاف مجموع البدن الصباحي و هو نصف قطر التدوير المارد بالبعد الألسط الذي في نصف الصاعد فيه لظهورها على طرفه قبل طول الشم مشرقته و المساءي وهو النصف الآخر من القطر المذكور لظهورها على طرفه في أول الليل ثم ومركز التدوير فيوضع معين من البروج لمجموعهما و مركز التدوير يوضع آخر منه لدالته على تقارب مركز التدوير من مركز العالم و تتبعته عنه

و الا لما أوتر مجموع البعدين زوايا مختلفة عند مركز العالم و لما اختفت زمنا اختفائها أيضا لكنه تختلف فان مركز التدويرها أن كان مسرعا و هي مستقيمة فيقل زمن الاختفاء و ان كانت رامعة فيعطي و ان كان مركز مبطنا و هي مستقيمة فيعطي زمنا الاختفاء و ان كانت رامعة فيقل

و انا لم يتعضوا بهذا التفصيل لان عند الأثريين أن مركز التدويرها لا يسرع ولا يبطى الا ان تسرع الشمس أو تبطي لتوهمهم أن مركز التدويرها مقرن ابدا لمركز الشمس بالحقيقة و ليس كذلك بل هو بالقرب و الا لما اختفت غابا بعدها الصباحي و المساءي و مركز التدوير في وضع معين نعم قد يقارنه و لهذا قد الاختلاف غايبان في بعض المواضع

و اذا كان كذلك فيتقيد مركز التدويرها على وسط الشمس إذا كان مسرعا و يتاخر عنه ان كان مبطنا و يظهر ما ذكرنا من التفصيل

ثم اختلافوا وجههما ومقدار خروج
فثبتوا لكل من الأربعة ثلاثة أفلاك وثلاث حركات.

وكذلك أثبتوا لكل من الأربعة ثلث أفلاك وثلاث حركات.

لكن جونز احول إلى كه ورمز
عكس كرره بودن جنا كل تقرر من
بجاير خوش بيد تشبة حركات
مركز تدور بوضع في مركز
معدل المسرح ومحاذات ذروه وسطي
هم با أو ميل أقطار كه بارزة
حضيض إيشان قشته باشنذ من ماهل
بر وجهي مخصصة وابن احول ازا
سه فلك حاصل نمذ شوك لاجرم ما در
هير يد أزن كوكب {كوكب} سه
فلك نهج زيدا كرديم تا مجموع
شم فلك وشم حركات شد وابن
امور بر وجه مراد من انتظام ابن
أفلاك وتركب ابن حركات حاصل.

وأحوال عطارد في الطول والعرض
شبهة باحوال الزهرة على الوجه
المذكور بعينه إلا أن أقرب ابعاده لا يقابل
ابعدها كما في الزهرة فإنه يقابلها كالعلوية
و كذا حكم الزهرة حكم العلوية في
حركة
الورج وانتقال المجازين

فلكا إثبات كردهن

بحسب ابن احوال هر يكي را

إذين سه فلك أثبات كردهن
<table>
<thead>
<tr>
<th>Anomaly</th>
<th>Nihāya/Limit</th>
<th>Tuhfa/Offering</th>
<th>Ikhtiyārīt/Selections</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Fast, intermediate and slow speeds.</td>
<td>1. eccentric orb. اصل الخارج</td>
<td>eccentric orb. اصل الخارج</td>
<td>eccentric orb (Chapter 2.5)</td>
</tr>
<tr>
<td>“ “</td>
<td>2. epicycle. اصل التنویر</td>
<td>epicycle. اصل التنویر</td>
<td>epicycle (Chapter 2.5)</td>
</tr>
<tr>
<td>II. Retrograde motion</td>
<td>3. epicycle and deferent اصل التنویر و الحامل</td>
<td>epicycle and deferent اصل التنویر و الحامل</td>
<td>epicycle and deferent (Chapter 2.5)</td>
</tr>
<tr>
<td>“ “</td>
<td>4. An eccentric with a concentric deferent اصل الخارج و الحامل</td>
<td>An eccentric with a concentric deferent اصل الخارج و الحامل</td>
<td>An eccentric with a concentric deferent (Chapter 2.5)</td>
</tr>
<tr>
<td>III. Motion uniform about a point other than the center of the mover.</td>
<td>5. The hypothesis of the encompasser: an additional epicycle to make the motion of the new epicycle center uniform about a point other than the center of the original deferent, based on Apollonius's Theorem. اصل المحیطة</td>
<td>Not used</td>
<td>Conjectural Hypothesis اصل حنیسی (in Chapter 2.7: The Moon)</td>
</tr>
<tr>
<td>“ “</td>
<td>6. The hypothesis of the maintainer and the dirigent, based on 'Urḍī's Lemma. اصل المحافظة و المدير</td>
<td>Not counted as an anomaly.</td>
<td>Hypothesis of the Dirigent اصل مدير (in Chapter 2.6: The Sun, and II.8: The Upper Planets) Also a species of Deductive Hypothesis اصل استنباطی</td>
</tr>
<tr>
<td>IV. Motion of the planet being uniform about a point from which the planet maintained a variable distance</td>
<td>7. The Tusi couple. اصل الصغریة و الكبیرة</td>
<td>“Based on one of the four also” i.e., an al-'Urḍī or Apollonius configuration. Un-numbered.</td>
<td>One of the four variations included in discussion of an ‘Urḍī or Apollonius configuration (in Chapter 2.8: The Upper Planets)</td>
</tr>
<tr>
<td>“ “</td>
<td>8. The maintainer and the encompasser. الحافظة و المحیطة</td>
<td>Not counted as an anomaly.</td>
<td>(not used as a hypothesis) درین اصل بکرہ حاقدة محتاج بیانیم (In Chapter 2.7: The Moon)</td>
</tr>
<tr>
<td>VI. Non-completion of a revolution in the heavens, either in latitude or longitude. (This anomaly is counted as the IVth anomaly for the Tuhfa/Offering).</td>
<td>9. “Spherical” Tusi Couple اصل الممیل</td>
<td>“Spherical” Tusi Couple اصل الممیل</td>
<td>“Spherical” Tusi Couple اصل الممیل (In Chapter 2.9: Venus and Mercury)</td>
</tr>
</tbody>
</table>
Appendix 4-G: The “Conjectural Principle” from the Ikhtiyārāt/Selections

And as for the second conclusion it is the detailed explication of the “Conjectural Hypothesis” since what was said in the first section of the fifth chapter was merely a summary. (Note: Shirazi here appears to be ignoring a full discussion of the Conjectural Principle in the Chapter on the Sun.) And since it will be needed for the five wandering stars its presentation here is crucial so that we are not preoccupied with describing it during the explication of their principles.

Thus we say, in the fourth section of the said chapter (i.e., Chapter five, on the hypotheses) that it is apparent that the motions of the centers of the epicycles of the five wandering planets are not uniform about the center of their deferents, rather it is uniform about a point that is called the equant, and the distance [of the equants] in the four upper planets (Shirazi appears to be counting Venus as an Upper planet) is equal to the distance of the center of their deferents from the center of the universe, as is the case for Mercury also.

And this can be made possible by having their epicycles surrounded by another epicycle such that the distance between this epicycle and the [planetary] epicycle is the same as the distance between the equant and the center of the deferent. And its motion is the same in magnitude but opposite in direction.
And for simplicity in conceiving this and describing it we will limit our discussion to one, say Venus. And will draw its embodied eccentric in a manner than can be conceived upon a plance. And we imagine that point Z is its center and E is the center of the world and H is the equant and E the center of the world, the distance of which from Z is the same as the distance between Z and E. We draw the perpendicular diameters AG and DB and at the four [cardinal] points YNOL we draw four orbs so that their convex surface is tangent at two points [each] to the convex and concave of the eccentric and we call these four the encompasser orb.

For example as Y meaning the center of the...
encompasser arrives at N through the motion of the eccentric, thus traversing a quarter of the equator of the eccentric, T, meaning the center of the epicycle traverses a quarter of its orbit, meaning TM, through a compound motion, and thus by necessity M lags N, because the motion of T in its orbit is in the direction opposite to the motion of Y and likewise as N traverses another quarter of its trajectory reaching O, M reaches X thus completing another quarter of its trajectory.

Now as O reaches L, X reaches K and falls ahead of it, since it is now moving through two motions in the same direction, and as L reaches U, K reaches T and the orbit of the center of the encompasser is completed through its compound motion. And this is the circle of the equant, since the center of the epicycle traverses equal arcs in equal times relative to its center.

Or for the reason that the distance of the center of the epicycle in all situations does not vary relative to its center H, or for the reason that the arc CM is always
similar to the arc \( YN \) due to the equality of the motion of the eccentric an the encompasser. So the angle \( CNM \) is equal to \( YZN \) and \( ZH \) is parallel to \( NM \) and \( HM \) is parallel to \( ZN \) and the angle \( THM \) is equal to \( YZN \) and the motion of \( T \) about the point \( H \) is uniform, as was described at the end of the chapter on the Sun,

**...**

And we deduced from the words of Ptolemy, as was described prior to this. And that which can be found in some books such as  \( \text{Tarkib al-aflak} \) of Abū Saʿīd Jūzjānī and which is similar to this is false, since he has assumed that \( T \) and \( Y \) are moving in the same direction, and in this scheme when \( U \) reaches \( N \), \( T \) does not lag it [i.e. \( N \)] rather it is in advance of it, and it of necessity reaches \( F \), since with the motion of \( Y \) along the equator of the eccentric being equal to the motion of \( T \) along its orbit and with \( Y \) having traversed a quarter [of its orbit] and from its motion relative to the center of the eccentric the right angle \( YZN \) having resulted, \( T \) that is at the center of the epicycle must of necessity traverse a quarter of its own orbit.
and relative to the center of the encompasser a right angle must result from its [i.e., T’s] motion as well, so of necessity it reaches F as we said, and in this reckoning the circle of the equant will not result and the motion of T will be uniform about the point E as was described not about the point E as he [i.e., Jāzāj] has said. Furthermore his [assigning] the lagging of T relative to Y to the fact that it is above it and the advancement of X relative to O to the fact that it is under it is also [fallacious], since the effective thing in this lagging and advancement is the difference in the directions of the motion or their agreement as we determined, and not the relative highness and lowness.

However for this hypothesis/principle we also require the use of a maintainer orb as was determined to be the case in the Moon, so that the planet moves on the epicycle through the motion of the epicycle alone, and the apex is thus not transformed to be the epicyclic perigee [in due time], meaning that the planet which is predicted to be at the apex is not discovered at the
perigee and vice versa.
Appendix 4-H  A comparison of the *Ikhtiyārāt/Selections* and the *Nihāya/Limit* in regards to the inclination of the Orbs of the Encompasser, the Dirigent, and the Maintainer for the Upper Planets. The *Ikhtiyārāt/Selections* retains an inclination scheme that was emended in the *Nihāya/Limit*. The underlined text was crossed-out from the *Nihāya/Limit*.

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<td>و اما اقلاع الكواكب العلوية</td>
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فكل واحد منها يشتمل على  
ست اكر  
ثلث منها هي المثل و الحامل  
و التدور كما هو عند الجمهور  
في الحركة و قدرها و جهتها  
و في وضعها الا في التدور  
و الباقية هي التي زدناها  

cالها الكرة المحيطة و هي في  
نُذْح الحامل بحيث يكون  
مركزها على منطقة الحامل و يماس  
سطحها سطحيه على نقطتين  

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| و سيم كره محيطه مركز أو بر  
منطقه حامل و مجدب أو مماس  
مجدب و مغمر حامل بدو نقطة  
و منطقة او مقاطع منطقه حامل و  
مايل او بقدر غاية ميل نروه ان  
كوكب از مايل ميلي ثابت  

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| | و منقطها في سطح منطقه  
الحامل ابدا  

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| و جهارهم كره مديرهم بر مركز محيطه و در اندرون او  
| و لكن منطقة او در سطح منطقة حامل ابدا  
| و محور با محور بر مركز متقاطع  
|  
| و بنجم كره حافظه دب اندرلون محيطه بر وجهه كه منطقة او كه در سطح منطقة محيطه باش و مركز از مركز او خارج بقدر ما بين المركزين ان كوكب اوعي مركز عالم و خارج و لكن بشرط اتك اين مركز نقطة بر سطح منطقة محيطه و محور او موازي محور محيطه  
| و منطقة او در سطح منطقة محيطه دو دائما بل وقتى كه  
|  
| و ثانيها الكرة المذكرة في جوف المحيطه و على مركزها  
|  
| لكن منطقتها في سطح منطقة الحامل ابدا  
|  
| تقطاع منطقة الحامل وشيل عنها بقدر مثل ذلك الكوكب عن المثل البليو ثابت ومحورها مقاطع لمحور المحيطه على المركز  
|  
| و ثالثا الكرة الحافظة في جوف المذكرة بحيث يكون منطقتها في سطح منطقة المذكرة و مركزها خارج عن مركز المذكرة بقدر خروج مركز حامل ذلك الكوكب عن مركز العالم على ان يكون هذا المركز نقطة على سطح منطقة المذكرة و محورها مواز لمحور المذكرة
"0ی در x"0ز از ذروه x"ز وض
Lg ب 02 در آن L"Lق8 t~0š H"0"2
6aqز ™اP —l 0ƒ9qاز و
ن 0٦ اذا x2 0{- دا 6اD# ا
6"0جv ا —l x-0# ا €g روة جv ا ۶z‌
"0ی در x"0ز از ذروه x"ز وض
Lg ب 02 در آن L"Lق8 t~0š H"0"2
6aqز ™اP —l 0ƒ9qاز و
ن 0٦ اذا x2 0{- دا 6اD# ا
6"0جv ا —l x-0# ا €g روة جv ا ۶z‌