Islamic Science and the Making of the European Renaissance by George Saliba

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The ambitions of this book are to rewrite the historiography of Islamic science in light of recent research and to transform our understanding of its relation to Copernicus' Sun-centered theory and the subsequent growth of European science. Although Saliba occasionally discusses other topics (e.g., medicine, mechanics, optics, instrumentation), his primary case study is astronomy, which he takes to be paradigmatic for Islamic science as a whole—as the first two words of his title indicate. The 'and' that follows conceals one of the most tantalizing cross-cultural questions in the history of late medieval and early modern science: How did Copernicus learn about the geocentric astronomical models from 13th-century Maragha and 14th-century Damascus that he recycled as heliocentric ones in his *De revolutionibus*? And this specific question opens up nothing less than the high-stakes problem of modern 'Western' science itself, which is often fathered on Copernicus. Throughout the book, Saliba's argument has a notable 'science and society' component, as he seeks to anchor his explanations in societal needs. Even when he tackles detailed questions, he is thinking about their place in a narrative of *longue durée* associated with the rise and decline of various scientific cultures and their interactions, up to and including the present.

Saliba self-consciously adopts the *persona* of an *agent provocateur* in the best sense of the term, a role that he performs admirably and with obvious relish (he refers to 'my follies' in the preface). His book will certainly be controversial among specialists in Islamic science, as Saliba takes on many of his colleagues. Just as clearly, he is also intent on reaching a wide audience, including readers who are approaching these issues for the first time. For the most part,

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Saliba has succeeded in offering an accessible narrative (including a nice summary of Ptolemy's models, for example) and in keeping to a minimum the sections that will be difficult for the proverbial 'general readers'. Thankfully, the hidden scholarly barbs and controversies will largely be subliminal for this audience, which is likely to take away a valuable picture of Islamic science as told by one of the leading participants in revising it.

Saliba's revisionism proceeds in opposition to a 'classic story' that lumps together a century of scholarship and interpretation. As outlined in chapter 1 ('Questions of Beginning I'), this classic narrative may be summarized as follows. Islamic science, seen largely as a body of ideas, emerges under the early ᶜAbbāsid caliphate in the late eighth and ninth centuries, thanks to a translation movement that is either left unexplained or traced to Byzantine or Persian stimuli. Building on this newly translated Greek material, Islamic science thrives between the ninth and 11th centuries. Following this brief flowering, Islamic science declines after either the 11th century for internal reasons (symptom: al-Ghazālī's *Incoherence of the Philosophers*) or the mid-13th century for political ones (when the Mongols bring the ᶜAbbāsid caliphate to an end). The grand narrative of the history of science then moves on to Europe.

Saliba's targets here are many—from Roland Carra de Vaux to our own contemporaries, from Toby Huff's widely criticized non-specialist meta-argument for European exceptionalism to such canonical specialist theses as A. I. Sabra's association of decline with the 'naturalization' of the Greek scientific tradition and Dimitri Gutas' argument for ᶜAbbāsid emulation of Persian philhellenism. To call these historians 'strange bedfellows' would be an injustice, as some do not even fit in the same room. Fitting all these accounts into a single composite 'classic story' requires simplifications that, however useful pedagogically and polemically, sometimes verge on oversimplification, as Saliba himself is no doubt aware. This foil allows Saliba to set up his revisionist alternative in 'Questions of Beginning II', which pushes the beginning of Islamic science/astronomy back in time, extends its heyday into the 16th century, and adopts an explanatory framework based on societal and competitive needs.

With respect to the translation movement from Greek and Syriac, Saliba believes that the 'classical narrative' is at best wrong and

at worst based on 'essentialist features of Islamic religion' or 'the racial composition of early Islamic society' [71]. Saliba reproduces and translates some of the canonical early sources that address the emergence of Arabic science. His detailed exegesis of them in effect makes them out to be myths that historians have trusted uncritically instead of seeing in them the 'legendary' expressions of self-interested parties [e.g., 49].

As an alternative to these accounts, Saliba argues that the translations began well before the ᶜAbbāsid revolution, and for practical reasons. The first reported translation turned a Greek alchemical text into Arabic, an event that Saliba reads as motivated by contemporary political issues associated with the minting of coins. He suggests that subsequent translations under both the Umayyads and the ᶜAbbāsids were driven by competition, most notably for courtly attention, between the Arabic-language specialists and the multi-lingual scholars interested in the philosophical ideas of the Greeks. The word 'competition' recurs often to explain the motivations of leading protagonists.

In the lengthy chapter 3 ('Encounter with the Greek Scientific Tradition'), Saliba surveys the translation movement from Greek and Syriac into Arabic, which he starts in the Umayyad period and frames as a continuously critical enterprise. On his account, that critique engages neither the Byzantine nor the Sassanian scientific traditions. He therefore argues that the latter are effectively irrelevant to Arabic developments, which were stimulated by unmediated interaction with the Greek classical tradition (his evidence includes the correction of long-term parameters from Greek rather than other sources).

Saliba minimizes the extent to which either the Byzantines or the Persians could have sparked, directly or indirectly, an Arabic interest in Greek materials. This part of Saliba's argument has the kind of classic 'Renaissance' structure that makes a medievalist like myself wince. Just as the traditional Renaissance was a revival of classic materials that owed nothing to the preceding millennium, so Saliba's translation movement reaches back to the classical Greek corpus, untainted by Byzantium or Persia. Looking at a historical map, however, one wonder how the Islamic empires could possibly have swallowed cities like Damascus, Alexandria, Nishapur, and many others while remaining aloof from Byzantine and Persian culture.

The sophistication of al-Hajjāj b. Mattar's first known translation of the *Almagest* (829) is an important exhibit in Saliba's argument for an Umayyad translation movement. To explain the excellence of this work, terminologically and otherwise, Saliba postulates that 'several generations of earlier translators of elementary sciences must have paved the way' [83]. That this translation is more sophisticated than some later ones poses a problem for Saliba's argument. If, starting from al-Hajjāj's translation, one ranks extant *Almagest* translations according to the criterion of sophistication, one does not get a slowly ascending chronological order. On the contrary, the most sophisticated one comes first. So, in the absence of any evidence for earlier translations, where is the warrant for postulating a slowly ascending terminological sophistication *before* al-Hajjāj's translation?

Likewise, Saliba deems it improbable that Hajjāj coined the new technical terms found in his translation, of which he gives only three examples ('apogee', 'perigee', and 'horizon'), which do not seem too onerous for one person. Saliba nevertheless postulates piecemeal coinages by many individuals over several generations, thus hypothetically pushing the translations back. Yet he offers no evidence for the early period of lexical competition that one would expect as multiple coinages sorted themselves out. This phenomenon is well attested in Greek medical terminology, as multiple Hellenistic 'coiners' vied for supremacy, a process discussed in G. E. R. Lloyd's *Ambitions of Curiosity* [2002] and also evident in 12th-century Latin astronomical translations. Conversely, there is good evidence that Nicole Oresme singlehandedly coined more than 100 Middle French astronomical and philosophical terms in his late 14th-century *Livre du ciel et du monde*, a vernacular translation of and commentary on Aristotle's *De caelo*. Why, then, should it be implausible to credit al-Hajjāj and his circle with the leap forward?

Chapter 4 ('Islamic Astronomy Defines Itself: The Critical Innovations') outlines the characteristic features of Arabic astronomy—its high technical competence at the quantitative and observational levels as well as its concern for consistency between these results and 'the cosmological presuppositions of the universe' [167]. Here Saliba sees a fundamental inconsistency between Ptolemy's *Almagest* and his *Planetary Hypotheses*, works that he reads—problematically, to my mind—as describing 'a universe completely composed of Aristotelian spheres' [134]. On this account, the *Almagest* sought consistency

with Aristotle ('his guiding cosmology' [138]), but failed to attain it, most notably in the invention of the equant, a problem that would also engross Copernicus (words like 'absurdities' occur repeatedly in these pages).

The polarity between Ptolemaic astronomy and Aristotelian cosmology pervades Saliba's account of Ptolemy. By Aristotelian cosmology, however, he often seems to mean no more than the requirement of using uniform circular motions when constructing planetary models. It is not clear to me that, in aspiring to uniform circular motions, Ptolemy was in fact trying to conform to peculiarly Aristotelian principles or to be an orthodox Peripatetic. It is, therefore, far from clear that Ptolemy overlooked or remained deliberately silent about the 'other Aristotelian conditions' [138] to which his supposed allegiance demanded adherence, as if he were trying to trick his readers by sneaking past them. The overall direction of Saliba's argument is that Arabic astronomy was so deeply critical of Ptolemy's *Almagest* that it in effect constituted an anti-Ptolemaic revolution.

In chapter 5 ('Science Between Philosophy and Religion: The Case of Astronomy'), Saliba contends that the fundamental premises of Islam gave Islamic astronomy a cast fundamentally different from that of its Greek predecessor, despite the similarities between the two. Different societies have different needs: 'societal forces ... required new disciplines to be created' [171]. Among these were *ʿilm al-hay'a*, the new discipline concerned with the 'configuration' of the universe, which salvaged the palatable aspects of Aristotelian cosmology while setting aside its controversial aspects (especially astrology). This selectivity meant that *hay'a* could enjoy broad support in political circles and among religious scholars, and interact fruitfully with both philosophy and religion. Although he mentions occasional tensions with religion at the fuzzy interface between astronomy and astrology, Saliba argues that Islamic civilization does not evidence what he calls 'the European paradigm of conflict between science and religion' [191]. Saliba's contrast, however, works only if the Galileo Affair is indeed paradigmatic of the European situation, a point that an increasing number of scholars doubt.

Given his overall goal, Saliba's choice of astronomy as the archetypical science is a clever one, for it is Copernican astronomy that opens the classic narrative of the Scientific Revolution and the beginning of modern science. Chapter 6 ('The Copernican Connection')

summarizes the scholarship of the last 50 years on the striking parallels between Copernicus' heliocentric models in his *Commentariolus* and *De revolutionibus*, on the one hand, and various earth centered 13th- and 14th-century Islamic models (notably those of Tūsī, Urdi, and Ibn al-Shātir). Since convincing connections have eluded historians thus far, the order of the day remains hypotheses about the way in which these models may have reached Copernicus. Although he alludes to the standard hypothesis of a Byzantine route of transmission (that is, a westward migration of Greek manuscripts containing summaries or translations of Islamic astronomy), Saliba suggests that translation into Greek or Latin may in fact have been superfluous. He points to a small cohort of 15th- and 16th-century Europeans who read Arabic, from Andrea Alpaga to Guillaume Postel and others. To support this hypothesis, Saliba is perhaps too eager to inflate manifold the size of this group, on the grounds that 'one has to conclude' that the 1000 Arabic copies of Tūsī's *Euclid* sold by the Medici Oriental Press went to a domestic market [228–229]. The necessity of this inference is far from obvious, however; in the face of such contingency, some evidence would be nice.

Even so, the historical interest of even a small number of European Arabists remains considerable, all the more so as some had astronomical interests. But improving the statistics by multiplying the known handful by 100 or more will not satisfactorily answer the question, What did that one man Copernicus read or see, and when? Here we must mind the law of small numbers. I can no more infer reliably from box office statistics what movies Saliba has seen than he can infer from 1000 putative European Arabists that Copernicus saw Ibn al-Shātir's models thanks to one of them. Only careful detective work into Copernicus' various circles and contexts will answer that question.

Another prong of Saliba's argument in this chapter is motivational. It consists in attempting to show that Latin astronomy had no internal reasons for criticizing Ptolemy; hence, the problems raised by a critique and the solution to them must have come from elsewhere (that is, from Islamic civilization). Here Saliba uses highly schematic stereotypes of the Renaissance to magnify the differences between Copernicus and his own context:

> [Maraghan astronomical works were] written expressly to counter Greek astronomical thought rather than to preserve

> it. So why would any Renaissance scientist be interested in them, if the purpose of the Renaissance intellectual project was the recovery of the sources of classical Greco-Roman antiquity as we are so often told? [211]

Saliba also refers here to the 'rupture of the Aristotelian universe by the Tūsī couple... [which could] now demonstrate that circular motion could produce linear motion and vice versa' [213]. In this chapter and in these quotations, we can glimpse the *telos* of Saliba's portrayal of Islamic astronomy as revolutionary. Since, by definition, Copernicus' revolution cannot have grown out of an antiquity-worshipping movement, the stimulus must have been external [e.g., 232].

This is a provocative argument on which the law of small numbers once again casts doubts. Even if the latter did not apply, one would have to be very cautious. Despite the stereotypes about the Middle Ages and the Renaissance, the Latin natural philosophy and some of the astronomy of the 14th and 15th centuries do much more than rehash Aristotle uncritically. Years ago, Claudia Kren [1971] pointed out that Nicole Oresme's commentary on Sacrobosco's *Sphere* effectively describes a Tusi couple to make precisely Saliba's point about the mutual production of circular and rectilinear motions. Moreover, there is no good evidence that astronomers like Regiomontanus in the generation before Copernicus valued antiquity over what they took to be the truth about the heavens. If these individuals were stereotypical humanists, this judgment is best reached inductively rather than deductively.

Not least (and here graduate students should pay attention), Saliba seems to assume that we already know what there is to know about the context and background of Copernicus. This is so far from being the case that, although Europe had dozens of universities, even historians of astronomy would be hard pressed to name ten 15th-century Latin astronomers, to say nothing of characterizing their work. Giovanni Bianchini, the leading astronomer of Italy in the 15th century and a student of the *Almagest*, has no entry in the *Dictionary of Scientific Biography*, while the 600-odd folios of controversy about the *Almagest* between George of Trebizond and Johannes Regiomontanus (1450s–1470s) have yet to receive sustained attention. Counterintuitive though it may seem, Latin astronomy in the 15th century has yet to be mapped, both in general and in detail.

The book's concluding chapter 7 ('The Age of Decline') challenges earlier chronologies of decline in Islamic astronomy specifically, and in Islamic science generally. Simply put, some of the best work in Islamic astronomy falls between the 13th and 16th centuries, squarely after both al-Ghazālī and the Mongol conquests, the two leading and competing benchmarks for earlier accounts of the decline of Islamic science. Saliba thus postpones the 'age of decline' to the later 16th century for reasons far more fundamental than science, as we shall see. Here it is important to notice that astronomy has once again become normative. Indeed, apart from its cosmological portions, Saliba has relatively little to say about the fortunes of the vast enterprise of natural philosophy in Islamic civilization, except as it relates to astronomy. Here one suspects that the trend represented by al-Ghazālī may be more important to the overall story than Saliba allows. What are the reasons for such suspicion? Ghazālī alone would seem to count against Saliba's claim that astronomy and natural philosophy follow the same trajectory and chronology, since Ghazālī himself treated the two endeavors very differently, allowing the one while being suspicious of the other. Saliba's decision to make astronomy the paradigm and to generalize from it leads to interesting questions, but it is does not address directly A. I. Sabra's broader 'decline thesis', which, as I read it, concerns the scientific enterprise as a whole, including the full range of natural philosophy. Indeed, Sabra was writing in full awareness of the significant astronomical developments between the 13th and 15th centuries, from Maragha to Samarkand.

Saliba's reflections on the problem of decline remain valuable and make several points that bear on the wider historiography of science. The first is his general definition of scientific decline as 'an age in which a civilization begins to be a consumer of scientific ideas rather than a producer of them' [248]. The second, using this definition, is his rejection of the commentary genre as a traditional symptom of decline. This problem is not unique to Islamic historiography: it surfaces in discussions of the decline of Greek science and is implicit in the stereotypical image of the Latin Middle Ages as an era of perpetual stagnation (commentaries as far as the eye can see).

Scholars who work on commentaries will easily agree with Saliba that the genre was in fact a leading medium for the production of new ideas, and played a role analogous to that of specialized periodical

literature today. One could extend this fruitful insight by noting that to write a commentary or a super-commentary on a specialized text is in effect to appeal directly to the specialized audience interested in the original text. Saliba's insights into the commentary suggest that his definition of decline may require revision. Despite its *prima facie* plausibility, it undersells the consumption of scientific ideas, a rubric that arguably encompasses both translation movements and education. It is hard to see how a high consumption of the best such ideas, even in the absence of much new production, could constitute an unalloyed scientific decline.

At the end of his last chapter, Saliba turns to the problem of modernity and the role of science in it. He notes that the discovery of the New World coincides with the division of the Muslim world into three empires (Ottoman, Safavid, and Mughal), events which, he argues, rerouted trade to the west, thereby gradually cutting out the Islamic world and setting it on the path of economic decline. Europe, in contrast, pulled in new wealth, drew on slave labor, and thrived economically. For Saliba, it is not a coincidence that royal and princely houses channeled some of this wealth into new institutions—scientific academies and societies—that he sees as responsible for the Scientific Revolution (note, however, that the Royal Society was royal only in name, not in munificence). In short, Saliba advances the grand thesis that

> the major scientific developments in Europe during the 16th and 17th centuries were the product of this dynamic cycle of wealth, mostly initiated by the 'discovery' of the New World. [253]

Overall, Saliba's book is certain to be an influential one, whether it conjures up support, opposition, or—more likely—a complex blend of the two. While it offers vast prospects on more than eight centuries of astronomy in Islamic civilization, it also advances bold explanations for these developments. Saliba deserves our gratitude for raising to a new level the debates about this central episode in world history.

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