Introduction: Astronomy, Empire, and Islamic Authority at the End of Days

In the town of Zagazig, in the eastern Nile Delta, a schoolteacher named Shaykh Mustafa Muhammad al-Shafiʿi brought good news to readers of his almanac for the year 1899: humanity would survive the middle of November. A need for existential reassurance had originated in Vienna, where the controversial geologist and science popularizer Rudolf Falb had predicted that a comet would demolish the earth on 13 November.[1] Journalists and astronomers from England to Russia debated Falb's prediction, their attitudes varying from frenzied alarm to dismissive condescension, as imminent doom became a matter of discussion in many parts of the world.[2] In Cairo, the daily newspaper *al-Muʾayyad* published a series of articles, beginning on 28 October, in which Shafiʿi elaborated on the errors underlying Falb's prediction.[3] The satirical journal *Himarat Munyati* chimed in the following week, also debunking Falb.[4] For many in Egypt, however, definitive relief came only on 15 November, when astronomers at the state observatory in Cairo gave the all-clear.[5]

[1] Falb later revised his prediction, claiming that the earth would merely pass through the comet's tail, which might flush the atmosphere with poisonous gases. See "The Menacing Comet," *Fortnightly Review* 66, November 1899, p. 769. On the debate over Falb's theory of subterranean lava tides in the history of seismology, see Deborah Coen, *The Earthquake Observers* (Chicago: University of Chicago Press, 2013), 53–55. For Falb's life, see H.G. Heller, *Rudolf Falb: Eine Lebens- und Charakterskizze nach persönlichen Erinnerungen* (Berlin: Friedrich Gottheiner, 1903).

[2] On Falb's prediction in Polish and Russian pamphlets, see Ekaterina Melnikova, "Eschatological Expectations at the Turn of the Nineteenth-Twentieth Centuries: The End of the World is [Not] Nigh?" *Forum for Anthropology and Culture* 1 (2004), 261. For reactions (mostly satirical) in the British press, see "Biela's Comet and I," *Fun*, 7 November 1899, p. 147; "When the End of the World Is Nigh," *Review of Reviews*, March 1894, p. 260; and "Old and New Astronomy," *Quarterly Review* 188, no. 375 (July 1898), 138.

[3] See *al-Muʾayyad* nos. 2901–2905, beginning on 23 Jumada II, 1317 (28 October 1899). Though I have not been able to locate an original copy of Shafiʿi's almanac, the relevant entry is preserved in a contemporaneous manuscript: see Mustafa Muhammad al-Shafiʿi, *Risala fi dhawat al-adhnab wa-takhtiʾat man zaʿm fanaʾ al-ʿalam bi-istidam al-ard bi-najm dhi dhanab*, MS TR 82, ENL, f. 2.

[4] "Al-Najma dhat al-dhanab," *Himarat Munyati* 2, no. 37 (3 Rajab 1317).

[5] See *al-Ahram*, 14 November 1899 and 15 November 1899.

Even as consensus emerged on the fallacy of Falb's prediction, the comet scare's broader significance for Egypt became a matter of debate. For Mustafa al-Shafiʿi, refuting Falb offered an opportunity to promote a specifically Islamic understanding of the relationship between celestial motion and the end of days, which he argued would not occur for another 200,104 years.[6] By contrast, for the Anglophile publishers of another Cairo daily, *al-Muqattam,* Egyptians' alarm illustrated their society's need for a new type of "education and culture," which would uproot the tenacious hold of "fabulous tales" on unenlightened minds.[7] Meanwhile, shortly after Shafiʿi's articles appeared in print, an anonymous writer transcribed them into a handwritten compilation of Arabic texts entitled *A Treatise on Comets, and on disproving whoever claims that the world will be destroyed by collision of the earth with a comet.*[8] In addition to Shafiʿi's articles (now a single "treatise"), the seventy-folio manuscript includes excerpts from several other Arabic newspapers and a number of Islamic historical works.[9] The manuscript ends with "the verses regarding the destruction of the world" (*al-āyāt fī kharāb al-ʿālam*), a series of Qur'anic statements that describe cataclysmic celestial events.

Comet Tempel did not strike the earth, but debate over Falb's prediction coincided with a period of upheaval in the relationship between science, the state, and Islam in Egypt. At the opening of the nineteenth century, astronomy had been deeply embedded in a broader culture of Islamic learning, practiced within certain circles of ʿulamaʾ: scholars of Islam who interested themselves in the workings of celestial motion alongside the study of Prophetic reports (hadith), jurisprudence (*fiqh*), and Qur'anic exegesis (*tafsīr*). Yet this astronomical knowledge held very limited authority in the ritual practices of most Muslims. By the end of World War I, after a century of Ottoman-Egyptian state-building, British occupation, and anticolonial struggle, astronomy took place largely outside of an Islamic scholarly context, among technically trained

[6] Shafiʿi believed that the world would end when the plane of the earth's equator coincides with the plane of the earth's orbit around the sun (i.e., when the obliquity of the ecliptic has declined to zero), an idea with deep roots in Islamic eschatological writing. Shafiʿi, *Risala fi dhawat al-adhnab,* f. 26. Compare Khalil ibn Aybak al-Safadi, *al-Ghayth al-musjam fi sharh lamiyyat al-ʿajam* (Beirut: Dar al-Kutub al-ʿIlmiyya, 1975), 414; and ʿAli ibn Abi al-Hazm, *The Theologus Autodidactus of Ibn al-Nafis,* trans. and ed. Max Meyerhof and Joseph Schacht (Oxford: Clarendon, 1968), 71–74.

[7] *Al-Muqattam*, 15 November 1899, p. 1.

[8] Shafiʿi, *Risala fi dhawat al-adhnab*, f. 1. The title may be the work of a later collector or cataloguer.

[9] Shafiʿi, *Risala fi dhawat al-adhnab,* ff. 44–59 and 60–69. Some, but not all, of the historical works were also quoted in Shafiʿi's articles.

bureaucrats who had passed through a new system of civil and military schools, as well as European universities and observatories. At the same time, more and more Muslims turned to astronomy to define the timing of daily prayers, to determine the beginning and end of the sacred month of Ramadan, and even to interpret the Qur'an.

How did new, apparently secular sites of state science come to play an authoritative role in the religious practices of Muslims, while an older knowledge culture – a science produced in Islamic scholarly discourses – was refashioned as an object of historical memory? Astronomy in the nineteenth century was an unusual science in the degree to which it was both crucial, globally, for the governance of imperial states, and vital, in Islamic contexts, for new projects of religious reform.[10] While surveyors timed the passage of stars in order to measure longitude and draw maps, Muslim activists sought to create a more unified *umma* (Muslim community) by using astronomy to define the timing of ritual duties. The history of astronomy in late Ottoman Egypt therefore provides a window onto the relationship between the globalization of science, the building of empire, and the fashioning of Islam in a transformative period for all three. This is a story of practitioners and institutions that were decidedly new, yet which depended upon – and expanded – a tradition of knowledge that had been cultivated by Muslim scholars for a millennium. It is a story in which science and technology became mobile as a result of the global ambition and resources of an empire and a religious tradition rooted firmly outside of Europe. And it is a story that points to a tense but powerful alignment between state-building and religious reform in the late nineteenth and early twentieth centuries. The Ottoman Empire was politically bounded, while the Muslim *umma* knew no such limitations. But imperial authorities and transnational religious activists alike seized upon technical institutions as a means of forging knowledge that could travel. As a result, science came to play a new role in defining the possibilities of both political and religious belonging in the twentieth-century Middle East.

[10] On surveying and empire, see Kapil Raj, *Relocating Modern Science* (Basingstoke: Palgrave Macmillan, 2007), 181–222; Bernard Cohn, *Colonialism and Its Forms of Knowledge* (New York: Oxford University Press, 2004), 7–8, 80–82; D. Graham Burnett, *Masters of All They Surveyed: Exploration, Geography, and a British El Dorado* (Chicago: University of Chicago Press, 2000); Martina Schivaon, "Geodesy and Mapmaking in France and Algeria: between Army Officers and Observatory Scientists," trans. Charlotte Bigg and David Aubin, in *The Heavens on Earth: Observatories and Astronomy in Nineteenth-Century Science and Culture*, ed. David Aubin et al. (Durham, NC: Duke University Press, 2010), 199–224; and Simon Schaffer, "Keeping the Books at Paramatta Observatory," in *Heavens on Earth*, ed. Aubin et al., pp. 118–47.

Recasting Science and Modernity in the Middle East: A Role for 'Ulama'

Historians of the modern Middle East have long recognized a connection between the rise of new sciences and the great sociopolitical transformations of the region in the nineteenth century. In Egypt, new understandings of space, language, and education made the land and its inhabitants colonizable years before British warships opened fire on Alexandria in 1882.[11] Inoculation campaigns, birth and death registries, and the placement of medical officers in police stations enabled new forms of state power, even while breeding their own forms of resistance.[12] Practitioners of the human sciences defined new "subjects of knowledge" (like "population"), giving rise to newly conceived social problems and agendas for solving them.[13] Even the physical environment underwent a sea change, as increasingly ambitious approaches to water and labor management transformed the land.[14] By the beginning of the twentieth century, science animated new social and political elites: from the *vulgarmaterialismus* of the Young Turks, to the medicalizing discourse of the emergent Iranian middle class.[15]

However, perhaps one reason that science appears to have been so disruptive in the nineteenth-century Middle East is that our understanding of its history in this context has been rooted precisely among new social groups, such as French-trained technocrats, missionary-educated science popularizers, and graduates of the civil and military schools.[16] Of course, even these new kinds of actors drew deeply on the resources

[11] Timothy Mitchell, *Colonising Egypt* (Berkeley, CA: University of California Press, 1988).
[12] Khaled Fahmy, *All the Pasha's Men* (Cambridge: Cambridge University Press, 1997); Khaled Fahmy, "Medicine and Power: Towards a Social History of Medicine in Nineteenth-Century Egypt," *Cairo Papers in Social Science* 23, no. 2, ed. Enid Hill (Cairo: AUC Press, 2000), 16–62; see also Liat Kozma, *Policing Egyptian Women: Sex, Law, and Medicine in Khedival Egypt* (Syracuse, NY: Syracuse University Press, 2011).
[13] Omnia El Shakry, *The Great Social Laboratory: Subjects of Knowledge in Colonial and Postcolonial Egypt* (Stanford, CA: Stanford University Press, 2007).
[14] Alan Mikhail, *Nature and Empire in Ottoman Egypt* (Cambridge: Cambridge University Press, 2011). Mikhail argues that these changes began in the late eighteenth century.
[15] M. Şükrü Hanioğlu, "Blueprints for a Future Society: Late Ottoman Materialists on Science, Religion, and Art," in *Late Ottoman Society: The Intellectual Legacy*, ed. Elisabet Özdalga (London: RoutledgeCurzon, 2005), 28–116; Cyrus Schayegh, *Who is Knowledgeable, is Strong: Science, Class, and the Formation of Modern Iranian Society, 1900–1950* (Berkeley, CA: University of California Press, 2009). On technology and revolution, see On Barak, *On Time: Technology and Temporality in Modern Egypt* (Berkeley, CA: University of California Press, 2013), 175–204.
[16] See also M. Alper Yalçınkaya, *Learned Patriots: Debating Science, State, and Society in the Nineteenth-Century Ottoman Empire* (Chicago: University of Chicago Press, 2015); Pascal Crozet, *Les sciences modernes en Égypte: transfert et appropriation, 1805–1902* (Paris: Geuthner, 2008).

of their society's intellectual traditions. Arabic debates over Darwin, for example, reinvigorated Islamic philosophy and natural theology.[17] Yet we know little about the practice of science in the nineteenth century among the old learned elite of Ottoman-Islamic society, the ʿulamaʾ.[18] Despite renewed attention to the role of ʿulamaʾ in shaping modern articulations of law, politics, and piety, the significance of their venerable scientific traditions in this period remains largely unexamined.[19]

Astronomy recasts the narrative of science in the modern Middle East, bringing ʿulamaʾ from the margins toward center stage. In part, astronomy's capacity to tell such a story derives from the distinctive place that astronomy long occupied in Islamic society. Beginning in the eighth century AD (more or less), scholars working under the patronage of the new Islamic Empire developed elaborate, written traditions of mathematical astronomy.[20] Such scholars translated, revised, and built upon Greek, Persian, and Indian sources in order to set the calendar, keep time, predict planetary positions, and make astrological judgments, but also to answer specifically Islamic questions such as the correct timing and direction of prayer and the visibility of the lunar crescent at the beginning and end of Ramadan.[21] Undermining an older narrative of scientific

[17] Marwa Elshakry, *Reading Darwin in Arabic* (Chicago: University of Chicago Press, 2013), especially pp. 131–59.

[18] An important exception is chapter 4 of Crozet, *Sciences modernes*. See also Ekmeleddin İhsanoğlu, "The Introduction of Western Science to the Ottoman World: A Case Study of Modern Astronomy (1660–1860)," in *Science, Technology, and learning in the Ottoman Empire* (Aldershot: Ashgate, 2004). By comparison, on the astronomical exchange between Europe and the Persianate world of the Qajar and late Mughal empires, see David Pingree, "An Astronomer's Progress," *Proceedings of the American Philosophical Society* 143, no. 1 (1999): 73–85; Simon Schaffer, "The Asiatic Enlightenments of British Astronomy," in *The Brokered World: Go-Betweens and Global Intelligence, 1770–1820*, ed. Simon Schaffer et al. (Sagamore Beach: Science History Publications, 2009), 49–104; S.M. Razaullah Ansari, "European Astronomy in Indo-Persian Writings," in *History of Oriental Astronomy*, ed. S.M. Razaullah Ansari (Dordrecht: Kluwer, 2002), 133–44; and Kamran Arjomand, "The Emergence of Scientific Modernity in Iran: Controversies Surrounding Astrology and Modern Astronomy in the Mid-Nineteenth Century," *Iranian Studies* 30, nos. 1–2 (Winter/Spring, 1997): 5–24.

[19] Muhammad Qasim Zaman, *The Ulama in Contemporary Islam: Custodians of Change* (Princeton, NJ: Princeton University Press, 2002); Malika Zeghal, *Gardiens de l'Islam: les oulémas d'Al Azhar dans l'Egypte contemporain* (Paris: Presses de la Fondation nationale des sciences politiques, 1996); Meir Hatina, *ʿUlamaʾ, Politics, and the Public Sphere: An Egyptian Perspective* (Salt Lake City: University of Utah Press, 2010).

[20] For the debate over whether these developments originated under the ʿAbbasids or late Umayyads, see George Saliba, *Islamic Science and the Making of the European Renaissance* (Cambridge, MA: MIT Press, 2007), 1–72; and Dimitri Gutas, *Greek Thought, Arabic Culture* (New York: Routledge, 1998).

[21] E.S. Kennedy, *Studies in the Islamic Exact Sciences*, ed. David King and Mary Helen Kennedy (Beirut: American University of Beirut Press, 1983); George Saliba, *A History of Arabic Astronomy: Planetary Theories during the Golden Age of Islam*

"decline," often attributed to post-twelfth-century religious "orthodoxy" and its putative animosity toward science, historians have shown that astronomy continued to thrive in Muslim societies well beyond its so-called "Golden Age."[22]

In fact, elements of this astronomy remained important and dynamic areas of knowledge for certain ʿulamaʾ in the nineteenth-century Middle East. However, my goal in illuminating their practices, which I call "scholarly astronomy," is not to add one more exhibit to the catalogue of evidence against the decline thesis.[23] Rather, I am interested in the social context of scholarly astronomy in late Ottoman Egypt: the relationships between students, teachers, and patrons; between texts, instruments, and practices; between technical questions and social problems; between astronomy and other areas of scholarship. Such a contextual understanding of scholarly astronomy challenges conventional narratives of modernity in the Middle East in terms of both the degree of continuity and the manner of change. In the first place, the implications of new sciences did not necessarily resonate where older ways of knowing remained intellectually coherent and socially relevant. In the second place, where new techniques did appeal to late Ottoman practitioners of scholarly astronomy, ʿulamaʾ made these techniques usable by adapting them to their own terminology and technical routines. They did so, moreover, with little fanfare. For such scholars, the rise of centers of astronomical knowledge in London and Paris was part of a long history, part classical and part Islamic, in which progress was rooted in continuities of genre (such as the *zīj*, or astronomical handbook), and continuities of practice (especially tabular calculation). These acts of technical and historiographical translation were essential for the introduction of new sciences within centers of Islamic learning, like the al-Azhar mosque in Cairo. But if a necessary characteristic of the "modern" is a perception of rupture with the past, or "epochal change,"[24] even these innovative

(New York: New York University Press, 1994); David A. King, *Astronomy in the Service of Islam* (Aldershot: Ashgate, 1993); David A. King, *In Synchrony with the Heavens: Studies in Astronomical Timekeeping and Instrumentation in Medieval Islam*, 2 vols. (Leiden: Brill, 2004).

[22] For an overview, see Saliba, *Islamic Science*; and Jamil Ragep, "When did Islamic science die (and who cares)?" *Viewpoint: Newsletter of the BSHS* 85 (2008): 1–3. For more detailed studies, see Robert Morrison, *Islam and Science: The Intellectual Career of Nizam al-Din al-Nisaburi* (Abingdon: Routledge, 2007); Ahmad Dallal (ed.), *An Islamic Response to Greek Astronomy* (Leiden: Brill, 1995); and contributions to F. Jamil Ragep et al., eds., *Tradition, Transmission, Transformation* (Leiden: Brill, 1996).

[23] For a recent and powerful example, see Khaled El-Rouayheb, *Relational Syllogisms and the History of Arabic Logic* (Leiden: Brill, 2010).

[24] C.A. Bayly, *The Birth of the Modern World* (Oxford: Blackwell, 2004), 11.

practitioners of scholarly astronomy testify to the tenuousness of any connection between new scientific techniques and "modernity" in late Ottoman Egypt.

In this sense, the history of astronomy contributes to our understanding of the late Ottoman era of "reforms," the *Tanzimat*, which included the centralization of rule in the bureaucracy, the establishment of new schools and legal codes, the elimination of legal differences between Muslim and non-Muslim communities, and constraints on the exercise of arbitrary power. Rather than characterizing this era in terms of straightforward, top-down Westernization beginning with the Rose Chamber Edict of 1839, recent scholarship has pointed to the origins of late Ottoman reform in sociopolitical and even cultural transformations of the eighteenth century. Changes in urban space, literary production, and economic relations were a gradual process in which provincial elites and middling actors played crucial roles.[25] Even in the sciences, where late Ottoman reformers saw themselves quite self-consciously as having much to gain from European ways, Ottoman and Islamic knowledge traditions remained relevant, dynamic, and crucial to the formation of new political and pedagogical institutions.

Science and State in a "Colonized Colonizer"

Powerful as scholarly astronomy remained, its practitioners had to compete with new kinds of astronomers in late Ottoman Egypt. Some of these new astronomers were prolific and famous: men like Mahmud Hamdi and Isma'il Mustafa, who trained in the Observatoire de Paris and eventually served as cabinet ministers.[26] (Adjacent to Cairo's famous Tahrir Square lies Midan al-Falaki, "The Astronomer's Square," which is named for Mahmud Hamdi.) Others toiled in obscurity, but their work had very public ramifications: men like Mahmud Naji, a Survey Department official who produced the government's almanacs in the

[25] On Ottoman cultural change in the eighteenth century, see Dana Sajdi, ed., *Ottoman Tulips, Ottoman Coffee* (London: I.B. Tauris, 2007). For a reinterpretation of the *Tanzimat* and subsequent eras through the history of technology, see Avner Wishnitzer, *Reading Clocks, Alla Turca: Ottoman Temporality and Its Transformation during the Long Nineteenth Century* (Chicago: University of Chicago Press, 2015). On urban space, see Stefan Weber, *Damascus: Ottoman Modernity and Urban Transformation, 1808–1918* (Aarhus: Aarhus University Press, 2009); Jens Hanssen, *Fin de siècle Beirut: The Making of an Ottoman Provincial Capital* (New York: Oxford University Press, 2005); and Keith Watenpaugh, *Being Modern in the Middle East* (Princeton, NJ: Princeton University Press, 2006).

[26] On Mahmud Hamdi's career, see Pascal Crozet, "La Trajectoire d'un scientifique égyptien au XIXe siècle: Mahmud al-Falaki (1815–1885)," in *Entre reforme sociale et mouvement national: Identité et modernization en Égypte* (Cairo: CEDEJ, 1995), 285–309.

early twentieth century. These astronomers not only introduced certain techniques and knowledge into Egypt, but also cultivated a new relationship between science and the state. Their rise must therefore be understood, first, in relation to Egypt's unusual political dynamics in the late Ottoman period: modern science, like the modern state in Egypt, emerged in relation to simultaneous and overlapping projects of empire.

With the evacuation of Napoleon's ill-fated Armée d'Orient in 1801, Egypt fell into several years of political uncertainty, resolved between 1805 and 1811 with Mehmed Ali Pasha's consolidation of power as governor (*vali*) in Cairo. Whereas the occupants of this office in the eighteenth century had typically been in a weak position relative to the local military, economic, and learned elites, Mehmed Ali harbored – and made good on – his own imperial and dynastic ambitions. In the Sudan, the Pasha's conquests in the 1820s introduced a colonial rule that would endure, in various forms and with one substantial interruption, until 1954. In the 1830s, it seemed that a similar fate might be in store for much of the Ottoman lands, as the Pasha sent his forces on an astonishingly successful campaign through the Levant and into the Ottoman heartland. The 1833 Peace of Kütahya granted Mehmed Ali and his son Ibrahim Pasha the governorship of Egypt, Western Arabia (the Hijaz), the Syrian lands, and Crete. As was so often the case in the Ottoman wars of the eighteenth and nineteenth centuries, however, great power politics came to the empire's rescue: after winning new economic concessions from Istanbul, Great Britain forced the Pasha to abandon his conquests outside the Sudan in 1841.[27] In exchange, however, he received a dynastic hold on the governorship of Egypt. The ambitions and outlook of Mehmed Ali's successors varied, beginning with the cautious retrenchment of Abbas Pasha, but they consistently maintained their household's unique legal privileges within the Ottoman state.[28]

As this narrative implies, Egypt during the long nineteenth century is best understood as part of a larger Ottoman sphere, rather than as an independent nation-state. Although Egyptian nationalist historiography has long celebrated Mehmed Ali as "the founder of modern Egypt,"[29] the Pasha, his dynastic successors, and much of the governing

[27] On the Ottoman economic concessions under the treaty of Balta Limanı, see E. Roger Owen, *The Middle East in the World Economy* (London: I.B. Tauris, 1993), 74–75.

[28] Ehud Toledano, *State and Society in Mid-Nineteenth-Century Egypt* (Cambridge: Cambridge University Press, 1990), 12.

[29] Afaf Lutfi al-Sayyid Marsot, *Egypt in the Reign of Muhammad Ali* (Cambridge: Cambridge University Press, 1984); Amin Sami, *Misr wa-l-Nil* (Cairo: Matbaʿat Dar al-Kutub al-Misriyya, 1938); Jamal al-Din al-Shayyal, *Tarikh al-tarjama wa-l-haraka al-thaqafiyya fi ʿasr Muhammad ʿAli* (Cairo: Dar al-Fikr al-ʿArabi, 1951).

elite in the nineteenth century were Turcophones with strong cultural, familial, and political ties to the Ottoman Empire.[30] The expansion of the Ottoman-Egyptian state spurred the growth of indigenous, Arabic-speaking elites, but it was not until the early twentieth century that post-Ottoman national identity became a serious possibility.[31] Even the basic geographic borders of "Egypt" were in flux during this period, meaning we should understand the territory as a category to be contextualized, rather than a predetermined and immutable location.[32] In fact, one of the key contexts for the emergence of a new relationship between astronomy and the Ottoman-Egyptian state was an effort to lend new specificity to "Egypt" as both a geographic and historical entity.

If much was Ottoman about late Ottoman Egypt, however, much was also distinctively Egyptian. In the history of empire, what is particularly striking about Egypt in this period is its location within multiple, nestled imperialisms. The province's political status became further complicated in the 1870s, during the ambitious reign of the viceroy Ismail Pasha (r. 1863–79). Ismail, the first to legally use the title of "Khedive" (having purchased the privilege from the Sultan), revived the experiments in technical education begun under Mehmed Ali, and established a full-fledged system of civil and military schools. He also built up Egypt's railways and steam fleet, and sought to expand his empire in East Africa. New neighborhoods of Cairo were laid out with boulevards, plazas, an opera house, and theater.[33] The Suez Canal, the concession for which Said had granted in 1856, opened in 1869. While the cotton boom of the American Civil War financed some of these projects, by the 1870s the Khedive was deeply in debt to European bondholders, who forced Egypt to accept Anglo-French financial oversight in 1876. But the increasingly

[30] Toledano, *State and Society;* Khaled Fahmy, *Mehmed Ali: From Ottoman Governor to Ruler of Egypt* (Oxford: Oneworld, 2009). The "Ottoman turn" in the historiography of Egypt owes much to work on the eighteenth century, particularly Jane Hathaway, *The Politics of Households in Ottoman Egypt: The Rise of the Qazdağlis* (Cambridge: Cambridge University Press, 1997).

[31] On the emergence of sociopolitical elites outside the state, see Robert Hunter, *Egypt Under the Khedives 1805–1879: From Household Government to Modern Bureaucracy* (Cairo: AUC Press, 1999). For a less dichotomous account, emphasizing the consolidation of power within the household of Mehmed Ali, see Ehud Toledano, "Social and Economic Change in 'The Long Nineteenth Century,'" *Cambridge History of Egypt*, vol. 2, ed. M.W. Daly (Cambridge: Cambridge University Press, 1998), 252–84, especially 256–63. On the debates over post-Ottoman political community, see Israel Gershoni and James P. Jankowski, *Egypt, Islam, and the Arabs: the Search for Egyptian Nationhood, 1900–1930* (New York: Oxford University Press, 1986).

[32] Matthew Ellis, "Between Empire and Nation: the Emergence of Egypt's Libyan Borderland, 1841–1911" (Ph.D. Diss., Princeton University, 2012).

[33] Janet Abu-Lughod, "Tale of Two Cities: The Origins of Modern Cairo," *CSSH* 7 (1965): 429–57; Mitchell, *Colonising Egypt*, pp. 64–68.

close relationship between the viceregal household and European interests stoked resentment among Egypt's other elites, including newly ascendant rural landlords and mid-ranking military officers, as well as certain ʿulamaʾ. These groups came together during the ʿUrabi Revolution (1879–82), which imposed a consultative government on the Khedive Tawfiq Pasha (r. 1879–92).[34] The ʿUrabist project only came to an end with British military intervention in 1882. Justified originally as a limited effort to restore the friendly Khedive and guarantee Egypt's financial obligations to European creditors, the British invasion grew into indefinite occupation, and became a formal protectorate in 1914.

In sum, until the outbreak of World War I, the sovereignty of Istanbul, the Nilotic quasi-empire of the Ottoman-Egyptian dynasty, and the "Veiled Protectorate" of Great Britain existed in one space. Astronomy was entwined in these overlapping histories of empire, or what Eve Troutt Powell has termed the phenomenon of the "colonized colonizer."[35] Thus, late Ottoman Cairo had multiple state observatories, each the project of distinct imperial ambitions. The first, which Mehmed Ali ordered built near the school of engineering and government press in Bulaq in the 1840s, was itself erected on the remains of a French observatory long abandoned by Napoleon's troops.[36] Two decades later, Ismail Pasha had a new observatory built in the tower of an old barracks, inside an enclave of military education at ʿAbbasiyya. Dissatisfied with this facility, British surveyors eventually built a new observatory at Helwan in 1903. It would be a mistake, however, to draw a line between "Egyptian" observatories at Bulaq and ʿAbbasiyya and a "colonial" observatory at Helwan. At each of these sites, astronomers contributed to a common set of empire-building projects – especially surveying, cartography, and time regulation – which sought to link Cairo with other points in both Egypt and Europe.

While state astronomy flourished within the nurturing culture of overlapping empires, it cannot be reduced to the political interests it served. Men like Mahmud Hamdi, Ismaʿil Mustafa, and Mahmud Naji utilized their knowledge, prestige, and access to resources like print, draftsmen, and (literally) armies of assistants, in order to articulate – publicly – new understandings of history, political community, and the performance of religious duties. In concert with European Orientalists, they helped articulate the notion that science in Muslim society, though an important

[34] Juan Cole, *Colonialism and Revolution in the Middle East* (Princeton, NJ: Princeton University Press, 1993).
[35] Eve Troutt Powell, *A Different Shade of Colonialism* (Berkeley, CA: University of California Press, 2003), 6.
[36] On the Bulaq Observatory, see Crozet, *Sciences modernes,* pp. 194–99.