Politics, Patronage and the Transmission of Knowledge in 13th–15th Century Tabriz

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WHAT *WAS* THE PURPOSE OF ASTRONOMY IN ĪJĪ'S *KITĀB AL-MAWĀQIF FĪ ʿILM AL-KALĀM*?

Robert Morrison

Around 1330, ʿAḍud al-Dīn al-Ījī (d. 1355), a *mutakallim* in contact with Rashīd al-Dīn,[1] composed *Kitāb al-Mawāqif fī ʿilm al-kalām*, a work of *kalām* that has attracted attention from academics as well as from Muslims throughout the centuries.[2] Some of this scholarship on the *Mawāqif* has attempted to explain why the *Mawāqif* included so much material from science and *falsafa* (philosophy in the Peripatetic tradition) and why it presented that material in ways that resembled but did not duplicate what was found in texts dedicated to science and *falsafa*. The article that has set the paradigm for explaining the purpose of this scientific and philosophic material is A.I. Sabra's 1994 article "Science and Philosophy in Medieval Islamic Theology." The publication has led other scholars to consider the role of science and philosophy in historical studies of *fiqh*, *kalām*, and *tafsīr*.[3] Sabra argued that, by Ījī's time, *kalām* was confidently

[1] Josef van Ess, *Der Wesir und seine Gelehrten* (Wiesbaden: *Franz Steiner*, 1981), 29, 48. Ījī is listed as ʿAḍudaddīn ʿAbdarraḥmān b. Aḥmad al-Muṭarrizī, whom van Ess took to be Ījī. Ījī's father and brother were also in contact with Rashīd al-Dīn. See Heidrun Eichner, *The Post-Avicennian Philosophical Tradition and Islamic Orthodoxy. Philosophical and Theological summae in Context* (Habilitationsschrift, Martin-Luther-Universität Halle-Wittenberg, 2009), 378 for the importance of the milieu of Tabriz in shaping his *kalām*.

[2] See Carl Brockelmann: *Geschichte der arabischen Litteratur* (Leiden: Brill, 1937–49), 2: 267–70; Supplement, 2: 287 for evidence of the proliferation of MSS of *Kitāb al-Mawāqif*. For information about Ījī, see Josef van Ess, *Die Erkenntnisslehre des ʿAḍudaddīn al-Īcī: Übersetzung und Kommentar des ersten Buches seiner* Mawāqif (Wiesbaden: Franz Steiner, 1966), 1–7.

The present article presumes that *kalām* was more than apologetics; Sabra himself made the same point in "Science and Philosophy in Medieval Islamic Theology: The Evidence of the Fourteenth Century," *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften* 9 (1994): 6–11. Sabra is not alone; his view is shared by a number of scholars, inter alia, Richard M. Frank, "The Science of *Kalām*," *Arabic Sciences and Philosophy* 2 (1992): 7–37.

[3] Sabra, "Science and Philosophy," 1–42. Sabra has since written another article on *kalām* as an alternative to *falsafa*: "*Kalām* Atomism as an Alternative Philosophy to Hellenizing *Falsafa*," in *Arabic Theology, Arabic Philosophy: From the Many to the One: Essays in Honor of Richard M. Frank*, ed. James E. Montgomery (Leuven, Dudley, MA: Peeters, 2006), 199–272; 257–72 are a translation from Ījī's *Mawāqif*. See, now, Sabra: "The Simple Ontology of *Kalām* Atomism: An Outline," *Early Science and Medicine* 14 (2009): 68–78. Sabra's 1994 article has informed the conclusions of several scholars, including F. Jamil Ragep, "Freeing Astronomy From Philosophy: An Aspect of Islamic Influence on Science," *Osiris* 16 (2001):

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on the offensive against *falsafa*, and that the *Mawāqif* was evidence of an attempt to develop a new Islamic philosophy and science.[4] Because the *mutakallimūn* saw themselves as victors in the debate with the *falāsifa*, the *mutakallimūn* were, then, free to incorporate science and philosophy into *kalām*.[5]

On the narrower question of Ījī's presentation of astronomy (*'ilm al-hay'a*), Sabra concluded that Ījī's view of astronomy was "not unlike" the instrumentalist perspective expressed in Osiander's preface to Copernicus' *De Revolutionibus*.[6] According to Sabra's interpretation, Ījī took the explanations of the astronomers to be neither true nor even probable; they simply accounted for the observed phenomena.[7] I interpret an instrumentalist view of astronomy to entail retrodictive and predictive accuracy. Sabra raised the possibility that an instrumentalist position might

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49–71; *ibid*. "Ṭūsī and Copernicus: The Earth's Motion in Context," *Science in Context* 14 (2001): 145–63; Robert Morrison, *Islam and Science: The Intellectual Career of Niẓām al-Dīn al-Nīsābūrī* (London: Routledge, 2007); Ekmeleddin İhsanoğlu, "Institutionalisation of Science in the Medreses of pre-Ottoman and Ottoman Turkey," in *Turkish Studies in the History and Philosophy of Science*, eds. G. Irzik and Güven Güzeldere (Dordrecht: Springer, 2005): 273–4; Gerhard Endress, "Mathematics and Philosophy in Medieval Islam," in *The Enterprise of Science in Islam: New Perspectives*, eds. Jan P. Hogendijk and A.I. Sabra (Cambridge and London: MIT Press, 2003), 159, note 182.

[4] Sabra, "Science and Philosophy," 12–13. Sabra observed that with the work of Juwaynī (d. 1085), *mutakallimūn* "realized that false premises do not necessarily lead to false conclusions." Thus *mutakallimūn* examined works of *falsafa* and science to understand and rebut their arguments.

[5] Sabra pointed out, in his article, that Ījī was not the first to conceive of *kalām* ontologically, and not theologically, but argued (pp. 13–17, esp. p. 16) that the *Mawāqif* was the fullest expression of that development. See also p. 19: "But what these few examples already show is not a confused *kalām* but a confident *kalām* on the offensive against *falsafa*." Heidrun Eichner has since argued for the centrality of Fakhr al-Dīn al-Rāzī's *al-Mulakhkhaṣ fī al-ḥikma* for the process of *kalām*'s incorporation of science and philosophy in her recent Habilitationsschrift. See Eichner, *The Post-Avicennian Philosophical Tradition*.

[6] Sabra, "Science and Philosophy," 38. For Osiander's preface, see Edward Rosen (translation and introduction), *Three Copernican Treatises* (New York: Columbia University Press, 1939), 24–5. See also Gad Freudenthal: "'Instrumentalism' and 'Realism' as Categories in the History of Astronomy: Duhem vs. Popper, Maimonides vs. Gersonides," *Centaurus* 45 (2003): 227–48. Freudenthal observed (p. 230) that instrumentalism (and realism) were positions in the philosophy of science; a figure such as Osiander might have had an instrumentalist position regarding Copernicus' theories, but one should not presume that he thought that science in general was instrumentalist. Sabra's implication, though, that Ījī was functioning more as a philosopher of science than as a scientist was apt.

[7] A classic statement of instrumentalism is Pierre Duhem's *To Save the Phenomena*. See Pierre Duhem, *To Save the Phenomena: An Essay on the Idea of Physical Theory from Plato to Galileo*, trans. Edmund Doland and Chaninah Maschler (Chicago: The University of Chicago Press, 1969).

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correlate with Ghazālī's critique of causality[8] found in the *Incoherence of the Philosophers* in that while there was no decisive reason to believe that humans could identify through coincidences what the true intermediate cause was, such causes could exist and could be a useful language for describing natural phenomena.[9] The evidence of other scholars from Ījī's own century, as well as the commentaries on the *Mawāqif* that defended astronomy, would seem to support Sabra's general assessment that *kalām* incorporated science and philosophy and that *kalām* sought to do so on its own terms.

Ahmad Dallal's recent *Islam, Science, and the Challenge of History* has challenged Sabra's thesis that Ījī's *Mawāqif* was evidence for *kalām*'s absorption of science and *falsafa*.[10] As astronomy was the science to which Ījī devoted the most attention, Dallal argued that Ījī's goal was to destabilize astronomy's (*'ilm al-hay'a*) foundations and conclusions in order to advance what Dallal saw as *kalām*'s more central strictly

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[8] Ghazālī's critique of causality in the seventeenth discussion of *The Incoherence of the Philosophers* has recently been re-assessed in Frank Griffel, *Al-Ghazālī's Philosophical Theology* (Oxford: Oxford University Press, 2009), 175–214.

[9] Sabra, "Science and Philosophy," 38–9. See also Ghazālī, *The Incoherence of the Philosophers*, trans. Michael Marmura (Provo: Brigham Young University Press, 1997), 166–77. See pp. 167–8 where Ghazālī described a blind man who acquired sight due to the removal of a film from over his eyes. That man would believe that the cause of sight was the removal of the film whereas "When, however, the sun sets and the atmosphere becomes dark, he would then know that it is sunlight that is the cause for the imprinting of the colors in his sight." Some, though not all, recent scholarship on Ghazālī has found that Ghazālī accepted at least a version of natural causality in his *kalām* texts. See, e.g., Richard Frank, *Creation and the Cosmic System: Al-Ghazālī and Avicenna* (Heidelberg: Carl Winter, 1992) and *idem*, *Al-Ghazālī and the Ash'arite School* (Durham: Duke University Press, 1994), 36–9. Frank Griffel has found that "[a] close reading of the seventeenth discussion shows, however, that on its two dozen or so pages, al-Ghazālī does not deny the existence of causal connections—and thus of causality—and he certainly does not argue that efficient causality as an explanation of physical change is false." See Griffel, *Al-Ghazālī*, 147. There, Griffel described Michael Marmura's position that Ghazālī denied causation as "false." See Marmura, "Al-Ghazālī's Attitude towards the Secular Sciences and Logic," in *Essays on Islamic Philosophy and Science*, ed. George F. Hourani (Albany: State University of New York Press, 1975), 109.

Sabra ("Science and Philosophy," 38–9) pointed out that Jurjānī's response to some of Ījī's criticisms of astronomy meant that an Ash'ari occasionalist outlook did not necessitate a certain view of astronomy. But even though Ījī and Jurjānī disagreed about the role of astronomy in *kalām*, the extent to which *Ījī*'s criticisms of astronomy were correlated with *his* denial of causality is unclear.

[10] Ahmad Dallal, *Islam, Science, and the Challenge of Modernity* (New Haven and London: Yale University Press, 2010), 133. "It is possible, however, to conceive of *kalām* as an apologetic undertaking that is not a complete philosophical system without diminishing its value as a genuine intellectual pursuit."

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religious arguments and in order to deny the *falāsifa* recourse to the prestigious science of *kalām* in order to support their positions. Ījī discussed astronomy in order to remove astronomy from the intellectual arsenal of the *falāsifa* and to show that all celestial phenomena depended directly on God for their existence.[11] *Kalām* was, inevitably, a science more prestigious than astronomy.[12] Dallal commented on how, throughout the précis of astronomy found in the *Mawāqif*, Ījī pointed out conceivable alternatives to the astronomers' formulations. For example, Ījī pointed out that that the planets did not need to be carried on orbs; cross sections of orbs would suffice.[13] Or, the numerous circles that the astronomers traced on the surface of the orbs were wholly imaginary.[14] Why would *kalām* comprise a science that it simultaneously criticized so deeply? Without doubt, Dallal has raised a few questions that Sabra did not fully address. First, when Ījī raised possibilities of alternative explanations, he never actually fleshed out any alternative model. Second, and along the same lines, Dallal argued that Ījī's discussion of astronomy contained nothing that suggested a positive statement of a distinctively Islamic astronomy. Third, by saying that astronomy's mathematical hypotheses were subject neither to affir-

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[11] Dallal, *Islam, Science,* 136. Note, though, that Ījī neither criticizes nor discusses every science at anything approaching the same length. Thus what is the organizational scheme that led to such a lengthy discussion of astronomy?

[12] Cf. Franz Rosenthal, *Knowledge Triumphant: Concept of Knowledge in Medieval Islam* (Leiden: Brill, 1970; reprinted 2007), 229.

[13] Ījī, *Mawāqif*, 2: 400–1 (when I cite *Kitāb al-Mawāqif*, I am citing a version that also contains Jurjānī's commentary); see also Sabra, "Science and Philosophy," 35. The idea that the orbs could be replaced with belts had appeared in Ptolemy's *Planetary Hypotheses*. See Johan L. Heiberg (ed.), *Claudii Ptolemaei opera quae exstant omnia*, vol. 2: *Opera astronomica minora* (2 parts) (Leipzig: Teubner, 1907), 130 for the possibility of replacing the orbs with rings. Naṣīr al-Dīn Ṭūsī's commentary on *al-Ishārāt wa-l-tanbīhāt* noted those who suggested that the planets be carried on cross-sections of orbs, belts, tambourines, and the like but categorized those who held such as ideas as *ghayr al-muḥaṣṣilīn*, 'those who do not discriminate.' See Ibn Sīnā, *al-Ishārāt wa-l-tanbīhāt ma'a sharḥ Naṣīr al-Dīn al-Ṭūsī*, ed. Sulaymān Dunyā (Cairo: Dār al-Ma'ārif, 1957–1968), 3: 187. The key for Ījī's position in the *Mawāqif*, it would seem, is whether Ījī meant spherical three-dimensional belts. At the risk of overreading, Ījī's avoidance of the question meant that he did not have to take a position [cf. Mu'ayyad al-Dīn 'Urḍī, *Kitāb al-hay'a*, ed. G. Saliba (Beirut: Markaz Dirāsāt al-Waḥda al-'Arabiyya, 1990), 37] about the likelihood (*bi-'l-ḥarī*) of the celestial bodies being spherical (*kurī*). Note that 'Urḍī did not attempt to argue there that the celestial bodies were complete orbs.

In *kalām*, the proposition that the planets might be carried by belts (*niṭāqāt*) was found in Bayḍāwī's *Ṭawāli' al-anwār*, ed. 'Abbās Sulaymān (Beirut: Dār al-Jīl and Cairo: al-Maktaba al-Azhariyya li-'l-Turāth, 1991), 139.

[14] Sabra took these comments as a reflection of Ījī's position that the astronomers' physical explanations were, at best, contingent.

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mation or negation, might Īǰī have been saying that *kalām* (which has to come to some conclusions about God) had little to do with astronomy? Like Dallal, I have been troubled, for over a decade, that nothing about Īǰī's rhetoric suggests a desire to incorporate astronomy into *kalām*. So while these questions that Dallal posed provoked this article, Dallal's suggestion that *kalām* and astronomy have little to do with each accepts a version of Sabra's conclusion that Īǰī's presentation of astronomy was instrumentalist.[15] By finding, in Īǰī's *Mawāqif*, discussions of astronomy that are even more pointed than those discussed in earlier scholarship, and which show that Īǰī was not an instrumentalist, this paper will argue that *kalām* certainly had something to say about astronomy.[16]

Two important books appeared too late for Dallal to take them into consideration. The first, Frank Griffel's *Al-Ghazālī's Philosophical Theology,* paid a great deal of attention to Ghazālī's position on causality. Griffel argued that Ghazālī accepted the existence of intermediate causes, and proposed alternatives to the Avicennan view about how intermediate causes could function.[17] Science was possible, though, because God's custom could be studied as an expression of nature's workings. Griffel's significant finding that the existence of causality was not as decisive a point of debate as earlier scholars (including Sabra) might have thought does not mean that there was agreement about what the causes for celestial motions were. This paper probes some instances of disagreement. In addition, the distance of the celestial bodies presented particular challenges to the astronomers when it came to arguing why any single causal explanation might be more correct than any other explanation. Thus, the question of whether Īǰī's presentation of astronomy was instrumentalist remains central. The second book, Heidrun Eichner's *The Post-Avicennian Philosophical Tradition and Islamic Orthodoxy. Philosophical and Theological summae in Context* (Habilitationsschrift, Martin-Luther-Universität Halle-Wittenberg, 2009) is a detailed argument for how later *kalām* texts took their form from Fakhr al-Dīn Rāzī's *al-Mulakhkhaṣ fī al-ḥikma*. The present article builds on Griffel's book because Īǰī, whether

[15] Dallal, *Islam, Science*, 134. "In other words, these matters [sc. astronomy] do not belong to theology and kalām has nothing to say in their regard."

[16] Dallal's earlier statement that Īǰī hoped to remove astronomy from the intellectual arsenal of the *falāsifa* was closer to what I am arguing, but that it is important to realize that the arguments of Īǰī's opponents were theological (and found in *kalām* texts) not those of the *falāsifa*.

[17] Griffel, *Al-Ghazālī*, 175–6.

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or not he took Ghazālī's position on the existence of intermediate causes, did not always think that astronomers proposed the correct intermediate causes. Eichner's habilitationsschrift raises the question of, given that the inclusion of astronomy in the *Mawāqif* would have been due to transformations in the organization of *kalām* texts, what was at stake for Ījī in the details of his presentation of astronomy. While Ījī's was a précis of astronomy in a *kalām* text after Rāzī's career, each précis was not the same.

This article, indeed, will show first that Ījī's presentation of astronomy in the *Mawāqif* was not instrumentalist. Second, this article will suggest that Ījī's scepticism about the reliability of observations is related to a position on how well the human intellect can sort out certain sense perceptions from things that are purely imaginary. After all, there were cases (rainbows, eclipses) where observational and geometric arguments communicated something certain about the physical structure of the universe. And sense perceptions had long been considered premises for demonstrations.[18] Third and finally, this paper will situate Ījī's presentation of astronomy within a debate about the role of astronomy within *kalām* and within other Islamic disciplines more generally. There I will advance a few tentative conclusions about what we gain once we understand that Ījī's presentation of astronomy was not instrumentalist. Other Islamic disciplines, e.g. *fiqh*, were more amenable to the probabilist knowledge that astronomy yielded; for Ījī, *kalām* seems to have demanded a level of demonstrative certainty often unattainable by astronomy. Would a *mutakallim*, by setting extremely high standards for demonstrations, have, in turn, ceded ground for certain plausible theological arguments to scholars of astronomers?

Why Ījī was not an Instrumentalist

By attempting to poke holes in astronomy's instrumentalist value, Ījī actually took on astronomy at its strongest point, where it, by definition, was least contingent. The first passage I wish to discuss, one that has received, to my knowledge, no scholarly attention, deals with explanations for solar and lunar eclipses and of the phases of the moon. Astronomers all said (and would continue to say today) that the moon's phases are the result of

[18] Ibn Sīnā, *al-Burhān min Kitāb al-Shifā'*, ed. 'Abd al-Raḥmān Badawī (Cairo: Maktabat al-Nahḍa al-Miṣriyya, 1954), 192. See also Ījī, *Mawāqif*, 1: 196. *Maḥsūsāt* were listed under *mushāhadāt*.

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the sun shining light on one hand, and the moon, sun, and earth's positions on the other. Eclipses would occur when the sun, earth, and moon are in a straight line in the same plane. Ījī explored alternatives, alternatives which he never rejected, writing, "Know that Ibn al-Haytham said, regarding the moon's phases, that it could be that way because the moon is a luminous sphere, with one half shining and one half not, and that it rotates on its own with a speed equal to that of its orb. If the luminous side is facing us, then it is a full moon. And if the dark side is toward us, then it's a new moon. In the intervening positions, the portion of the moon visible to us varies. But what we have said about solar and lunar eclipses annuls what Ibn al-Haytham said.[19] The response, after considering the hypotheses, is that the negation of this possibility (*iḥtimāl*) does not negate all possibilities. Perhaps there is another reason, and again what you have mentioned makes it conceivable that, due to God's creation, there is light in the sun and the planets or that they are illuminated by other planets hidden from us."[20] Ījī suggested that God might create light in the sun, which is what happens, and/or in the other planets. Or the sun and the rest of the planets might be illuminated by planets not visible to us. It could be that the sun's light comes from an unknown source, but, it would be difficult to explain the moon's phases and eclipses equally as well while postulating an unknown, unobserved light source.[21] One should note that this comment elicited Jurjānī's ire; Jurjānī generally appeared less opposed to Ījī's jibes at the contingency of astronomy's physical explanations. Jurjānī's commentary picked up on these sharp points, saying that, yes, it was possible that there be another reason such as a dull, dark (*kamad*) planet beneath the orb of the moon that obscures it (*yankhasif bih*) in some conjunctions (*istiqbālāt*), but that astronomers do not know of it.[22] In addition, Ījī's arguments in favor of occasionalism depended on the perception of a natural order; astronomy was crucial for demonstrating the reality of that order.[23] Thus, since an argument for occasionalism was

[19] Cf. Bayḍāwī, *Ṭawāliʿ al-anwār*, 140. This much about eclipses denying this possibility is in Bayḍāwī's text, though there is no reference to Ibn al-Haytham. As we will see, Ījī did not grasp what Ibn al-Haytham actually said. See Ibn Al-Haytham, "The Light of the Stars: A Short Discourse by Ibn Al-Haytham," trans. W. ʿArafat and H.J.J. Winter, *The British Journal for the History of Science* 5 (1971): 282–8.

[20] Ījī, *Mawāqif*, 2, 462.

[21] In this case, Ījī's scepticism exceeded that of Ghazālī's in *Tahāfut al-falāsifa.* Cf. Ghazālī, *The Incoherence*, 6.

[22] Ījī, *Mawāqif*, 2: 463.

[23] Cf. Sabra, "Science and Philosophy," 35. Sabra explained that Ījī's intent was "to insist on the hypothetical and conjectural character of astronomical theories and thereby to

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not inherently an attack on astronomy, Ījī's views of astronomy emerge only through a careful reading of his presentation of astronomy's findings.

In order to cast doubt on the validity of astronomers' explanation of the eclipses; Ījī has introduced the possibility of an unknown, unobserved celestial body. Previously in the précis of astronomy, when Ījī proposed alternatives to the astronomers' physical models of uniformly rotating orbs, he did not have to contest any *observation* of uniformly rotating orbs. That is, different configurations of orbs might well not produce different observations. If Ījī's only concern with astronomy was to argue that it was instrumentalist, that astronomy's purpose was to save the phenomena, he would not have had to invent heretofore unobserved phenomena. By doing so, Ījī has cast doubt on astronomy's ability to account for or predict planets' future positions. As a point of contrast, Ghazālī, in the *Incoherence of the Philosophers*, commented that only the stubborn would contest astronomers' explanation for eclipses.[24] Ījī was sceptical of the astronomers' claim that the lunar phases and eclipses were caused by the relative positions of the sun and the moon *and that it could not be otherwise.*[25] Ījī proposed some scenarios in which things might be otherwise.[26]

Or, Ījī might have been saying that the constant possibility of new observational data is a reminder not to have undue confidence in astronomy. But the move Ījī has made has been to introduce the possibility of unobserved celestial bodies in order to argue that the astronomers' explanation might not always be able to account for observations. For if these

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vindicate the Ashʿarite conception of a contingent world." The better one understood the reality of order in nature, the more powerful the spiritual impact of perceptions of a contingent universe would be.

[24] Ghazālī, *The Incoherence*, 6. "[T]hese matters rest on demonstrations—geometric and arithmetical—that leave no room for doubt. Thus, when one who studies these demonstrations and ascertains their proofs, deriving thereby information about the time of the two eclipses [and] their extent and duration, is told that this is contrary to religion, [such an individual] will not suspect this [science, but] only religion."

[25] Cf. Fakhr al-Dīn al-Rāzī, *Manṭiq al-Mulakhkhaṣ*, ed. Aḥad Qarāmalikī (Tehran: Dānishgāh-i Imām Ṣādiq, 2002), 345, on how it would be impossible to rule out all other possible explanations including that God made things run in such a way as to create such an effect with the occurrence of that specific thing without it having an effect on it.

[26] Cf. Morrison, *Islam and Science*, 110–1 where Rāzī used the (unobserved) possibility of minute variations in motion from one fixed star to another to allege that, therefore, the astronomers' preference of placing all of the fixed stars in a single orb was false. See Carlo Nallino, *ʿIlm al-falak: tārīkhuh ʿind al-ʿarab fī al-qurūn al-wusṭā* (Rome, 1911; reprinted Cairo: al-Dār al-ʿArabiyya li al-Kitāb and Beirut: Awrāq Sharqiyya, 1911), 257–9.

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unobserved (cf. Jurjānī's comment about a dull planet beneath the orb of the moon) celestial bodies never affected observations then, at least by Ghazālī's standards, the phases of the moon and eclipses would always correlate with the relative positions of the sun and the moon. Elsewhere in the *Mawāqif*, Ījī had written that we could have confidence in things that customarily occur (*al-ʿādiyyāt*); Ījī acknowledged there that we get nowhere by lingering on the possibility that an aged person was, in fact, created that way just a few moments beforehand.[27] Or, Ījī could have been going beyond an instrumentalist position that would remind one of the shakiness of foundations borrowed from *falsafa* to attacking observations as a foundation for astronomy. Beginning with Bīrūnī, moving through the astronomers at the Marāgha Observatory, and culminating with Qūshjī's vision (reminiscent of Bīrūnī) for an astronomy with foundations solely in observations and mathematics, the astronomers of Islamic societies themselves aimed, as much as possible, to move the foundations of their science away from conclusions borrowed from *falsafa*.[28] Questioning explanations for eclipses might have been necessary for conclusions based on eclipse data, and the assumption that eclipses were due to the positions of the sun, earth, and moon, was the foundation for any physical model to explain the motions of the moon.

We must also place Ījī's reference to Ibn al-Haytham in the intellectual context of what Ibn al-Haytham actually said about eclipses. Since Sabra's article appeared, numerous other publications have independently and externally (i.e. not just on the basis of the *Mawāqif*) confirmed Sabra's conclusion that by the thirteenth and fourteenth centuries, scholars such

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[27] Ījī, *Mawāqif*, 1: 104–6. Interestingly, Ījī pointed out that the philosophers (*ḥukamāʾ*), who attributed terrestrial occurrences to celestial configurations, might have been unaware of some celestial occurrence before recorded history that would have the same effect of changing the way events would transpire on earth.

[28] I am not sure that such a move away from *falsafa*, on its own (*pace* Dallal, *Islam, Science*, 81–2), constitutes a move towards instrumentalism. See Ījī, *Mawāqif*, 2: 314. In a discussion of mathematical bodies (*ajsām taʿlīmiyya*), Ījī wrote that the evidence of mathematics was certain, giving the soul a type of knowledge of which it could not be convinced otherwise. Jurjānī clarified in his commentary (*Mawāqif*, 2: 317–8) that the *wahm* (estimation) was the place (*maḥall*) of mathematical bodies, though the *wahm* itself is not a body, but rather one of the corporeal faculties (*quwan jismāniyya*). There is an important discussion in *Mawāqif*, 2: 318 (Jurjānī's commentary) about how mathematical bodies are real.

On Qūshjī, see Ragep, "Freeing Astronomy," 49–71. Dallal used this article to place Qūshjī at the culmination of a trend in which astronomers attempted to separate astronomy from *falsafa*. See Dallal, *Islam, Science*, 82. I may differ from Dallal, though, in holding that these astronomers were still making realist or probabilist claims.

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as Ījī must have studied astronomy.[29] Ījī's insinuation that eclipses were not necessarily due just to the interposition of the sun, moon, and earth relied on a misunderstanding of a statement by Ibn al-Haytham about the luminosity of the moon. Ījī alleged that Ibn al-Haytham wrote that the moon might very well be self-luminous and, then, that the phases of the moon could be due only to the moon's own rotation in its orb. A full moon would be when the moon's luminous face was facing the earth.[30] Ījī argued, seemingly correctly, that the evidence of eclipses showed that Ibn al-Haytham's theory was wrong. But the disproving of one alternative did not entail the rejection of all alternative explanations for eclipses, so perhaps the moon and other planets were illuminated by a source other than the sun, etc.

The problem was that Ījī misunderstood Ibn al-Haytham; Ibn al-Haytham, in fact, wrote that while other planets besides the sun could be luminous, the moon was not luminous.[31] Jurjānī, too, pointed out Ījī's erroneous citation of Ibn al-Haytham.[32] Thus Ījī's misunderstanding of Ibn al-Haytham led him to find a debate among astronomers where, in fact, there was none; as Ījī himself acknowledged at the beginning of the *Mawāqif*, the explanation of eclipses was a paradigmatic example of the use of *ḥads*, defined in this case as intuition.[33] The matter of eclipses

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[29] Quṭb al-Dīn al-Shīrāzī (d. 1311) and Niẓām al-Dīn al-Nīsābūrī (d. c. 1330), two scholars who were also talented astronomers, were contacts of Rashīd al-Dīn. On Nīsābūrī and Rashīd al-Dīn, see van Ess, *Der Wesir*, 50. On Shīrāzī and Rashīd al-Dīn, see van Ess, *Der Wesir*, 21 and 56. Heidrun Eichner (The Post-Avicennian Philosophical Tradition, 285) has argued for placing ʿUrḍī's *Kitāb al-hay'a* within a tradition of religious scholarship. Naṣīr al-Dīn al-Ṭūsī's voluminous oeuvre encompassed all manner of subjects including *kalām* and ethics. Al-Sayyid al-Sharīf Jurjānī (d. 1413), the author of the most famous commentary on the *Mawāqif*, was also an important commentator on Ṭūsī's *Tadhkira*.

[30] Ījī, *Mawāqif*, 2: 462.

[31] Ibn al-Haytham, "The Light," 282–8.

[32] Ījī, *Mawāqif*, 2: 463.

[33] Ījī, *Mawāqif*, 1: 197. Here Ījī presented *ḥads* as one of the ways to find the premises of a syllogism, a means of speculation (*naẓar*), the way of confirming (*ithbāt*) religious creeds. Because *kalām* (*Mawāqif*, 1: 43) was a science that did not (hence could not) depend on the findings of another science (as *hay'a* did), Ījī wanted to ascertain that any finding from astronomy was acceptable according to the epistemology of *kalām*. If a finding of astronomy could not meet the standards of Ījī's *kalām*, then that finding of astronomy would be like knowledge of Islam garnered solely from, say, the Bible.

Once again, Ījī's criticism of astronomy comes, as far as Ījī knows, from within astronomy.

An important definition of *ḥads* came in Ibn Sīnā's *Shifā'*. See Ibn Sīnā, *al-Burhān*, 192. *Ḥads* (intuition) was the movement of a faculty of the soul to grasping the middle term of a syllogism on its own, such as the intuition that the phases of the moon are due to the moon's position with respect to the sun.

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had been the sole example of *ḥads* mentioned by Ibn Sīnā in his *Kitāb al-Burhān*.[34] It is possible that Ījī's incomplete understanding of what Ibn al-Haytham had actually said affected his ability to understand and appreciate astronomers' use of *ḥads* and might explain why he did not understand how the astronomers, of whom Ibn al-Haytham was one, had excluded other explanations for eclipses. Besides or beyond any misunderstanding of astronomy on Ījī's part, Ījī may have been interested in *ḥads* because, after Ibn Sīnā, *ḥads* assumed an even larger role in astronomers' epistemology; Mu'ayyad al-Dīn al-'Urḍī wrote that Ptolemy intuited the existence of the epicycle and eccentric.[35] Ījī wrote that *ḥads* was the process through which we determined, by observing that God's deeds were perfect, that God was perfect.[36] Langermann has suggested that *ḥads* may not be intuition; astronomers might have understood *ḥads* as a conjecture or as an inspired solution to a problem that has not met with any other solution (i.e. a guess).[37] The first example (Ījī's discussion of the lunar phases and eclipses), then, could be understood as a zealous

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[34] Y. Tzvi Langermann, "Ibn Kammūna and the 'New Wisdom' of the Thirteenth Century," *Arabic Sciences and Philosophy* 15 (2005): 287. Ījī also remarked on the distinction between *innī* and *limmī* proofs, roughly paralleling Aristotle's distinction between the proof of the fact and the proof of the reasoned fact (*Posterior Analytics*, Bk 1, Ch 13). Ījī defined an *innī* demonstration as reasoning from the effect to the cause, giving the example of a fever leading one to infer a decay of the humors (*ta'affun al-akhlāṭ; Mawāqif*, 1: 177). See also Ṭūsī's *Sharḥ al-Ishārāt* where a tertian fever (*ḥummā al-ghibb*) arose in the discussion of *innī* and *limmī* proofs. See Ibn Sīnā, *al-Ishārāt*, 1: 487. Ibn Sīnā also mentioned eclipses as an example of a *limmī* proof. In *Posterior Analytics* 78b20, Aristotle explained that if the absence of balanced heat led to sickness, then the presence of balanced heat brought health. Subsequently, Aristotle recognized that the boundaries of *innī* and *limmī* proofs differed from one science to another. For the role of *innī* proofs in astronomy see Naṣīr al-Dīn al-Ṭūsī, *Naṣīr al-Dīn al-Ṭūsī's* Memoir on Astronomy (*al-Tadhkira fī 'ilm al-hay'a*), ed. and trans. F. Jamil Ragep (New York: Springer, 1993), 39. Indeed, it seems that Ījī has different standards for astronomy regarding the principle that if the absence of x entails the absence of y, then the presence of x entails the presence of y.

[35] Langermann, "Ibn Kammūna," 293.

[36] Ījī, *Mawāqif*, 1: 197.

[37] Langermann, "Ibn Kammūna," 295. Niẓām al-Dīn Nīsābūrī, in his *Kashf-i Ḥaqā'iq-i Zīj-i Īlkhānī*, validated astrological prognostications with the principle of *ḥads*, drawing general conclusions from specific instances (see Morrison, *Islam and Science*, 67). He also defined *ḥads* in his *tafsīr* entitled *Gharā'ib al-Qur'ān wa-raghā'ib al-furqān* (see Morrison, *Islam and Science,* 143). Nīsābūrī's teacher, Quṭb al-Dīn Shīrāzī, had discussed *ḥads* in his astronomy text entitled *Nihāyat al-idrāk fī dirāyat al-aflāk*. See Robert Morrison, "Quṭb al-Dīn al-Shīrāzī's Hypotheses for Celestial Motions," *Journal for the History of Arabic Science* 13 (2005): 92 note 84. Shīrāzī taught from his *Nihāyat al-idrāk* in the Gökmedrese in Sivas. See Ekmeleddin İhsanoğlu, "Institutionalisation," 270. Finally, Shīrāzī's teacher, Naṣīr al-Dīn Ṭūsī, also used *ḥads* to validate astrological prognostications. See Naṣīr al-Dīn Ṭūsī, *Sharḥ-i Thamara-yi Baṭlamyūs*, ed. Jalīl Akhavān Zanjānī (Tehran: Āyina-yi Mīrāth, 1999), 6–7.

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(or, perhaps, over-zealous) attempt to clarify and restrict the application of *ḥads*, a process that Ījī agreed could yield certain knowledge.

The second passage in the *Mawāqif* that I would like to discuss that would militate against concluding that Ījī's presentation of astronomy was instrumentalist is his comments on the sphericity of the earth. Ījī began the paragraph by stating that they (the astronomers or *falāsifa*) alleged (*zaʿamū*) that the earth was spherical (*kurawiyya*).[38] They acknowledged that the earth was not perfectly spherical, but that the undulations that did exist were comparatively insignificant. At the end of the paragraph he remarked: "granted that what you have mentioned is like that, so what do you say about what is covered with water?"[39] Then, Ījī commented that simplicity (*al-basāṭa*) necessitates the sphere, but that undulations, even unobservable ones or minute ones, prevent the recourse to sphericity. Thus, he has implied that if the effect (sphericity) is not certain, the cause (simplicity) cannot be presumed. Jurjānī, in his commentary, reminded the reader that while it is possible that there might be hidden undulations, mathematical astronomers (*arbāb al-taʿālīm*) are content with (*yaktafūn*) what appears to the senses.[40] We see, first, that Ījī has strayed from the instrumentalist task of just saving the phenomena. In order to undercut the physical assumptions of astronomers, Ījī had to propose undulations in the Earth that had not been observed because they were under water. But undulations that had not been observed would not affect observations; thus they would be beyond the scope, probably, of *ʿilm al-hayʾa*, and certainly beyond that of mathematical astronomy. Were astronomy's purpose simply to explain the observations, Ījī could have presumed the sphericity of the earth. Second, if Ījī's goal were to undercut the presumption of the Earth's simplicity, then he would be better off relying on undulations that have actually been observed rather than underwater undulations that may or may not exist. By conceding that the noticeable undulations could not sufficiently upset the presumption of the earth's simplicity, he had to resort to the possibility that beneath the oceans were mountains that, were they visible, could upset the presumption, based on observations, of the earth's simplicity.[41] Ījī's scepticism of sense perception did double

[38] Ījī, *Mawāqif*, 2: 476.
[39] Ījī, *Mawāqif*, 2: 476.
[40] Ījī, *Mawāqif*, 2: 478.
[41] Again, we see parallels with Rāzī's comment about observations of the motion of the fixed stars in *al-Tafsīr al-kabīr*. Cf. fn. 26.

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duty. It undercut the observations that bolstered the astronomers' adoption of principles from *falsafa* and it worked to deprive the astronomers of claiming the certitude of arguments based solely on observation. The findings of *falsafa* would then be, after all, only persuasive (*iqnāʿī*).[42] Hence, if sense perceptions, in addition, were wrong, astronomy's accuracy, even as a set of mathematical models, would be called into question.

The third and final aspect of Ījī's presentation of astronomy that I would like to focus on, in order to argue that the presentation of astronomy in *Kitāb al-Mawāqif* was not instrumentalist, was Ījī's statement that the equant was a difficulty in the model for Mercury that astronomers could not solve.[43] The matter of the equant arose from Ptolemy's conclusion that certain motions of planets were uniform about axes that did not run through the center of the orb, but rather those motions were uniform about an axis that ran through an off-center point called the equant. The only way that an orb could, in fact, rotate uniformly in place would be about an axis that *did* run through the center of that orb. In other words, Ījī understood, correctly, that the equant threatened the astronomers' principle that celestial motions were uniform and circular and that that principle motivated the entire discipline.[44] Ījī wrote, à propos astronomers' concern about the equant point, that, perhaps, partial inclinations (*irādāt juzʾiyya*) would suffice to produce motions that appeared uniform about the equant point. If astronomers accepted that proposition then there was no reason to be concerned about the equant point and there was no reason to be concerned with trying to resolve the problem.[45] Jurjānī, in his commentary on the *Mawāqif*, related the problem with Mercury to the difficulty (*ishkāl*) associated with the other planets, an *ishkāl* that had been solved.[46] Ījī concluded that the truth was to transfer (*iḥāla*)

[42] Ragep, "Ṭūsī and Copernicus," 155.

[43] Cf. Sabra, "Science and Philosophy," 37. Sabra noted that Ibn al-Haytham, like Ījī, described the equant as a problem that threatened to destroy astronomy's foundations.

[44] Cf. what ʿUrḍī said on page 211.

[45] Ījī, *Mawāqif*, 2: 451. "*Wa fī al-kull fa-inna ḥarakāt al-aflāk irādiyya fa-mādhā yamnaʿ an takhtalif bi-ḥasab mā yataʿāqib ʿalayhā min irādāt juzʾiyya*?" On the same page, Ījī attributed the astronomers' frustration with the equant to their insistence on uniform rotation.

[46] Ījī, *Mawāqif*, 2: 457. Jurjānī's commentary made the connection between the problem of Mercury and those of the other planets, but did not note that those problems had been solved. Of course, Jurjānī wrote a famous commentary on a text with a solution for those problems.

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everything to *al-qādir al-mukhtār*.[47] Jurjānī added that this was the salvation (*manjāh*) from all these difficulties.[48] Astronomers' solutions to these difficulties did not seem to play a role. ʿUrḍī, in his *Kitāb al-Hay'a*, a text written before the construction of the Marāgha Observatory, put it differently. He pointed out à propos the Ptolemaic equant point, that if orbs could speed up and slow down, there would be no need for any of the orbs that Ptolemy proposed such as eccentrics and epicycles.[49] By implication, if orbs could speed up and slow down, what would prevent them from moving backward and forward? Thus ʿUrḍī has argued that scepticism about the need for solutions of the difficulty of the equant point meant, by extension, scepticism about the enterprise of astronomy. In fact, the most noteworthy achievement of astronomers in Islamic civilization, including astronomers known to Rashīd al-Dīn, were models that solved the equant problem. That is, astronomers of Islamic civilization, beginning with Ṭūsī and ʿUrḍī, proposed models that retained the predictive and retrodictive accuracy of Ptolemy's models but in which all the orbs rotated uniformly about axes passing through their centers.[50] More important, Quṭb al-Dīn Shīrāzī (d. 1311) resolved the difficulties of the Mercury model.[51] Ījī did not open himself to that possibility because he wanted to restrict closely the available ways to gain true knowledge.[52]

As was the case with Ījī's views about the phases of the moon and eclipses, Ījī's position has forced us to be more specific about what we mean by 'instrumentalist'. The noted astronomer al-Khafrī (d. c. 1550) has been understood as an instrumentalist in that he presented four

[47] Ījī, *Mawāqif*, 2: 452.

[48] Ījī, *Mawāqif*, 2: 457.

[49] ʿUrḍī, *Kitāb al-hay'a*, 212. See also p. 214, where he mentioned those who composed books of doubts about Ptolemy, i.e. Ibn al-Haytham and Jābir Ibn Aflaḥ, before he (ʿUrḍī) began to discuss solutions for the doubts, implying that doubts were for the sake of solutions, not doubts.

[50] For ʿUrḍī's solutions, see ʿUrḍī, *Kitāb al-hay'a.* For Ṭūsī's solutions, see Ṭūsī, *Naṣīr al-Dīn al-Ṭūsī's* Memoir. For a well-informed survey of these theories and more, see George Saliba: "Arabic Planetary Theories after the Eleventh Century AD," in *Encyclopedia of the History of Arabic Science*, eds. Régis Morelon and Roshdi Rashed (London: Routledge, 1996), 58–127.

[51] Edward S. Kennedy: "Late Medieval Planetary Theory," *Isis,* 57 (1966): 365–78. Reprinted in E.S. Kennedy, *Studies in the Islamic Exact Sciences* (Beirut: American University of Beirut, 1983), 84–97.

[52] Ījī, *Mawāqif*, 2: 450–1. See also Sabra, "Science and Philosophy," 38–9. Dallal (*Islam, Science*, 134–5) interpreted Ījī's statement (cf. Sabra, "Science and Philosophy," 37) about the neutral status of astronomy as applicable to the orbs as well as the circles imagined on the surface of the orbs. I disagree.

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mathematically equivalent Mercury models without taking a position on which one was the real model. But the inclusion of uniformly rotating orbs remained the criterion of viability, meaning that predictive accuracy alone was insufficient. Thus, Khafrī's multiple solutions for Mercury implied (though he did not say so himself) that solutions composed of uniformly rotating orbs were better than solutions that involved orbs that did not rotate uniformly. By questioning the need for the orbs' motions to be uniform, Ījī undermined the grounds for the argument that models with uniform motions were probably better than those without. Finally, if Khafrī was an instrumentalist, he was an instrumentalist operating within the project of astronomy which was to explain complex celestial motions in terms of uniform rotational motions.

Ījī's lack of awareness of recent developments extended to optics, in this case the explanation for the phenomenon of the rainbow. Ījī explained that the colors of the rainbow

> differ according to the parts/atoms (*ajzā'*) of the clouds and what is behind them, and the light from heavy bodies that is reflected from them. An eminent scholar of our time (*ba'ḍ al-fuḍalā' min zamāninā*) has opined that a prism (*ka'b ʿāl*^{in}) maintains (*yadda'ī*) the falsehood of that. But it is the opinion of most (*ra'y al-jumhūr*), so we have mentioned it here following them.[53]

In his commentary, Jurjānī identified this eminent scholar as Kamāl al-Dīn Fārisī (d. 1320).[54] Fārisī found, by conducting an experiment with a transparent sphere, that the colors of the rainbow were the product of rays of light being refracted a second time after being refracted within the droplets of water.[55]

This is, indeed, an important part of the *Mawāqif* because Fārisī's experiment regarding the rainbow indicates how it was possible to provide an explanation, based on experiment, for physical phenomena. A rainbow was not material with the color of the spectrum in the sky, but rather light broken down into the color of the spectrum. This experiment, within the science of optics, was, perhaps, a threat to Ījī's portrayal of science because the demonstrations that supported it were geometric and mathematical. They were beyond refutation. Thus, if Ījī did not fully understand Fārisī's

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[53] Ījī, *Mawāqif*, 2: 596. Cf. Rāzī, *al-Mabāḥith al-mashriqiyya*, 1: 181.

[54] Ījī, *Mawāqif*, 2: 603.

[55] Roshdi Rashed, "Kamāl Al-Dīn Abu'l Ḥasan Muḥammad Ibn al-Ḥasan Al-Fārisī," in *Complete Dictionary of Scientific Biography* (Detroit: Charles Scribner's Sons, 2008), 7: 212–219. Accessed via Gale Virtual Reference Library. Web. 16 Apr. 2011.

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theory of the rainbow, rejecting Fārisī's theory would be to his advantage because attributing the colors of the rainbow to the colors of clouds served his goal of attributing natural phenomena, as entirely as possible, to God.[56] For Ījī, it would have been unclear how that light would have been anything other than either something imaginary or something material.[57]

On the next page of the commentary, Jurjānī cited Rāzī's *al-Mabāḥith al-Mashriqiyya* where it was alleged that the cause of these atmospheric phenomena, rainbows, were celestial conjunctions (*ittiṣālāt falakiyya*).[58] Or, non-material powers (*quwan rūḥāniyya*) brought about their existence. Then Jurjānī wrote that atmospheric phenomena such as rainbows were not imaginary (*min qabīl al-khayālāt*). Were such phenomena imaginary, it would be like seeing one's image in the mirror while knowing that oneself, in the truth of the matter (*fī nafs al-amr*), is not in the mirror.[59] Rainbows, then, were real. My colleague İhsan Fazlıoğlu of Istanbul Medeniyet University has drawn my attention to the importance of this phrase (*nafs al-amr*) as a technical term and is preparing a lengthy study of the subject.[60] Jurjānī was saying that it is the mode of existence known

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[56] Jurjānī mentioned Fārisī by name on *Mawāqif*, 2: 603.

[57] Ījī certainly had grounds for insinuating that observers did not always know what they saw. For instance he commented, at the beginning of his précis of astronomy (*Mawāqif*, 2: 400) that geometers (*muhandisūn*) who found that the orb of Venus was above the sun would, then, discredit Avicenna's statement that he observed Venus as a blemish on the face of the sun. See Bernard Goldstein, "Some Medieval Reports of Venus and Mercury Transits," *Centaurus* 14 (1969): 52–3. But what the geometers' position, if true, would really have meant was that whatever Ibn Sīnā observed in the face of the sun, it was not Venus. Thus, the question was not necessarily even whether Ibn Sīnā observed a transit, but whether Ibn Sīnā could discern which planet it was; Ibn Bājja had observed a Mercury transit. Goldstein, "Some Medieval Reports," 55. Also interesting is Goldstein's (p. 54) account of Gersonides' argument for why transit observations were not, actually, observations of Venus and Mercury transiting the sun.

[58] Ījī, *Mawāqif*, 2: 604. One place where Fakhr al-Dīn Rāzī discussed the influence of the orbs' motions on the sublunar elements was in *al-Mabāḥith al-mashriqiyya*, ed. Muḥammad al-Muʿtaṣim bi-ʾllāh al-Baghdādī (Beirut: Dār al-Kitāb al-ʿArabī, 1990), 2: 114–5.

[59] Ījī, *Mawāqif*, 2: 604. Further down on the page is a spot where Jurjānī rebutted Ījī.

[60] On *nafs al-amr*, see Hans Daiber, *Bibliography of Islamic Philosophy: Index of names, terms, and topics* (Leiden: Brill, 1999), 2: 103, 413. For Jurjānī's treatise on *nafs al-amr*, see Recep Duran: "Nefsü'l-emr Risaleleri," *Ankara Üniversitesi Dergiler Veritabanı* 14 (1992): 97–106. For Dawānī and Ardabīlī's treatises on *nafs al-amr*, which were commentaries on Ṭūsī's, see Recep Duran: "Nefsü'l-emr Risaleleri," *Bilim ve Felsefe Metinleri* 1 (1992): 77–102. For Ṭūsī's treatise see *Sargudhast va-ʿaqāʾid-i falsafī-yi Naṣīr al-Dīn Ṭūsī*, ed. Muḥammad Mudarrisī Zanjānī (Tehran: Intishārāt-i Dānishgāh-i Tihrān, 1957), 169–172 (*Risālat Ithbāt jawhar mufāraq*). The same treatise is also found in Muḥammad Taqī Mudarris Raḍavī, *Aḥvāl va-āthār-i Khvāja Naṣīr al-Dīn Ṭūsī* (Tehran: Bunyād-i Farhang-i Īrān, 1354; second printing 1375), 464–7. It is followed by a list of MSS of Ṭūsī's treatise and a list of the known commentaries thereon.

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as *nafs al-amr* through which one can tell the difference between what one imagines and reality. Considering the truth of the matter (*nafs al-amr*) differentiates a real natural phenomenon from something imaginary (*khayālāt*).

In a famous part of the *Mawāqif*, Ījī remarked, forcefully, that the circles, such as the celestial equator, that the astronomers posited on the surface of the orb were purely imaginary.[61] Jurjānī responded in his commentary that (following Sabra's translation) "they are 'correctly imagined (*mutakhayyala takhayyul*^{an} *ṣaḥīḥ*^{an}) in accordance with what things are in themselves.'"[62] The Arabic phrase *fī nafs al-amr* is what Sabra translated as 'in accordance with what things are in themselves.'[63] This comment has also been interpreted as a broader defense of astronomy since, again, the question, as it was with the rainbow, would be whether there was another correct way to imagine the same circles.

Jurjānī wrote a short treatise entitled *Risāla fī taḥqīq nafs al-amr wa-'l-farq baynahu wa-bayn al-khārij*. Recep Duran has edited the treatise and has translated it into Turkish. Jurjānī explained that ascertaining something (*taḥaqquq al-ashyā'*) is a supposition (*farḍ*) that is either within the faculties of perception or external to them. But *nafs al-amr* is more general than external existence (*aʿamm min al-khārij*). That is, a compound body might be compound in the truth of the matter (*fī nafs al-amr*), but not externally if such a body does not exist externally.[64] The example Jurjānī gave was of a blackness (*sawād*) that did not exist externally but did in itself (*fī nafsih*). Such a blackness might plausibly exist, unlike, say, a three-headed monster or the abstractions of numbers. Rather such a blackness was a color just like colors the external existence of which has been assented to because the scope of that which exists in *nafs al-amr* subsumes that which exists externally.[65] Jurjānī cautioned that most errors resulted from confusion of the determination (*ḥukm*) of the intellect (*dhihn*), external reality, and the truth of the matter (*nafs al-amr*).[66]

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[61] Ījī, *Mawāqif*, 2: 410. See also Sabra, "Science and Philosophy," 37.

[62] Ījī, *Mawāqif*, 2: 432. The quoted translation comes from Sabra, "Science and Philosophy," 37.

[63] Although Jurjānī, when returning to a blackness (*sawād*) not existing (*maʿdūm*) externally might be a color in itself (*fī nafsih*). Thus, *nafs al-amr* might be better understood as a mode of existence.

[64] Duran, "Nefsü'l-emr Risaleleri," 103.

[65] So the application of *nafs al-amr* to prove non-existence is more narrow than applying externality (Duran, "Nefsü'l-emr Risaleleri," 103).

[66] Duran, "Nefsü'l-emr Risaleleri," 104.

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An earlier commentator on the *Tadhkira*, Niẓām al-Dīn al-Nīsābūrī, understood knowledge gained from the *nafs al-amr* to be equivalent to syllogistic knowledge.[67] As *Kashf al-Ẓunūn* put it, the existence of something in *nafs al-amr* depended directly on neither the mind (*dhihn*) or external reality.[68] Though explanations of 'the truth of the matter' varied and are sometimes difficult to understand, it is clear that existence in the truth of the matter was not the same as mental existence (*al-wujūd al-dhihnī*) or as external existence but was a real form of existence.

Correlations with Occasionalism?

al-ʿAllāma al-Ḥillī's (d. 1325) *Kashf al-murād fī sharḥ Tajrīd al-iʿtiqād* was also from the Tabriz circle of Rashīd al-Dīn.[69] When Ḥillī (a Shiite) came to Ṭūsī's account of the orbs in the *Tajrīd al-iʿtiqād*, Ḥillī commented, though not at the length at which Ījī did, in a tone that was as critical as Ījī's. Ḥillī's strongest critiques of astronomy came with his arguments against the astronomers' arguments for the transparency (*shaffāfa*) of the orbs. The astronomers' argument that the orbs were simple, and consequently for the orbs' transparency, was contradicted (*manqūḍ*) by the example of the moon.[70] Though Ḥillī did not specify what it was about the moon (the moon's color comes to mind), *manqūḍ* was a strong word. The moon's observed color contested but did not necessarily contradict the astronomers. The second argument, that what was beyond the orbs, e.g. the stars fixed in the eighth orb, was not obscured from sight, was deemed by Ḥillī only presumptive (*ẓannī*) and not certain. He argued that it was possible that the orbs had a weak color insufficient to obscure the stars from sight. This is a distinction without a difference as Ḥillī could not contest either the observations themselves or the functional transparency of the orbs.

Ḥillī also pointed to the problem of planetary distances, namely the principle that the greatest distance of a planet must be the least distance of the planet above it, as an area of uncertainty as the *jawzahr* of the moon

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[67] Niẓām al-Dīn al-Nīsābūrī, *Tawḍīḥ al-Tadhkira*, MS Fatih 3397, fol. 13r apud the distinction between *innī* and *limmī* proofs.

[68] Duran, "Nefsü'l-emr Risaleleri," 105.

[69] van Ess, *Der Wesir*, 42, 44, 47.

[70] Jamāl al-Dīn al-Ḥassan al-Ḥillī (with comments and marginalia by al-Sayyid Ibrāhīm al-Mūsawī al-Zanjānī), *Kashf al-murād fī sharḥ Tajrīd al-iʿtiqād* (Beirut: Muʾassasat al-aʿlamī li-l-maṭbūʿāt, 1979), 164.

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intervened between the moon's greatest distance and the nearest distance of Mercury.[71] According to the astronomers, the planets' orbs had to nest within each other lest there be a void between orbs.[72] Thus, a *mutakallim*'s position was as correlated with his commitment to the discipline of astronomy as it was with his intellectual tradition in *kalām*; aside from the fact that Ījī's treatment of astronomy was more extensive, Ḥillī's was as critical.[73] Ḥillī's criticisms of astronomy are fascinating because they went beyond asserting the contingency of the astronomers' (and Ṭūsī's) conclusions. Even more important, they came in a text that explicitly recognized causality.[74] Thus, it would be difficult to correlate Ḥillī's position on astronomy with his position on causality.[75] Given Ījī's chronologically posterior position to Ḥillī in the circle of Rashīd al-Dīn, Ḥillī's concern for certainty and *kalām* must have been more compelling than the general question of causality. Eichner has noted in Ḥillī's *Kashf al-murād fī sharḥ Tajrīd al-iʿtiqād* an emphasis on rationalist demonstration.[76] And Sabine Schmidtke has noted that Ḥillī never defended philosophy at the expense of his views on *kalām*.[77] Ḥillī, for instance, rejected emanation and held that God could know particulars. Though he did not deny the existence of a soul, he did not argue directly for its existence.[78] With respect to Ḥillī, an acceptance of causality did not correlate with a realist or even instrumentalist astronomy.

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[71] al-Ḥillī (with comments and marginalia by al-Sayyid Ibrāhīm al-Mūsawī al-Zanjānī), *Kashf al-murād fī sharḥ Tajrīd al-iʿtiqād* (Beirut: Muʾassasat al-aʿlamī li al-maṭbūʿāt, 1979), 163.

[72] See Ṭūsī, *Naṣīr al-Dīn al-Ṭūsī's* Memoir, 517–23 for more on how astronomers dealt with what Ragep termed the 'unpleasant realities' of planetary sizes and distances.

[73] See Eichner, The Post-Avicennian Philosophical Tradition, 291: "An analysis of the section dealing with astronomy shows that al-Āmulī—although being an author whose Ashʿari affiliation is quite explicit—was influenced by the tradition represented by the commentary by the al-ʿAllāma al-Ḥillī on al-Ṭūsī's *Tajrīd al-iʿtiqād*," It depends what one means by tradition, for Ḥillī's views on astronomy were not Ṭūsī's.

[74] Ḥillī, *Kashf al-Murād*, 113.

[75] Such a link would not be impossible, for in the milieu of Tabriz, Ḥillī could have picked up the critique of astronomy from Ashʿari scholars. Still, such a hypothesis would imply that the text of *Kashf al-Murād* is a student's notes.

[76] Eichner, The Post-Avicennian Philosophical Tradition, 308.

[77] Sabine Schmidtke, *The Theology of al-ʿAllāma al-Ḥillī* (Berlin: Klaus Schwarz Verlag, 1991), 255–60, esp. 255. See also p. 215 for Ḥillī's rejection of the philosophers' doctrine of the world's eternity.

[78] Schmidtke, *The Theology*, 257–8.

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The Implications of Ījī's Non-Instrumentalist Presentation of Astronomy

Having argued that Ījī's presentation of astronomy in *Kitāb al-Mawāqif* was not instrumentalist, there are three tentative conclusions that I would like to advance. First, because *kalām* texts such as the *Mawāqif* paid special attention to matters of logic and to how all demonstrations had to be based on certain (*yaqīnī*) premises in order to free the reader from *taqlīd*, then Ījī was likely troubled by how little or nothing of what the astronomers said could be established deductively from self-evident principles.[79] If Rāzī's *al-Mulakhkhaṣ fī al-ḥikma* is indeed as important for the development of *kalām* as Eichner has argued, then the final section of the *Manṭiq al-Mulakhkhaṣ* is crucial for understanding sections in later *kalām* texts, such as Ījī's that are critical even of astronomy's instrumental value.[80] In this section on the principles of demonstration (*mabādi' al-burhān*), Rāzī enumerated five: *awwaliyyāt* (the *a priori*), things that have been observed (*mushāhadāt*), *mutawātirāt*, experiences (*mujarrabāt*), and *ḥadsiyyāt*. Regarding *ḥadsiyyāt*, Rāzī remarked that our example is our conviction (*iʿtiqādunā*) that the light of the moon comes from the sun owing to how we see the phases (*ikhtilāf ashkālih*). But Rāzī said that he had already shown the weakness of that premise (*muqaddima*) in *ḥikma*, for that premise was neither sensed (*maḥsūs*) nor *a priori* (*awwalī*). He explained that what is sensed is the phases of the moon; that the phases are due to the moon's proximity and distance from the moon is not sensed. Thus a demonstration would be necessary. And since it requires a proof, the explanation for the phases of the moon could not be certain on its own; therefore intuition (*ḥads*) cannot be numbered among the premises (*al-mabādi'*).[81] It appears that Rāzī's strategy, then, has been to exclude

[79] See Sabra, "Science and Philosophy," 10: "As the fourteenth-century Ashʿarite al-Ījī as to put it in unequivocal terms, the first advantage of kalām was to raise the adept 'from the perigee of *taqlīd* to the apogee of certainty'." On the non-deductive nature of astronomy, George Saliba perceived that the *mutakallimūn*'s qualms with astronomy had to do with how the principles of astronomy were not self-evident. See Saliba "Astronomy and Astrology in Medieval Arabic Thought," in *Les doctrines de la science de l'antiquité à l'âge classique*, eds. Roshdi Rashed and Joël Biard (Leuven, Dudley, MA: Peeters, 1999), 148–9.

[80] On the significance of Rāzī's *al-Mulakhkhaṣ fī al-ḥikma*, see Eichner, The Post-Avicennian Philosophical Tradition, 32. For the portion of the text under discussion, see Fakhr al-Dīn Rāzī, *Manṭiq al-mulakhkhaṣ*, ed. Qaramquli (Tehran: Dānishgāh-i Imām Ṣādiq, 2002), 344–54.

[81] Rāzī, *Manṭiq al-mulakhkhaṣ*, 344–5.

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ḥads from the list of acceptable principles for a syllogism by noting that it is not a sense perception.[82]

Subsequently, Rāzī went on to attack experientia (*mujarrabāt*) as a way to obtain a premise of a syllogism.[83] He cited the observation that diarrhea has been observed to occur upon taking scammony (*saqmūniyā*) time after time (*marra baʿd ukhrā*). His critique was far-reaching: correlating diarrhea and scammony depended on observing the effect (diarrhea) when scammony was taken. The implication is that one could not be forever certain of the correlation. Seemingly implicit, too, is occasionalism as one might otherwise argue that there was an element in the scammony that caused diarrhea to occur. From that position comes Rāzī's conclusion: sense perceptions do not yield universal certainty (*al-ḥiss lā yuʿṭī al-qaḍiyya al-kulliyya al-yaqīniyya*).[84] Rāzī has attempted to weaken *ʿilm al-hayʾa*'s claim to any certain knowledge, meaning that little of what the astronomers say could be considered to meet the demonstrative standards of *kalām*. Rāzī's position on sense perceptions reminds one of Ījī's attempts to undermine confidence in observations.

Ījī also provided his own cautious assessment of *ḥadsiyyāt, mujarrabāt*, and *mutawātirāt* in the *Mawāqif*.[85] As Rāzī had written (and Ṭūsī would agree in his *Tajrīd al-manṭiq*), the main support (*ʿumda*) for demonstrations was first principles (*awwaliyyāt*).[86] Ījī argued that while *ḥadsiyyāt*, *mujarrabāt*, and *mutawātirāt* could be a satisfactory argument for an individual, these premises would not necessarily serve to convince someone who, say, lacked the intuition or the transmitted material. It would not be possible to convince an opponent by rejecting all alternatives (*ʿalā sabīl al-munākara*), perhaps for the reason that Rāzī mentioned. Conversely, only the truly deficient would lack the first principles. The only way to use induction comprehensively would be by conceiving of the two extremes,

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[82] Notably, Ījī did acknowledge *ḥads* when he listed the possible premises of a demonstration. Ṭūsī also excluded *ḥads* from the premises of a demonstration in his *Tajrīd al-Manṭiq*, but he allowed that *ḥads* could lead one to the middle term of a syllogism. See Naṣīr al-Dīn Ṭūsī, *Tajrīd al-Manṭiq*, [no editor listed] (Beirut: Muʾassasat al-Aʿlamī li al-Maṭbūʿāt, 1988), 53–4.

[83] Rāzī, *Manṭiq al-mulakhkhaṣ*, 345.

[84] Rāzī, *Manṭiq al-mulakhkhaṣ*, 345.

[85] Ījī, *Mawāqif*, 1: 198–99. On this part of the *Mawāqif*, see van Ess, *Die Erkenntnislehre*, 398–9.

[86] Ṭūsī, *Tajrīd al-Manṭiq*, 52. See also Rāzī, *Manṭiq al-mulakhkhaṣ*, 448. This is part of the editor's commentary, but the contemporary commentator was citing Ṭūsī, and not just Ḥillī's view of Ṭūsī.

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and that would not always be possible.[87] Without the ability to form an induction by arguing from the two extremes, the intellect would need something to help it in its judgment. Sometimes that would be the estimative faculty (*al-wahm*), a faculty Ījī explained was capable of error.[88] While Ījī's position may have differed from Rāzī's in that Ījī may have acknowledged that some sense perceptions did provide certain knowledge, Ījī has left room to doubt some demonstrations, e.g. those of the astronomers, based heavily on sense perceptions.

The second implication of concluding that Rāzī's discussion of astronomy was not instrumentalist is that one might speculate that Ījī discussed astronomy in the way that he did in order to reinforce a distinction between *ʿilm* and *fiqh*.[89] By Ījī's time, astronomy (*ʿilm al-hayʾa*) had become part of a tradition of religious scholarship and the astronomers, like the *fuqahāʾ* (for God's law in a particular instance cannot always be known with certainty) depended necessarily on probabilist reasoning. Because *kalām* sought *ʿilm*, not *taqlīd*, *kalām* had to distinguish itself from the demonstrative standards of *fiqh* and astronomy inasmuch as astronomy's reasoning resembled that of *fiqh*. Niẓām al-Dīn Nīsābūrī, in fact, pointed out similarities between the *uṣūl* of *fiqh* and the *uṣūl* of astronomy.[90] In another text, Fakhr al-Dīn Rāzī, in his *Maḥṣūl*, a work about *fiqh*, used the word *ḥadsiyyāt* (along with *mujarrabāt*) in a way that was closer to 'conjectures on the basis of experience' than it was to 'intuition.'[91] Because the *Mawāqif* appropriated *falsafa*'s epistemological terminology and methods of demonstration, Ījī had to pay special attention to the way astronomers interpreted those terms and methods to arrive at probabilistic knowledge, a type of knowledge that, again, was quite helpful in *fiqh*. He was concerned that the same method of speculation (such as *ḥads*) that led to

[87] Ījī, *Mawāqif*, 1: 198. Ījī added that if one can conceive of the two extremes, then such an argument would be tantamount to an argument from the *a priori* (*awwaliyyāt*).

[88] Ījī, *Mawāqif*, 1: 198.

[89] van Ess, *Die Erkenntnislehre*, 12–33.

[90] Morrison, *Islam and Science*, 67–70.

[91] Rosenthal, *Knowledge Triumphant*, 238. On Rāzī, see Rāzī, *al-Maḥṣūl fī ʿilm uṣūl al-fiqh*, ed. Jābir Fayyāḍ al-ʿAlwānī (Beirut: Muʾassasat al-risāla, 1997), 1: 84. *Ḥadsiyyāt*, along with *tajrībiyyāt* were judgments of the mind (*aḥkām al-dhihn*) that combined the other senses (other than hearing—that would be for *samʿiyyāt*) with the intellect. *Ḥadsiyyāt* were clearly sufficient to necessitate (*mūjib*) something, for Rāzī contrasted *ḥadsiyyāt* with *iʿtiqād al-muqallid*.

See Ījī, *Mawāqif*, 1: 196–9. Here Ījī listed the ways to arrive at premises (*muqaddamāt*): *awwaliyyāt*, *qaḍāyā qiyāsātuhā maʿahā*, *mujarrabāt*, *ḥadsiyyāt*, *mutawātirāt*, and *wahmiyyāt*. These premises constituted definitive evidence (*dalāʾil qaṭʿiyya*); presumptive evidence (*muqaddamāt ẓanniyya*) followed.

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probable knowledge in astronomy, and of God's law in *fiqh*, might be used to garner certain knowledge of God in *kalām*. Another example would be how, at the beginning of his précis of astronomy, he reviewed how the astronomers established the order of the orbs.[92] Determining whether Venus and Mercury were above or below the sun depended on transit observations, a tricky undertaking.[93] This second example represents a critique that would have been and was valid for the astronomers themselves; transit observations as well as the determination of planetary sizes and distances were notably difficult. Jurjānī's response, though, involved a legal term—*istiḥsān* (preference).[94] That was also the process through which astronomers determined the order of the planets, as placing Venus and Mercury below the sun met criteria of symmetry.[95] In sum, the reasoning of the astronomers evinced parallels with the reasoning of the *fuqahā'*, reasoning that led to *fiqh*, not the *'ilm* that *kalām* sought.[96]

Third, Ījī's critical depiction of astronomy indicates that natural theology, using an appreciation of nature to come to conclusions about God and God's actions, must have been a heated topic of debate in *kalām* without being a formally-defined topic of *kalām*. Ījī's points that scientists' explanations were not certain were an argument for how God's existence and power over nature were certain. In his own arguments, he combined a sense of wonder with a reminder that God was the only knowable cause of the wonders of nature. A crucial part of Ījī's argument was that the human intellect's inability to explain certain features of nature would heighten one's sense of wonder.[97] Near the end of his précis of *'ilm al-hay'a*, Ījī mentioned his reasons for his presentation of the topic. He wrote:

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[92] Ījī, *Mawāqif*, 2: 400–1.

[93] See note 55. See also Ṭūsī, *Naṣīr al-Dīn al-Ṭūsī's* Memoir, 391 for references on Ṭūsī and Shīrāzī's positions.

[94] On *istiḥsān*, see Aron Zysow: *The Economy of Certainty: An Introduction to the Typology of Islamic Legal Theory* (Unpublished Ph.D. Dissertation, Harvard University, 1984), 399–402. *Istiḥsān* emerged by the ninth century if not earlier; see Wael Hallaq, *The Origins and Evolution of Islamic Law* (Cambridge: Cambridge University Press, 2005), 116–8, 144–5.

[95] Ījī, *Mawāqif*, 2: 402.

[96] Shīrāzī also mentioned the principle of the optimum (*al-aṣlaḥ*), an idea found both in *fiqh*, via *maṣlaḥa* as well as Mu'tazilī *kalām*. On *Shīrāzī* and *al-aṣlaḥ*, see Morrison, "Quṭb al-Dīn al-Shīrāzī's Hypotheses," 26–8. On Nīsābūrī and *al-aṣlaḥ*, see Morrison, *Islam and Science*, 75–6.

[97] There is a thematic resemblance here with Maimonides' comments in Book Two, Chapter 24 of *The Guide of the Perplexed*, trans. Shlomo Pines (Chicago and London: The University of Chicago Press, 1963), 2: 322–7. But at the end of the chapter, Maimonides did raise the possibility that humans' science could advance sufficiently to solve certain outstanding problems. On that possibility, see Y. Tzvi Langermann: "The 'True Perplexity': The Guide of the Perplexed, Part II, Chapter 24," in *Perspectives on Maimonides: Philosophical*

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> In the Earth are hills and depressions due to external reasons, and successive cols without any beginning to them. Water flows, naturally, to the depressions, and the hills are found to be a source of life (*maʿāsh*) for animals and vegetables. No reason for it has been mentioned except for God's providence/solicitude (*ʿināya*) in animals and plants, for without that their creation and endurance would not be possible. And this recourse to *al-qādir al-mukhtār* it is specifying a part of the simple [substance—*al-basīṭ*] to be prepared to receive as opposed to another with the relationship of the prepared material to it being something that the intellect has no path to.[98]

Jurjānī did not criticize this statement.

Ījī's sometime scepticism of even astronomy's instrumental value created a way for scientists to argue for a different, though related, sense of wonder. Nīsābūrī's writings on *ʿilm al-hayʾa* contained remarks, as had other texts on astronomy of that era, about God's role in certain phenomena (e.g. eclipses). The most extensive of such comments, and one of the most meaningful for asserting the religious value of *ʿilm al-hayʾa* as practiced by the astronomers, came in the course of the discussion of retrograde motion in *Tawḍīḥ al-Tadhkira*. Retrograde motion is when the planets halt their west to east motion, move from east to west for a short time, then resume their previous west to east motion. This was an exceedingly complex phenomenon that attracted a dedicated treatise from Kamāl al-Dīn al-Fārisī.[99] Nīsābūrī wrote:

> I say: some of the proofs of these laws (*qawānīn*)[100] are actually mentioned in the *Almagest*, and some are not mentioned, only potentially. And I have produced all of them here (*akhrajtuhā al-jamīʿ hāhunā ilā al-fiʿl*) set forth in detail and made easy, especially the demonstration of the planet's retrogradation in the uppermost portions of the epicycle or the eccentric, how the two hypotheses agree there, and the conditions for that. And these things from the *Almagest* are in a state of neglect and the author (Ṭūsī)

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and Historical Studies, ed. Joel L. Kraemer (Oxford: Oxford University Press, 1991), 159–174. See, now, Langermann: "My Truest Perplexities," *Aleph* 8 (2008): 313 in which he argues, forcefully, that Maimonides did not see the perplexities of *Guide* II: 24 as insolvable. Langermann cited Ibn Naḥmias (in addition to Gersonides) as one who ventured to resolve the perplexities.

98 Ījī, *Mawāqif*, 2: 493–4.

99 Kamāl al-Dīn Fārisī, *Ḥāshiya ʿalā dhikr aṣl al-rujūʿ wa al-istiqāma fī al-Tadhkira*, Istanbul MS Damad Ibrahim Paşa 848, fols. 163v–166v. ʿAlī Qūshjī's work on retrograde motion may have paved the way for the transition from a geocentric to heliocentric cosmos. See F. Jamil Ragep, "ʿAlī Qūshjī and Regiomontanus: Eccentric transformations and Copernican revolutions," *Journal for the History of Astronomy* 36 (2005): 359–71.

100 Here he is commenting on the penultimate portion of the chapter on *uṣūl* II.[10]: "These then are models and rules that should be known. We have only stated them here; their geometric proofs are given in the *Almagest*." (*Tadhkira*, 140–1) For the *Tuḥfa*, cf. Morrison, "Quṭb al-Dīn al-Shīrāzī's Hypotheses," 62.

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> abbreviated the demonstration by speaking extremely generally. And by my life (*la-ʿumrī*), achieving truth in eliciting the reasons that necessitate the observed variations of the planets, with their motions being themselves (*fī anfusihā*) uniform, is something of majestic import (*amr ʿaẓīm al-qadr*) and truly complete (a true complement?) for the mathematical perspective of philosophy (*fa-tamām li-l-naẓar al-taʿlīmī min al-falsafa*). And as for its great import, it is because what it rests on regarding that [the mathematical perspective] are things found in the observable divine bodies which are among the observed bodies (*al-ajsām al-ilāhiyya allatī min bayn al-ajsām al-marʾiyya*), whose affairs proceed directly and orderly although it is my opinion that it is presumed that they are sought at a distance (*baʿīd al-marām*), and it was not like that.[101]

First, Nīsābūrī's reference to proofs (*barāhīn*) is notable, as it reminded the reader of the astronomers' view that astronomy's conclusions were demonstrable if one accepted astronomy's predictive ability. Second, Nīsābūrī noted the equivalence of the eccentric and epicyclic hypotheses, meaning that he was not claiming that the usual causal explanation, an epicycle with an eccentric deferent, surely existed externally. Nīsābūrī, nevertheless, did seem to be saying that it would be difficult to conceive of a meaningfully different alternative to the astronomers' explanation as eccentrics and eccentrics served to explain not only the planets' observed variations in longitude, including the loops of retrogradation, but also the observed variations in distance from the earth due to the size of the epicycle; such variations would be particularly notable in the case of Mars. Two possible conclusions from Nīsābūrī's remarks are possible, and both of them would be compelling to a reader interested in arguments about God based on nature. First, and most likely, the effectiveness of the astronomers' explanations for retrograde motion indicated these models were a step in the right direction towards understanding the structure of the heavens, a structure that would be a source of wonder. Failing that, a second conclusion, foreshadowing an argument that Qūshjī would make later, was that the ability of the astronomer's models to explain the hypotheses would be, itself, a source of wonder.[102]

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[101] Nīsābūrī, *Tawḍīḥ al-Tadhkira*, Istanbul MS Fatih 3397, fols. 37r–v. Here Nīsābūrī was commenting on the penultimate portion of the chapter on *uṣūl* II.[10]: "These then are models and rules that should be known. We have only stated them here; their geometric proofs are given in the *Almagest*." (*Tadhkira*, 140–1) For the *Tuḥfa*, cf. Morrison, "Quṭb al-Dīn al-Shīrāzī's Hypotheses," 62. See also Morrison, *Islam and Science*, 87–9.

[102] Ragep, "Freeing Astronomy," 63. Ragep wrote, "Qūshjī, though, in rejecting the view that somehow we can know true reality, is attempting to present a rather more sophisticated position: that the correspondence between our human constructions and external reality is itself a source of wonder." Jurjānī, in his famous statement (*Mawāqif*, 2: 432; see

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Conclusion

Heidrun Eichner has observed that *kalām* texts associated with the Marāgha astronomers begin with the format of a philosophical text, which she argues at length was based on Rāzī's *al-Mulakhkhaṣ fī al-ḥikma* and that, throughout the Ilkhanid period, these texts were characterized by discussions among *mutakallimūn*.[103] Thus Ījī's position on science[104] was not, as Dallal implied, the position of *kalām* on science; rather, Ījī represented a point in a debate. In addition, Eichner has proposed that at Marāgha astronomy texts were, in fact, produced in the context of debates about *kalām*.[105] More advanced science texts might have been produced in a dialogue with *kalām* and would have more sophisticated arguments for the religious value of scientific theories contained within. Researching the connection that Eichner has proposed between astronomy and *kalām* at Marāgha would help explain why more sceptical accounts of astronomy sometimes contained erroneous and/or incomplete portrayals of the state of the discipline. But what is already clear is that Ījī and others' (mentioned in this article have been Rāzī and Ḥillī) denial of astronomy's instrumentalist and predictive value meant that more scientifically-informed religious scholars (e.g. Nīsābūrī and Jurjānī) could and did legitimately contest Ījī's position as a foundation for arguments about natural theology.

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also Sabra, "Science and Philosophy," 39–41) defending the mathematical hypotheses of astronomy, had pointed out that while those hypotheses lacked external reality, they were true according to what was attested by *al-fiṭra al-salīma*.

[103] Eichner, *The Post-Avicennian Philosophical Tradition*, 352. Thus, a text such as the *Mawāqif* considered the ideas of *Ashʿari*, *Imami Shiʿi*, and *Maturidi mutakallimūn*.

[104] Eichner, *The Post-Avicennian Philosophical Tradition*, 133.

[105] Eichner, *The Post-Avicennian Philosophical Tradition*, 138. See also p. 285 on the introduction to ʿUrḍī's *Kitāb al-hayʾa*.

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