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## Heavenly Numbers: Astronomy and Authority in Early Imperial China

By Christopher Cullen, Oxford University Press. 2017. 426+xiv pages

I would be remiss in reviewing Cullen's new book of [November] 2017 not to mention his new book of [January] 2017 that is meant as its technical counterpart, *Foundations of Celestial Reckoning: Three Ancient Chinese Astronomical Systems* (Routledge), for my review of which see *East Asian Science, Technology, and Medicine* 46 (2018). I would be equally remiss not to mention what will probably be seen in retrospect as its more theoretically-focused and historically posterior counterpart of [August] of the same year: my own *Astral Sciences in Early Imperial China: Observation, Sagehood and the Individual* (Cambridge University Press, 2017). All of these, in a way, go together.

*Heavenly Numbers* is a history of astronomy in the Han dynasty (206 BCE–220 CE) as told from the perspective of individual experts and the political, historical, and social context of their technical contributions to their art—writings, where extant, that one can read in translation in *Foundations of Celestial Reckoning* and the nearly complete set of other sources that Cullen has translated over his long career. His intended audience, and as per p. 4, is historians of science, historians of China, and historians of science in China, to which end he assumes no prior knowledge of either and proceeds in clear language with concise, coherent explanations of the most basic physical phenomena in question and the tools, categories, coordinates, assumptions, stories, and institutions that his subjects brought to bear upon them. Technical details play an important part of this story, one notes, and where they might act to scare off the non-technically minded historian or otherwise encumber the very human story that he has to tell, Cullen outdoes himself in cordoning off the one from the other and in punctually reorienting the reader with summaries and chapter abstracts.

As to approach, Cullen's is, at the surface, almost embarrassingly simple. At the core of his methodology is “the principle of ‘show, don't tell’: instead of telling the reader what people thought on the topic of this book two thousand years ago, I am often able to let the ancient actors' own words speak for them” (p. 4), which translates to an ample use of primary sources in translation and an emphasis throughout on actors' categories, actors' tools, actors' questions, and actors' answers to their own questions. Cullen apologetically reassures the reader that he knows “this book is a narrative history[, and a] narrative is, ultimately, a story that somebody chooses to construct and to tell” (p. 13), but it is hard to say where one could fault the author for taking something radically out of context. Where he imposes his own questions upon his sources, they tend to be good and obvious ones like ‘so, how accurate was this?’ and, more importantly, ‘how accurate did this *need* to be?’ Where he brings in sources from outside of China, he does not limit himself to Greece and the European “West,” nor does he do so to place the two in the sort of East–West dichotomies that have defined our field for most of the twentieth century: he does so, rather—and admirably so—to build parallels and to show how what might seem strange in these pages isn't *so different* from what others' ancestors were doing. Anyway, whatever context we *do* have for the building blocks of his history is on open display in translation in his companion volume for you to judge.

As to structure, Cullen's history follows Lewis Carroll's equally simple dictum that one should “begin at the beginning... and go on till you come to the end: then stop” (p. 10), which is to say that he proceeds chronologically through the period in question. As he does this, however, the expert reader does see his hand shaping the narrative on two additional levels. First, rather than follow a single technical topic from 206 BCE to 220 CE, we hop instead from the highlights of one to those of another, letting one thread go to pick up another. Second, rather than rehash the history of twentieth-century he-said-she-said, Cullen has us file past a series of historical cases carefully chosen to showcase recent breakthroughs in our understanding of the philosophy, sociology, politics, and historiography of science in this period.

Chapter 1 focuses on the period of scripture and mythology, in pre-imperial times (< 221 BCE), and the protagonists of ancient sage kings. Its technical contents introduce the basics and origins of the early civil calendar, in the abstract, and the primary sources at our

disposal. Behind this is the higher-order argument that historical practice has an eye as much to myths and classical models as it does to experience and observation.

Chapter 2 focuses on 221–156 BCE and the person of the anonymous calendar user. Its technical contents introduce the reader to Chinese dates and the early civil calendar as found in concrete, excavated examples. At the sociological level, it shows how what is, on the one end, an elite scientific activity grounded in imperial ideology and ancient mythology extends, at its other end, if I may, into the daily life of the average Zhou.

Chapter 3 focuses on 156–78 BCE and the characters of the immortality-obsessed Emperor Wu (r. 141–87 BCE) and his exasperated lead historian-astronomer Sima Qian (d. 86 BCE). Its technical contents treat the creation of a new *li* “astronomical system,” its testing and government adoption in 104 BCE, excavated evidence of its implementation, the question some three decades later about alternatives amongst the “six astronomical systems of antiquity,” and the question of whether *that question* was not a product of the first-century historical imagination. In so doing, we are confronted with the mix of experts, professionals, non-expert professionals, and non-professional experts constituting the relevant scientific community involved, the mix of cultural and political threads running through the fabric of scientific practice, the openness of the process to official questioning and reappraisal, and evidence of how the story of this famous “calendar reform” depends on the Han-era historian doing the telling.

Chapter 4 focuses on *circa* 30 BCE–10 CE and the polymathic nobleman intellectual titan/hated turncoat Liu Xin (c. 50 BCE–23 CE). Its technical contents cover Liu’s *Santong li* of *circa* 10 CE, the first complete astronomical system procedure text to have come down to us in Chinese history, notably its more-than-just-a-calendar eclipse and planetary models and its integration into Liu’s greater project concerning ancient chronology (*pu*) and the synthesis of astronomy, harmonics, and metrology with *I Ching* numerology. As to context, here again the purity of “science” is put to question, especially as Liu’s served as part of the ideological justification of his political benefactor’s usurpation of the Han throne in 9 CE.

Chapter 5 focuses, at around the same time, on the amateur philosopher and professional waterclock-operator Huan Tan (c. 43 BCE–28 CE) and his friend Yang Xiong (53 BCE–18 CE). Its technical contents cover celestial coordinates, observational instruments, measurement-taking, and the debate about flat- versus spherical-sky cosmology that appears for the first time in the written record in their works. In terms of context and higher-order questions, we are confronted here with an expert dialogue *wholly independent of the state*, the peculiar entanglement of abstract cosmological speculation with the concrete physical instrument meant to measure and/or represent it, and questions of epistemology, argumentation, and how one goes about changing a friend’s mind about the shape and mechanics of his world.

Chapter 6 focuses on 32–139 CE, following the restoration of the Han, and on the figures of Jia Kui (30–101 CE), Huo Rong (fl. 102 CE), and Zhang Heng (78–139 CE). Its technical contents cover a second reform in 85 CE and, following that, said experts’ successive breakthroughs in data analysis, physical explanations, mathematical models, and cosmological and physical constructs concerning eclipses (the ecliptic, the reduction to the equator, lunar inequality, improved solar tables, etc.). Here again, as in the proceeding chapters, we are met with protagonists in very different social and professional positions contributing to a common expert discourse beyond the confines of the state astronomical office, and, perhaps more importantly, we see a conversation that is rapidly *evolving* along a line of questioning.

Chapter 7 focuses on “the age of debates” in 133–175 CE and two experts from the provinces, Lang Yi (fl. 133 CE) and Xiang Kai (fl. 166 CE), and one consummate capital intellectual, Cai Yong (132–192 CE), who took part therein. After introducing the question of how actors dealt with discrepancies between predictions and observations in terms of mathematical modeling and/or omenological interpretation via Lang and Xiang, Cullen follows Cai Yong in 175 CE through the institution of the *yi*—a debate for deciding public policy in a public forum—reflecting, once again, on the mix of actors, values, and epistemologies involved in the practice of contemporary astronomy and how, in a more formal setting, one went about convincing one’s peers that time and space really work the way you say they do.

Chapter 8 turns, lastly, to 175–237 CE and the career and immediate legacy of Liu Hong (c. 130–c. 210 CE), whose ground-breaking model for lunar inequality, latitude, and nodal crossing would go on to revolutionize eclipse prediction. Cullen places Liu’s technical achievements in the context of a rather complex life and transmission network of a figure who is, for most of his career, a man of the provinces, ending on the question of what happens when an omenologically-charged “anomaly” like a solar eclipse becomes fully predictable via mathematical modeling.

In the Epilogue, Cullen concludes with a reflection about how “the Han paradigm” carried on for centuries thereafter in the face of wave after wave of foreign transmission.

As to faults, one might complain that this book is too expensive for the standard introductory work that it is destined to become, but that is out of the author’s control. One could nit-pick about the quality of scanned images, the spacing of Chinese characters, or the irregular formatting of the abstract opening Chapter 8, but *there* no publication is ever perfect. My only real criticism is the scarcity of Asian-language sources that Cullen cites, particularly those written on the history of astronomy proper since the mid-1990s. Completely absent from the bibliography, for example, are Kawahara Hideki’s *monograph*, *Chūgoku no kagaku shisō: ryō Kan tengaku kō* (Sōbunsha, 1996) and the epoch-making ten-book series *Zhongguo tianwen-xue shi daxi* released by China Science and Technology Press in 2008–2009, both of which treat the majority of the sources, subjects, people, institutions, and questions treated here but in significantly greater detail and scope. Going back even earlier, as someone who has written extensively on Liu Hong himself, I also find it rather odd, for example, to find no mention of Chen Meidong’s foundational treatment of Liu’s biography and transmission history in *Ziran kexue shi yanjiu* 5.2 (1986): 129–142. I understand that citation is a matter of personal style, and that Cullen does not want to lard his book with Asian-language references for the sake of the outside reader, but I would have wished that such an excellent introduction to the subject introduce the reader to a little more by way of secondary sources.

The reason for this, to be fair, probably has everything to do with the way that this book was written. Rather than slap together a collected works to cap off a long career and call it done, Cullen has gone to the extraordinary effort of cannibalizing nearly every article and chapter that he published on the history of astronomy between 1981 and 2017—listed in pp. 8–10, n24–29—so as to rework a four-decade publishing record into one seamlessly coherent and up-to-date narrative. Free of the perennial burden of devoting the first ten pages of every thirty-page article to explaining both how the world works and the conceptual apparatus by which the Chinese described it, Cullen is able to develop his earlier work here in exquisite new detail and new directions, *but* those chapters reworked from articles written in the 90s, one notes, happen to be those that most rarely cite relevant secondary scholarship from the last twenty years (e.g. Chapter 3). It’s hard to hold Cullen’s bibliography against him when viewed in this light, and, what is more, one begins to wonder what it matters. If there is a singular virtue that stands out in Cullen’s writing it is the refusal to clutter the picture presented in our sources with arguments for and against the baseless colonialist and/or/as nationalist claims about “the Chinese” that scholars since the nineteenth century seem intent to hash out therewith. If there is one person (other than Henri Maspero [1883–1945]) who can claim to “show, don’t tell” as concerns sources for the history of astronomy in early imperial China, it is Christopher Cullen, and this, now, is the first thing of his that you should read.

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