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# A Sphere unto Itself: the Death and Medieval Framing of the History of Chinese Cosmology

Daniel Patrick Morgan\*

**Abstract:** The history of cosmology in China is something of a dead topic, our interest in “cosmology” having shifted in recent years to divination, political prophecy, and the metaphysics of correlative thought. This paper attempts to reopen the topic to examine how it was closed. What we know about the history of cosmology in first-millennium China derives from three sources: Shen Yue and Li Chunfeng’s respective “heavenly patterns” monographs (5th & 7th cent.) and Gautama Siddhārtha’s *Kaiyuan zhanjing* (729), all of which present that history as a contest of “three schools, one winner” that was settled by the second century. Evidencing a greater plurality of “schools,” I examine how and why each author perpetuated this single reductionist narrative, focusing in particular on the question of why the latter—an Indian-origin expert—is silent on Indian-origin ideas. If the history of “heaven’s form” cosmology is a dead topic, I argue, it is the medieval historian who wanted it so, albeit to end a debate that was very much still alive in his day. As to why the *modern* historian is content to let it lie, I suggest that it is for much the same reason.

**Keywords:** China, India, cosmology, historiography of science, Li Chunfeng

## Chinese Cosmology, a Modern History

Modern histories of early Chinese cosmology inevitably tell the same story. The story goes like this. There were once three “schools” 家. One was clever, one was silly, and one was lost. The earth was flat.<sup>1</sup> The silly one said the sky was flat too, the clever one said that it was a great encompassing sphere, and the lost one said there was no sky, or so we think, because the lost one is lost. Unlike the story of the turtle and the hare, the favorite won the race almost as soon as it began, in the second century,

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<sup>1</sup> The introduction of modern/European astronomy has, since the seventeenth century, inspired some to coax evidence from early Chinese sources to the effect that the idea of a spherical earth was conceived of and then lost to China prior to its (re)importation in the second millennium. It is true that some sources describe the earth as a shape other than “flat” (平)—flat with tapering edges, inclined, etc.—and that others appeal to round objects to describe how the earth floats in water—a yolk, a bladder, etc.—but there is, tellingly, no discussion of antipodes or of objects falling *inwards*, rather than *down*, prior to the second millennium. For early critiques on how this issue has continued in twentieth-century history of science, see Tang (1989) and Jin (1991, 36–41).

before which we have very few sources. The race was over, and everyone was happy, but some lingered to explain the results or to say some nonsense to the contrary. Five centuries later, a Buddhist monk named Yixing 一行 (683–727) pointed out that no one had actually won the race. Everyone was so convinced/disinterested ever after that it was never spoken of again until Catholic monks arrived some eight centuries later.

The competition was one of elegance and compromise, the story goes, between the (clever) “sphere” 渾 and the (silly) “umbrella” 蓋. Spherism posited the sky with a shape intuitive to our experience of the stars rising, setting, surrounding, and rotating around us at a more-or-less constant distance (fig. 1). A sphere not only looked right, it explained things. With the sun as the sole source of light, for example, the disposition of the sun, moon, and earth would explain lunar phases and eclipses. With the sun and moon travelling on a “yellow path” (ecliptic) at an incline from the equator, their changing declinations would explain their changing points or rising, setting, and culmination. The sky, more importantly, was inclined such that the Chinese observer may take his rightful place at the “earth’s center” 地中. Umbrellism, on the other hand, posited heaven and earth to be parallel disks, hats, umbrellas, or (upside-down) plates, one above the other (fig. 2). This is (and was) very unintuitive, and it requires some ingenuity to square with experience. Nothing “enters” 入 (sets), for example, things simply appear to converge with the “earth/horizon” 地 at a distance; and so too does it get dark when the sun gets far enough away. The moon is eclipsed in opposition because, quite simply, yin and yang. Also, rising, setting, and culmination vary because the sun and moon cycle through different orbits like a record needle. Why go to all this trouble? Umbrellism offers several physical advantages over spherism, but those underscored by its proponents come down to metaphysics: it made heaven and earth perfect mirrors of one another, it kept one on high and one on low, and it prevented the sun (: fire) from having to “enter” the world ocean (: water).

Faced with a choice, most thinkers (and *all* experts) preferred, in Liu Zhuo’s 劉卓 (544–610) words, (spherist) “truth duly verified by experience” 真已驗 over (umbrellist) “reasoning” 理 and “arbitrary supposition” 意斷.<sup>2</sup> Even thinkers otherwise steeped in religious and metaphysical thought like Ge Hong 葛洪 (283–343) took extraordinary pains after the fact to observationally refute and rationalize their way around yin-yang, five-agents, and analogical arguments against the sphere.<sup>3</sup> So the sphere was victorious, and so too was it vanquished, for Monk Yixing ultimately dismissed the debate on empirical grounds:

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<sup>2</sup> *Sui shu* 隨書 (ed. Zhonghua shuju), 19.521.

<sup>3</sup> See Ge Hong’s meticulous case against Wang Chong’s 王充 (27–c. 100) umbrellism, also mentioned in Yixing’s citation below, as recorded in *Jin shu* 晉書 (ed. Zhonghua shuju), 11.280–84; tr. Ho (1966, 54–58). On Ge Hong, see Campany (2002).

今誠以為蓋天，則南方之度漸狹；以為渾天，則北方之極浸高。此二者，又渾、蓋之家未能有以通其說也。由是而觀，則王仲任、葛稚川之徒，區區於異同之辨，何益人倫之化哉！

Now, if you sincerely take it as an umbrella heaven, then [how do you explain that] the *du* 度 ( $\approx$  degree)<sup>4</sup> gradually narrows as you go south [?] And if you take it as a sphere heaven, then [how do you explain that] the pole steadily rises as you go north? These two things are what neither the sphere nor umbrella school are as yet able to reconcile with their explanations (說). If you observe/contemplate (觀) [the matter] from this [perspective], then for the disciples of Wang [Chong] 王充 (umbrellism) and Ge [Hong] (spherism), what aid ultimately was their trifling over such distinctions to the betterment of man?!<sup>5</sup>

This, but for differences of nuance and detail, is the version of events that one finds in essentially every piece of modern scholarship on the topic: THREE SCHOOLS, ONE WINNER.<sup>6</sup> It is not a particularly good story in the sense that there is no tension, no build-up, and no surprise; nor is there any character development, if you will, as we care mostly about an idea's true original form, and so the story just stops, multiple times, skipping from the second century to the eighth, and from Han China to Enlightenment Europe. The topic is a dead one, and we have thus buried it under the name “cosmography”, leaving “cosmology” open for scholars to fill with the sort of “analogical” and “correlative” thought (once “primitive” and “magical”) at the center an evolving centuries-old narrative about the strangeness of the oriental mind.<sup>7</sup> Try to speak to a sinolo-

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<sup>4</sup> Definition: the *du* 度 is a linear measure, convertible with terrestrial distances, used in the context of the astral sciences (and that context only) as a pseudo-angle with which to measure along the circumference of any given great circle, and defined as the distance travelled by the mean sun in one day, where the number of *du* in one “circuit of Heaven” depends upon the accepted value in days for the length of the solar year (*sui* 歲). In other words,  $360^\circ \approx 365\frac{1}{4} du$ .

<sup>5</sup> *Jiu Tang shu* 舊唐書 (ed. Zhonghua shuju), 35.1307. For an explanation of Yixing's argument, see Jin (1986).

<sup>6</sup> See for example Forke (1925), Maspero (1929), Needham (1959, 210–27), Nakayama (1969, 24–44), Loewe (1975), Xi & Zheng (1975), and Jin (1991). Important exceptions to my sweeping statement include Cullen (1977), which treats third- to eighth-century cosmology in significant detail, Cullen (1996), which makes a substantial argument for the relationship between cosmologies and observational instrumentation, and Chen (2007, 128–532), which makes a valorous effort to take us beyond the eighth century and the ‘three schools’ framework. The current paper is, needless to say, heavily indebted to these studies.

<sup>7</sup> The “cosmology”/“cosmography” distinction goes back to Cullen (1977), though a clearer explanation of what is meant is found in Cullen (1996, xi n2): “My use of the term ‘cosmography’ rather than ‘cosmology’ is a deliberate distinction. By the first of these terms I mean a description that is mainly concerned with the shape and size of the heavens and the earth, and with the disposition and motions of the heavenly bodies—a cosmic equivalent of geography. By the second term I mean any theory of how the universe works in a more metaphysical sense. In China I would call discussion of Yinyang and Five Phase thinking cosmology in this sense. ... In a case such as Plato's *Timaeus* the cosmographical/cosmological distinction hardly seems to be present in the author's mind at all.” Scholars have since taken up “cosmology” to refer exclusively to such “metaphysics” and to place divination and political prophecy at the center of the

gist today about Plato, let alone Ptolemy (c. 100 – c. 170), and you will likely be told “in China, they practiced a very different kind of cosmology,” followed by something that sounds like Neoplatonism. I think that this is a problem, and this article is a preliminary attempt to address how this problem came about.

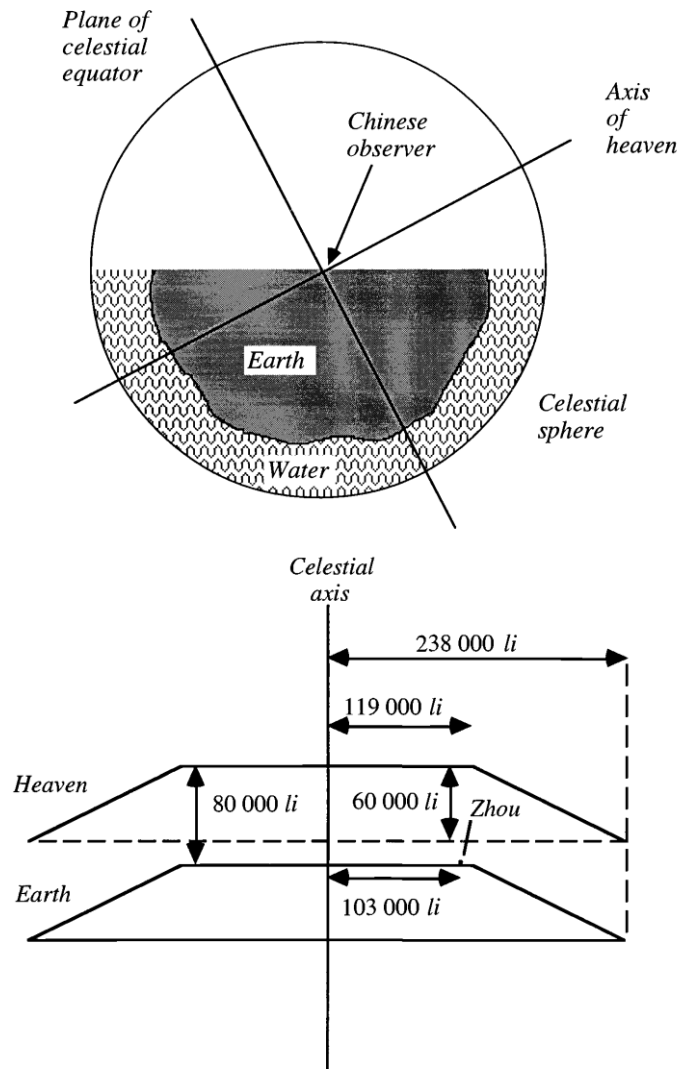


Figure 1 Sphere heaven (above) and Umbrella heaven (below). Source: Cullen (1996), 65, fig. 6; 136, fig. 13.

history of science and the study of “numbers & procedures” (數術) in China. Such, according to a personal communication 13 January 2015, was not Cullen’s original intention.

## Chinese Cosmology, Medieval Modern

If the story of Chinese cosmology/cosmography is not a good one, the modern sinologist is not entirely to blame, because he is retelling a story written twelve centuries ago in a very different context. The near entirety of what survives of this subject, which actors labeled “heaven’s form” (天體) or “discourses on heaven” (天論), comes down to us from four sources. Three of these are histories: the “Heavenly Patterns Monograph” 天文志 of the *Book of Song* 宋書, *Book of Jin* 晉書, and *Book of Sui* 隋書. The other is an omen compendium: the *Kaiyuan zhanjing* 開元占經 (Kaiyuan Era Omen Classic). These sources were compiled by three men. The Liu-Song (420–479) monograph was written by Shen Yue 沈約 (441–513), a Buddhist southern poet, statesman, historian, and omen enthusiast of high birth then serving the Southern Qi 南齊 (479–502). Shen, who does not himself seem to have been an expert on astronomical matters, clarifies that he is “following” 因 the celebrated astronomer He Chengtian’s 何承天 (370–447) now-lost monograph of the period.<sup>8</sup> The Jin (265–420) and Sui (589–618) monographs were written by Li Chunfeng 李淳風 (602–670), a celebrated Daoist polymath deeply involved in every facet of the astral and mathematical sciences.<sup>9</sup> The *Kaiyuan zhanjing*, lastly, was written by Gautama Siddhārtha 瞿曇悉達 (fl. 729),<sup>10</sup> a Chinese-born member of one of the three “Western” lineages that ran the early Tang 唐 (618–907) astronomical office.<sup>11</sup>

Let us speak first of Shen Yue and Li Chunfeng, since they were writing in the same genre. Though their histories are constituted primarily by extensive overlapping citations, drawn from He Chengtian, Shen and Li present these sources to very different ends. Where they did agree was on the point of departure. Both frame their respective histories around Cai Yong’s 蔡邕 classic statement of THREE SCHOOLS, ONE WINNER in 178:

論天體者三家，宣夜之學，絕無師法。周髀術數具存，考驗天狀，多所違失。惟渾天僅得其情，今史官所用候臺銅儀，則其法也。

<sup>8</sup> *Song shu* 宋書 (ed. Zhonghua shuju), 11.205–06. On Shen Yue, his historiography and omenology, see Lippiello (2001).

<sup>9</sup> On Li Chunfeng, see Chen (2003, 350–57).

<sup>10</sup> The name 瞿曇悉達 is composed of a common Sinicized abbreviation of the family name Gautama—瞿曇 (MC \*Kju-dom), also rendered 俱譚 (MC \*KjuH-dom), 具譚 (MC \*GjuH-dom), and 喬答摩 (MC \*Gjew-top-ma)—followed by a common Sinicized abbreviation of the given name Siddhārtha—悉達 (MC \*Sit-dat), also rendered 悉達多 (MC \*Sit-dat-ta), 悉多 (MC \*Sit-ta), and 悉多頽他 (MC \*Sit-ta-at-tha). For the abbreviations 瞿曇 and 悉達, see Hirakawa (1997), items 0482 & 0884. For an example of how Chinese sūtras alternate between these abbreviations in speaking of the Gautama Siddhārtha, the Buddha, see *Fo shuo benxing jijing* 佛說本行集經 (T. no. 190), *passim*. Middle Chinese (MC) reconstructions are those of Jeff Tharsen’s Digital Etymological Dictionary of Old Chinese (<http://edoc.uchicago.edu/>).

<sup>11</sup> On Gautama and the foreign lineage experts at the Tang astronomical office, see Jiang (2001), 246–72, and Lai (2003).

The discourse on heaven's form is comprised of three schools (家), but the study of expansive night (宣夜) has died out and has no master method. Both the procedures and numbers of the *Gnomon of Zhou* 周髀 (umbrella heaven 蓋天) survive, but when examined (考) and verified (驗) against the case of heaven, there is much that misses the mark. It is only sphere heaven (渾天) which completely grasps the true circumstances (情). The observatory bronze sight (armillary sphere) employed by the Clerk's Office (史官) of our day is patterned upon this model (法).<sup>12</sup>

Where they also agreed was that the history of cosmology *after* 178 was mostly marked, in Shen Yue's words, by schools of "curious chatter that missed the mark by some distance" 好異之談，失之遠矣。<sup>13</sup> Neither historian deigns to give us more than a couple sentences on these "schools" 家 or "explanations" 說.

Where Shen Yue and Li Chunfeng go their different ways is in the direction of history and the epistemology implied therein. Shen places the sphere first and attributes its invention to sage kings at the dawn of man; he then argues that *Gnomon of Zhou* umbrellism is a later fabrication and places it with the absurdities of post-178 times, which he saves to criticize at the end. Working from the same sources, Li Chunfeng places *Gnomon of Zhou* umbrellism back in the Zhou 周 (1045–771 BCE) and debunks claims about the antiquity of the sphere as a myth begun in the first century CE and perpetuated by bad historians (i.e. Shen Yue). In the *Book of Sui*, after cutting back to "curious chatter," Li concludes with an account of how spherists progressively solved the problem of apparent solar diameter from the sixth century BCE to the sixth century CE by moving from (1) ignorance to (2) discovery to (3) "reasoning" 理 from anecdotal observation and *finally* to (4) falsification by mathematical proofs and instrument-guided measurement. In other words, Shen Yue assumes a history of knowledge that begins with ancient suprahuman revelation and proceeds by decay, loss, and misdirection, while Li Chunfeng assumes that knowledge is the cumulative work of humans, and, thus, that good knowledge must be "modern" 今/新.<sup>14</sup>

It's easy for an expert like Li Chunfeng to win a debate on astronomy, especially when his opponent is dead; and judging from the frequency of citation by the later textual tradition, Li indeed seems to have won. The reason he won, however, probably had less to do with the vision of knowledge that he used the medium of state history to substantiate but the genius and ruthlessness of his writing strategy: he took *the entirety* of Shen Yue's text on cosmology, reorganized it into an argument against Shen's every claim and filled it out in terms of details and historical scope into *two* bigger and better monographs. That is devilish by today's standards, and the fact that Shen Yue's name alone is excluded in refer-

<sup>12</sup> *Song shu*, 23.673; cf. *Jin shu*, 11.278, and *Sui shu*, 19.505.

<sup>13</sup> *Song shu*, 23.680. For Li Chunfeng's assessment, see Note 47.

<sup>14</sup> For more on the question of "progress" in pre-modern histories of astronomy in China, see Henderson (2006).

ence to Li's historiographic exemplars, inspiration and sources suggests that it was devilish too in his own day.<sup>15</sup>

It is better to be hated than ignored, of course, which is more than can be said for Gautama Siddhārtha, whose *Kaiyuan zhanjing* would have been lost to history were it not for a single copy accidentally rediscovered in a Buddha statue around the turn of the seventeenth century. To be fair, he Gautama was writing in a different genre, which saw different circulation and prohibition, as the case may be, but it is safe to say that his writing was of negligible historical impact until the twentieth century.<sup>16</sup>

The *Kaiyuan zhanjing* opens with two fascicles (卷) on cosmology. This is not unprecedented for a “heavenly patterns” 天文 omen compendium, for Li Chunfeng's own *Yisi zhan* 乙巳占 (Omens of [Year] *Yisi* [645]) begins the same way. In this case, compared to Li's historical monographs, it is clear that the point is simply to tell the reader what he needs to know about the cosmos before he/she gets to omen-reading. In “Part 1: Heaven's Appearance(s)” 天象第一, Li Chunfeng lists eight “schools” but explains that “of these eight schools, sphere heaven is dearest (to the truth), [which is why I] have selected it alone so as to document here” 凡此八家，渾天最親，今獨取之，以載於此。<sup>17</sup> What follows is an extended citation of Zhang Heng's 張衡 (87–140) *Lingxian* 靈憲 (Constitution of the Numina). “Part 2: Heaven's Numbers” 天數第二 then cites and adds to Wang Fan's 王蕃 third-century spherist account of the dimensions of the cosmos, the *Huntian xiang shuo* 渾天象說 (The Sphere Heaven Effigy Explained).<sup>18</sup>

In the *Kaiyuan zhanjing*, Gautama Siddhārtha likewise prioritizes spherism in fascicle 1, “The Ancestry of the Sphere as Heaven's Form” 天體渾宗, which lists extensive citations of primary sources on spherism in chronological order from the first to seventh century. He does this with minimal editorial, but what he does add accords with the Shen-Li historical frame: “the explanations beyond this on [coordinates] & [eclipses] are all the same as Mr. Cai [Yong] and Zhang Heng, thus do [I] abridge” 自外諸說，度次交會，與蔡氏張衡同，故畧云。<sup>19</sup> Fascicle 2, “Discoursing Heaven” 論天, is somewhat harder to penetrate. It begins with a promisingly pluralistic approach:

夫言天體者，蓋非一家也。世之所傳，有渾天，有蓋天。

<sup>15</sup> On the Li Chunfeng's appropriation and dialogue with Shen Yue's history, see Morgan (forthcoming).

<sup>16</sup> On the history of prohibiting “heavenly patterns” 天文 omen literature in China, see Wu (1990) and Lü (2003).

<sup>17</sup> *Yisi zhan* (ed. Shiwan juan lou congshu), 1.1b.

<sup>18</sup> On *The Sphere Heaven Effigy Explained*, see Kalinowski (1990).

<sup>19</sup> *Kaiyuan zhanjing* (ed. Siku quanshu), 1.12b.



Now, those who speak about heaven's form, however, are not all of one school. In what has been passed down through generations one has sphere heaven and one has umbrella heaven.<sup>20</sup>

From there Gautama goes on to cite the spherist sources already found in fascicle 1, but in a different order, and with ellipses, in the middle of which one finds a brief summary and condemnation of the *Gnomon of Zhou* and Zheng Xuan's 鄭玄 (126–200) umbrellism. Near the end, a rather odd ellipse leads us back to his opening statement:

...渾天之義，蓋與此同。云云。餘已見前篇，至與蔡氏張衡同，故略云。

... the meaning of sphere heaven should thus be the same”—and so on and so on—the rest already appears in the prior chapter, up to “are the same as Mr. Cai and Zhang Heng, thus do [I] abridge.”

故曰：言天體非一家也。

And thus do [I] say that “those who speak of heaven's form are not all of one school.”

吳時，廬江王蕃，字興元，為中常侍，善數術，嘗造渾儀及渾天象說云...

In the time of the [Sun-]Wu 孫吳 (222–280), Wang Fan of Lujiang 廬江, who was styled Xingyuan, was a regular palace attendant; he was adept at numbers & techniques and once constructed a sphere instrument (a demonstrational armillary sphere) as well as the *Huntian xiang shuo*, which says...<sup>21</sup>

The point that Gautama is making in “Discoursing Heaven” is clear: there is not only the Zhang Heng, Cai Yong and Wang Fan school of spherism: *there is and always has been a plurality of cosmological theories*. The amount of text that he devotes to this point, and the degree to which he goes above and beyond Li Chunfeng's omen compendium to make it, highlights just how important plurality is to him.

The *Kaiyuan zhanjing*'s pluralism is classic, but it reads odd coming from Gautama Siddhārtha. It is odd because we know the author to have known yet other cosmologies—foreign cosmologies—by the date of its authorship. At the other end of the *Kaiyuan zhanjing*, in rolls 103 & 104, we find the *Jiuzhi li* 九執曆 (“Nine Seizers” or *Navagraha* procedure text), which Gautama, as director of the state astronomical office, translated by imperial decree in 718. The text is in Chinese, and it uses some Chinese coordinates and terminology, but it is otherwise as foreign as Gautama presents it to be in his preface:

臣等謹案：『九執曆』法，梵天所造，五通仙人承習傳授。肇自上古，百（白）博義（又）二月春分朔。

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<sup>20</sup> *Kaiyuan zhanjing*, 2.1a.

<sup>21</sup> *Kaiyuan zhanjing*, 2.7a.

[We] servants [of His Majesty] state humbly: the method of the Nine Seizers system was constructed by Brahma and received, practiced and transmitted by magicians of the five powers. It commences from [a conjunction of] the spring equinox and new moon of [white] *pak[ṣa]*<sup>22</sup> month II, in high antiquity.<sup>23</sup>

Among other things, Gautama’s procedure text presents for the first time in any extant Chinese text the 360-*du* (degree) circle and sexagesimal *fen* 分 (“minute”); the 360-*ri* (*tithi*) year and 30-*ri* (*tithi*) “month”; the zero (written 〇) and other Indian numerals; as well as a sine table (間量命 “Interval Life-counting”),<sup>24</sup> which runs from 0° to 90° in 3°45′ intervals using a very Indian radius of 3438. The contents of Gautama’s procedure text are of clear Indian origin, and Yano Michio’s supplementary remarks in Yabuuti (1979, 10) traces its elements to Varāhamihira’s *Pañcasiddhāntikā* (6th cent.) and Brahmaguṭpa’s *Khaṇḍakhādyaka* (7th cent.).

What do Gautama’s Sanskrit sources have to say about cosmology? Both are fairly explicit about the sphericity of the earth. According to the *Pañcasiddhāntikā*, for example:

*pañcamahābhūtamayas tārāṅapañjare mahīgolaḥ |  
khe ‘yaskāntāntastho loha ivāvasthito vṛttaḥ ||*

XIII,1. The sphere of the earth, which consists of the five elements, stands in the cage of the constellations in the sky like a round piece of iron standing at the end of a loadstone;

*meroḥ samam upari viyaty akṣo vyomasthito dhruvo ‘dho ‘nyaḥ |  
tatra nibaddho marutā pravahena bhrāmyate bhagaṅaḥ ||*

XIII,5. Directly above Meru in the sky is (one) fixed pole, below in the sky is another; bound to these the constellations are turned around by the *pravaha* wind.<sup>25</sup>

And so too does the *Khaṇḍakhādyaka* rely on a spherical earth, like any contemporaneous Sanskrit procedure text, for the calculation of lunar parallax and day-length:

*pañcadaśahīnayuktās carārdhanāḍībhir uttare gole |  
yāmye yuktavihīnā dviṣaṅguṅā rātridinānāḍyāḥ ||*

<sup>22</sup> I thank Bill Mak for explaining to me that 百博义 (义) “hundred *pak[ṣa]*” should be read 百 (白) 博义 (义) “white *pak[ṣa]*,” referring to the *Sanskrit* term for the half-month counting from new moon corresponding to *Chinese* civil calendar conventions.

<sup>23</sup> *Kaiyuan zhanjing*, 104.1a; tr. modified from Yabuuti (1979, 11). Note that, in addition to the *Sanskrit* terminology deployed here, beginning the year and astronomical *yuga* from spring equinox is a convention completely foreign to *Chinese* astronomy, which anchored all cycles instead to the winter solstice.

<sup>24</sup> I thank Yano Michio for explaining to me that “life” (命) here is a translation of *jīva*, a transliteration of the Greek βίος, meaning “[half] chord” or “sine”, which, in *Sanskrit*, is a homophone of the word for “life.”

<sup>25</sup> Tr. Neugebauer & Pingree (1970–1971), vol. 1, 109.

III.3. The number of *ghaṭikās*, etc., in the *caradala* at the observer's station added to and subtracted from 15 *ghaṭikās*, and the results doubled, gives respectively the lengths of the day and night in *ghaṭikās* at that place. This is so, when the sun is in the northern hemisphere. When in the southern hemisphere, the *caradala* in *ghaṭikās*, added to and subtracted from 15 *ghaṭikās*, and the results doubled, gives respectively the lengths of the night and day in *ghaṭikās*.<sup>26</sup>

If pluralism was so important to him, you would think that Gautama might mention these ideas several fascicles earlier, but Gautama was not the only medieval expert complicit in the simplification of the history of cosmology to his day. Shen Yue reduced its history to “three schools,” discarding the “curious chatter” to follow, so as to support his classicist argument for sphere heaven. Li Chunfeng kept the “three schools” frame but inverted the contents of his predecessor's work as an argument for his *progressivist* case for the same. Indeed, *historiography* has been consistent about the THREE SCHOOLS, ONE WINNER frame since the second century CE. When we look at what experts were saying outside of historiography, however, none of them—not even the history-writers—seemed to agree on just how many “schools” there were. In a memorial of 604, Liu Zhuo rails against the existence of “different schools” 異家, listing “three explanations” 三說 and “four heavens” 四天 for a total of “seven distinct varieties of explanation” 七種殊說.<sup>27</sup> In his omen compendium of 645, written around the time of his histories, Li Chunfeng lists “eight schools” (above). In his *Li yi* 曆議 (Opinions on *li* Mathematical Astronomy) of 727, lastly, Monk Yixing mentions “six schools of explanation” 六家之說.<sup>28</sup>

If the battle was won by 178, as everyone insists, why were they still fighting it five centuries later? Who are all these “schools”? More curiously, why does even the “Westerner” fail to mention “Western” theories?<sup>29</sup>

<sup>26</sup> Tr. modified from Chatterjee (1970), vol. 1, 58. The *ghaṭikā* is a unit of sidereal waterclock time, where 60 *ghaṭikās* = 1 day; *caradala* refers to ascensional difference.

<sup>27</sup> *Sui shu*, 19.521.

<sup>28</sup> *Jiu Tang shu*, 31.816.

<sup>29</sup> Note that Yixing does not enumerate his list. Liu Zhuo's list, with reference to Table 1, places sphere (1), umbrella (3) and expansive night (2) under the “three explanations” and “flat” 平 (?), baseboard (4), secure (6) and vault (5) under the “four heavens.” Liu's “flat heaven” may be one and the same as “the square” (7), which Li Chunfeng attributes to Wang Chong, but it may also refer to any number of known or unknown sources, e.g. Zhu Shi's 朱史 (6th cent.) *Ding tian lun* 定天論 (Discourse on Fixed Heaven), recorded in 3 rolls in the *Book of Sui* bibliographic monograph (*Sui shu*, 34.1018) and briefly cited in *Kaiyuan zhanjing*, 1.37a–b. Li Chunfeng's “quadruple heaven” (8), by “Yao Hu” 祆胡, presents us with a bigger problem. The latter term appears nowhere else in the written tradition, so we have no idea of who or what it is. Parallelism would imply that “Yao Hu” is an author. The problem, however, is that *yao* 祆 “bewitching” is not a typical surname, and while *hu* 胡 is well-precedented by a given name, it is also a term used in vague reference to bearded foreigners. It is conceivable, therefore, that Li is attributing “quadruple heaven” to “bewitching bearded

no.	School	Notes
1	渾天 sphere heaven,	that which [I] record here from Zhang Heng's Lingxian;
2	宣夜 expansive night,	which has died out and has no master method;
3	蓋天 umbrella heaven,	recorded in the Gnomon of Zhou;
4	軒天 baseboard heaven,	explained by Yao Xin 姚信 (fl. 3rd cent.);
5	穹天 vault heaven,	dreamt up by Yu Song 虞聳 (fl. c. 265);
6	安天 secure heaven,	described by Yu Xi 虞喜 (fl. 335-342);
7	方天 square heaven,	discoursed by Wang Chong 王充 (27 – c. 100);
8	四天 quadruple Heaven,	sayings attributed to (the?) Yao Hu 祜胡.

Table 1 The ‘eight schools’ of cosmology according to Li Chunfeng’s *Yisi zhan*. Source: *Yisi zhan*, 1.1a-b. Note that this list is comprised of the usual ‘three schools’ (1–3), three “curious chatterers” (4–6), Wang Chong (7), who is here no longer identified with ‘the umbrella’, and an eighth mentioned nowhere else in any other source but referring potentially to a foreign people.

## Of Science and Religion

There is the material here for a joke: Four men write the history of Chinese cosmology, three of which are Buddhist. The modern historian asks “Wait, where’s India in all this?” and the guy named Siddhārtha says, “Hey! We invited *the Daoist*, how much more diversity do you want?”

We get a *very* different Chinese-language narrative about cosmology if we turn to Monk Daoshi’s 道世 encyclopedia *Fayuan zhulin* 法苑珠林 (Forest of Pearls from the Garden of the Dharma, *T.* no. 2122), finished (near the end of Li Chunfeng’s life) in 668. There we are treated to a classical description of Indian-origin religious cosmology. The world, in short, is a flat disk at the center of which lies Mt. Meru 須彌山, and the perimeter of which is established by the “Iron Enclosure Mountains” 鐵圍山 or *Cakravāla*. On the great world ocean between the *Cakravāla* and the eight mountain [ranges] and eight seas surrounding Mt. Meru lie four continents 四洲 in each cardinal direction, humanity occupying the (triangular) southernmost continent—Jambudvīpa 閻浮提, “the Land of Rose Apples.” The sun, moon, planets and stars orbited around Mt. Meru carried by their own accord rather than by the sort of great rotating surface postulated and disputed by men involved in “heavenly patterns” astronomy (fig. 2).<sup>30</sup>

There is nothing new about Daoshi’s treatment of the topic, he is simply excerpting from foundational and long-available sources within the Chinese Buddhist corpus: the *Longer Āgama-sūtra* (*Chang ahan jing* 長阿含經, *T.* no. 1), translated by the Kashmiri Buddhayaśas 佛陀耶舍 and Chinese Zhu Fonian 竺佛念 in 412/13 Chang’an under the proto-

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foreigners,” and that this refers to some Serindian cosmology, but the evidence of this connection is, in my opinion, tenuous.

<sup>30</sup> On Buddhist religious cosmology, see Okada (1997) and Sadakata (1997).

Tibetan rule of the Later Qin 後秦 (384–417), as well as the *Sūtra on the Arising of Worlds* (*Qi shi jing* 起世經, T. no. 24), translated by the Gandhāran Jñānagupta 闍那崛多 in a Chang’an newly under the Chinese rule of the Sui 隋 (581–618).<sup>31</sup> One finds concise descriptions of this world-model in these texts, but it is something that one finds diffuse throughout Buddhist writings, stories, art, architecture and so on, as their very doctrine, practice and experience were intertwined with Mt. Meru cosmology. And the more Chinese that Buddhism became, the more Buddhist the Chinese, elements of this cosmos seeping not only into the politics, festivals, public life, vocabulary and skyline of every city, but into the very indigenous religions marginalized begrudgingly thereby.<sup>32</sup> Ironically, Mt. Meru was in medieval Chang’an enormous and everywhere and yet somehow invisible.

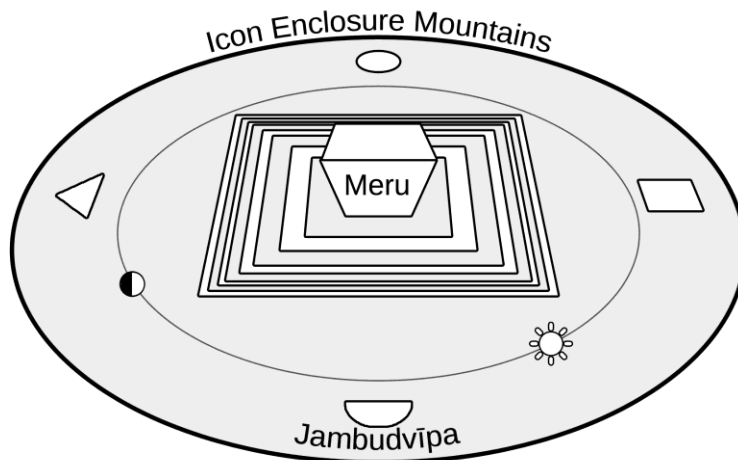


Figure 2 “The Buddhist model,” author’s reimagining.

It might well serve the historian of astronomy to insist on a distinction here between “religious” and “natural” cosmology—between mythic settings and explanations for the stories that give human life spiritual purpose and experiments to save or discredit astronomical, climatological, and optical phenomena. These are different worlds, after all, and if the modern mind is capable of keeping them separate, we might expect no less of the pre-modern mind. The Chinese myth of Pangu 盤古, for example, who hatched from a cosmic egg at the beginning of time to separate yin and yang and heaven and earth from one another has no place in “heaven’s form” cosmology, so why should an invisible mountain separating heavens from hells? Indeed, we only find Mt. Meru in

<sup>31</sup> For a detailed history of Buddhist translation and the flow of ideas and people through China during its confusing middle period, see Zürcher (2007).

<sup>32</sup> On the integration of Buddhism and Buddhist cosmology into Chinese social and religious life in this period, see Teiser (1988).

“heaven’s form” where it is insisted upon by someone absent any sense of the unspoken boundaries between professional categories.

At some point during his 47-year reign, the avidly Buddhist Liang Wudi 梁武帝 (r. 502–549) is said to have summoned the expert mathematician Zu Geng 祖暅 (fl. 504–510) to court to speak about cosmology. Zu delivered a long spherist account of the importance of the observational-inductive and mathematical-deductive approach and the detailed mathematical proof of the failure of both his opponents and predecessors in this regard. “The principals of sphere heaven are credible and have evidence” 渾天之理，信而有徵， he confidently announces to the emperor.<sup>33</sup> The emperor then tells him how it *really* is. Wudi’s model is clearly grounded in Buddhist cosmology: he has “four great seas” 四大海; he has the “Iron Enclosure Mountains” at their edge, which he calls the “Vajra Mountains” 金剛山; he has “Me[ru] Summit” 彌峻 in the north/center; and he has the sun and moon orbiting around a mountainous *axis mundi*. What Liang Wudi adds to this picture is the assertion that heaven is simply “pure & floating *qi*” 清浮之氣, some climatology and the “Black Mountain(s)” 黑山, whose sloping shape (combined with up-down and in-out variations in the sun’s orbit) explain seasonal changes in daylight and solar rise, set, and culmination. Content with his own explanation, the emperor then orders a group of academicians to “go do the math” 算其度數, which they did (sort of), by pulling a list of unrelated numbers from an old text, which we find appended to the written version of this the first and only imperial proclamation on “heaven’s form.”<sup>34</sup> Zu Geng, needless to say, had nothing more to add.

This was an abuse of power and of academic propriety, and the way that later scholars present the mater speaks volumes to their contempt. Mostly, that is to say, no one ever spoke about it again. Shen Yue has nothing to say, but he, of course, had finished the *Book of Song* for the prior court. Li Chunfeng, who must deal with the episode in the *Book of Sui*, places it under the rubric “umbrella heaven” and gives it all of 32 characters:

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<sup>33</sup> *Sui shu*, 19.511; cf. *Kaiyuan zhanjing*, 1.29a.

<sup>34</sup> That the extant fragments of Zu Geng and Liang Wudi’s cosmology derive from a single early sixth-century oral exchange is not something that subsequent historians make particularly explicit, but it can be pieced together from clues. First, Li Chunfeng identifies Liang Wudi as having publicized his cosmology in a “speech at the Hall of Eternal Spring” 長春殿講義 (see block quote in next paragraph). Second, we know from repeated mention in sources like imperial annals that the Hall of Eternal Spring was a space within the imperial palace at Jiankang 建康 where the southern emperors held audience and banquets. Third, the *Book of Sui* and *Kaiyuan zhanjing* both introduce Zu as “Liang audience attendant Zu Geng” 梁奉朝請祖暅, which would place him in regular attendance at the Hall of Eternal Spring (*Sui shu*, 19.514; *Kaiyuan zhanjing*, 1.29a). Fourth, the *Kaiyuan zhanjing* introduces Liang Wudi’s speech immediately after Zu’s with, simply, “Liang Wudi said” 梁武帝云 (*Kaiyuan zhanjing*, 1.33a). For more on this point, see Note 36. On Liang Wudi’s cosmology, see Yamada (1975), Cullen (1977, 364–72), Jiang (2001), 229–33, Chen (2007, 169–76) and Yuan & Qu (2008).

逮梁武帝於長春殿講義，別擬天體，全同周髀之文，蓋立新意，以排渾天之論而已。

And then [we] come to Liang Wudi's speech at the Hall of Eternal Spring: [he] dreamt up his own heaven's form (cosmology), which was completely the same as the text of the *Gnomon of Zhou*, for the sole purpose, probably, of establishing [some] fresh idea to dismiss the discourse on sphere heaven.<sup>35</sup>

It is a miracle that Liang Wudi's speech is extant: it is recorded only in the *Kaiyuan zhanjing*, where it was nearly lost, and it is recorded there only by fluke of context, as an appendix to Zu Geng's speech (which speaks to Gautama Siddhārtha's opinion about its legitimacy).<sup>36</sup> Were it not for all this, we would have only Li Chunfeng's word to go on.

If Li Chunfeng's approach to Shen Yue's writing be any indicator, it is probably better that we do not take him at his word. Simple comparison reveals that Wudi's speech is *not at all* "completely the same as the text of the *Gnomon of Zhou*." As for their *ideas*, there is a certain amount of overlap between the two, but so too is there between statements of spherism and umbrellism.<sup>37</sup> Where Liang Wudi is "umbrellist" is that he posits a world mountain and a single celestial pole; that, however is where any resemblance ends. As to 'heaven's form', the emperor tells us there is none.

Whatever its grounds, Li's identification of Wudi with *Gnomon of Zhou* umbrella heaven clearly succeeded in the long term, because we see it repeated throughout scholastic discourse to our day.<sup>38</sup> What is strange and noteworthy here is that, prior to Li's involvement with the *Book of Sui* project in 641, we actually see a parallel *monastic discourse* appear in commentary to the *Mahāparinirvāṇa-sūtra* (*Daban niepan jing* 大般涅槃經, T. no. 7). Where the sūtra arrives at a description of the moon, Guanding's 灌頂 (561–632) Sui commentary supplies brief descriptions of our 'three schools' followed by extended citations from the

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<sup>35</sup> *Sui shu*, 19.507.

<sup>36</sup> Gautama's placement of Liang Wudi's speech is odd in several respects. First, it clearly does not belong by itself in a roll titled "The Ancestry of the Sphere as Heaven's Form" and otherwise completely devoted to excerpts of sphere heaven writings. Second, the Siku quanshu edition of the text does not place a paragraph break between Zu Geng and Wudi's presentations, as it typically does when moving from one written source to another, nor does it introduce the latter with any more than "Liang Wudi said"—all of which suggest that the two constituted a *dialogue* within a single source to the compiler (see Note 34).

<sup>37</sup> There is perhaps no better example of the confusion in even experts' minds between the two "schools" than the case of Wang Fan's work, treated in Kalinowski (1990).

<sup>38</sup> We find Li Chunfeng's identification repeated word-for-word, for example, in Zhang Ruyi's 章如愚 (fl. 1198) reference work *Qunshu kaosuo* 羣書考索 (ed. Siku quanshu), 56.10b, and Wang Yinglin's 王應麟 (1223–96) encyclopedia *Yuhai* 玉海 (ed. Siku quanshu), 2.50b–51a, and modern scholars continue to speak about it in terms of the *Gnomon of Zhou*, e.g. Yamada (1975), Cullen (1977), 360–74, Jiang (2001), 212–46, and Yuan & Qu (2008).

*Longer Āgama and Arising of Worlds*. His description of the *Gnomon of Zhou* is as follows:

『周髀』者，是周公問殷齊論天地義，云：天如圓織，邊下中高，為「蓋天」義。日月橫行，同於佛法。

As to the *Gnomon of Zhou*, it [recounts how] the Duke of Zhou 周公 asked the Yin 殷 (the remnants of the former dynasty) for a level discourse on the meaning of heaven & earth. It states that heaven is like a round parasol—low at the rim, high at the center—thus the meaning of “umbrella heaven.” The sun & moon travel in *heng* 橫 (concentric tracks); this is the same as the Buddhist model.<sup>39</sup>

Guanding’s identification of umbrellist and Buddhist cosmology is carried down in subsequent editions and subcommentaries, earning a permanent place in the hermeneutics of this important sūtra.<sup>40</sup> Though they probably had a difference of opinions as to *why*, in the early seventh century, the fourth patriarch of Tiantai 天台 Buddhism and the premier Daoist mathematician of the day could at least both agree that “the Buddhist model” and the *Gnomon of Zhou* belonged to the same category. The patriarch, one imagines, is appealing to antiquity, grounding Buddhist doctrine in age-old scholastic and scientific tradition; and this—the dustbin of history—is where Li, the modernist, is content to leave it.

It is perhaps *Gautama*’s disregard of the “Buddhist model” that is the more striking, but here he is well within the norms of the Sanskrit tradition. Consider for example the following lines from Bhāskara’s 629 commentary to *Āryabhaṭīya* 3.12:

*anye punaḥ sugatamatāvalambinaḥ sūryocandramasor ekāṃ kakṣyām ācakṣate |*

Others who cling to the thoughts of Buddha (*sugata*) tell that there is one orbit for the sun and moon:

*ardhena meroś candrārkaḥ pañcāśatsaikayojanau |*

*ardharātro ’stagamanaṃ madhyāhna udayaḥ sakṛd || iti |*

“Halfway up Mt. Meru is the moon and the sun, having [a radius] of fifty and [fifty]-one *yojanas* [respectively]. Midnight, sunset, midday, and sunrise [occur] at once [at the four islands]” (*Abhidharmakośabhāṣya* 3.66).<sup>41</sup>

*naivam yujyate |*

This is not appropriate.

*yadi pañcāśad yojanāni candraḥ, ekapañcāśad yojanāni sūryas tadā kim iti sūryo na mahān upalabhyate, tulyāv etāv ardhoditāv ardhāstamitau paurṇamāsyām lakṣyete?*

<sup>39</sup> *Daban niepan jing shu* 大般涅槃經疏, T. no. 1767, 12:112a19–20.

<sup>40</sup> See, for example, Zhiyuan’s 智圓 (976–1022) *Niepan jing shu sande zhigui* 涅槃經疏三德指歸, X. no. 662, 9:462a21–b01.

<sup>41</sup> Citing *Abhidharmakośabhāṣya* 3.66.



If the moon were fifty *yojanas* and the sun fifty-one *yojanas*, then why is that the sun is not perceived as large, [and that] these two, half rising and half sinking on a full-moon day, appear equal? ...

*anyac ca tulyakakṣyāvyaavasthitatvāt sūryācandramasoḥ sūryagrahaṇaṃ naiva syāt |*

Moreover, due to the sun and moon being fixed on the same orbit, a solar eclipse would never exist.<sup>42</sup>

*Jyotiḥśāstra*, as Minkowski (2002) explains, paid little credence to flat-earth religious cosmology because, in the context of mathematical astronomy, it was the borrowed Aristotelian world of epicycles and concentric spheres that made geometric and physical sense—it is what allowed them to compute things like daylight hours and lunar parallax for any given location. *That*, in 629, in Guanding and Li Chunfeng’s respective lifetimes, is what was “appropriate.” It is not surprising to see Guanding adduce the *Abhidharmakośabhāṣya*, contradicting the idea that “the Buddhist model” has “the sun & moon travel in *heng*,” but why, one century later, does Gautama Siddhārtha fail to present the “appropriate” alternative?<sup>43</sup>

Maybe it *is* there, the Aristotelian cosmos, like “the Buddhist model,” having been lumped into an existing category as a Western instantiation thereof. If “the Buddhist model” suggests itself as “umbrella heaven,” why not “sphere heaven” for the *golas*? Maybe the centuries-old historiographic frame of THREE SCHOOLS, ONE WINNER was simply too rigid to admit any new ideas. Opening the door to one theory, one might argue, would open the floodgates to all sorts of “curious chatter” and antiquarian nonsense. Or maybe the ideologues of the capital would not hear yet another cosmology that would question their place at “the earth’s center”—that, after all, was as much the focus of the sphere-umbrella debate as any astronomical reality.<sup>44</sup> Whatever the reason that we find no discussion of a round earth or epicycles in the cosmopolitan eighth-century intellectual culture of Chang’an, it is, at least for Gautama Siddhārtha, a willful act of omission. Maybe there’s no room in “heaven’s form,” but Gautama scrubs even *jyotiḥśāstra* clean of *golas*, latitude, and “hemispheres” in his translation of the *Navagraha* system—clean to the point that “the effect of the moon’s parallax upon a solar eclipse is not fully discussed” (Yabuuti 1979, 43). This is the one concession this procedure text makes to *li* 曆 mathematical astronomy, which, as a whole, has no interest in calculating things for *any given location*; there is but *one* loca-

<sup>42</sup> Shukla (1976), 212; tr. Hirose (2012), 45–46, and rendered kindly into English in a personal communication of February 13, 2016.

<sup>43</sup> While absent in the Chinese translation of the *Abhidharmakośabhāṣya* (*Apidamo jushe lun* 阿毗達磨俱舍論 [T. no. 1558]), Guanding cites a parallel passage from the *Longer Āgama* and *Arising of Worlds* in *Daban niepan jing shu*, T. no. 1767, 12:112a24–26.

<sup>44</sup> For the problem posed by “the Buddhist model” in this regard, see Jiang (2001), 249–50.

tion—one city, at “the earth’s center”—and as much as that city may have benefited from a model for lunar parallax, the implications for its place in the cosmos may have given him pause.<sup>45</sup>

## Conclusion

Chinese cosmology, in the sense used here, lies dead and discarded as a topic of discussion: “the conceptual crisis... was long over,” Sivin (1986, 159) tells us, “and a disinterest in cosmology was the norm among astronomers.” Having washed our hands of this dreadfully boring story, we have since shifted our focus to the “correlative cosmology” of early divination and political prophecy. Affirming the popular opinion that the latter—post-1970 “Chinese cosmology”—is “a primordial and quintessential expression of the ‘Chinese mind’... a mode of thought which in its basic principle corresponds closely to what Lévi-Strauss has described as the primitive ‘science of the concrete’,” Schwartz (1985, 351), for example, offers us the following conundrum:

The crucial categories associated with correlative cosmology—the concept of yin and yang, the five element categories, and others—will remain a universally accepted language for talking about nature and about many aspects of human life. They penetrate deeply into the popular culture and dominate the language of medicine, geomancy, and other accepted “sciences” without major challenge. One is thus again tempted to ask why the Chinese did not with some minor exceptions conceive of alternate categories for understanding the structure of the natural world. One would have to reply again that their basic concerns may have lain elsewhere (Schwartz 1985, 381–82).

Perhaps this makes for the better story than “sphere vs. umbrella”—the Chinese mind, pure, harmonious, and mystical, living in a bubble of world every bit as static and self-contained as the sphere-world dreamt up by the intelligentsia of its ancient Yellow River capitals. To sustain it, of course, we must quarantine the sort of thought(s) that one sees in contemporary mathematics, astronomy, law, administration, engineering, metrology, sports, economics, warfare, *materia medica*, forensic medicine, and most of the rest of the written record, and we must remember that “heaven’s form,” in particular, has no business in “cosmology.”<sup>46</sup>

Such is the way that we construct the past—the China—for which we yearn, and such has it always been, for we are little better than our medieval counterparts in this regard. The story of “heaven’s form” is one

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<sup>45</sup> On lunar parallax in later Chinese eclipse prediction, see Qu (2008), 390–531, and Sivin (2009), 497–516.

<sup>46</sup> Note that major studies since at least Graham (1986) do try to square this new “cosmology” with correlative thought as it appears equally in other civilizations. Against a monolithic reading of yin-yang and the five agents/phases as the *sine qua non* of East Asian thought and science, see Henderson (1984) and Harper (1999).

written by a small handful of men in medieval times: Gautama Siddhārtha, Li Chunfeng, and He Chengtian and Cai Yong, before them. That story, which we continue to tell today, reduces an evolving, centuries-long debate to a formula, a *fait accompli*: THREE SCHOOLS, ONE WINNER. Their reasons for perpetuating this formula were as various and complicated as our own—historical argument, plagiarism, religion, political ideology, and individual philosophy—and so too were their efforts. Once the history of “heaven’s form” had been decided, it too required quarantine, because THREE SCHOOLS, ONE WINNER doesn’t leave a lot of room for expansion. The first to go are, in Li Chunfeng’s words, “whimsical & fantastical opinions that discuss heaven other than by exhausting [the tools of] mathematics” 好奇徇異之說，非極數談天者也。<sup>47</sup> There was no room here for heavens and hells and invisible mountains—no cosmic eggs or titans—and nor are any of these men (or their sources) particularly kind to the antiquarian and yin-yang, five-agents arguments in support of umbrella heaven. Because then, like now, there is no room for “Chinese cosmology” in “Chinese cosmology,” nor for “Western” ideas in “the Chinese mind.”

We might not be able to explain Gautama Siddhārtha’s motivations in all this, but he stands as a stark reminder of all that the writing of such reductionist histories leaves hidden—things as big as the fact that the earth is round. “Cosmology” is an observer’s category, which means that it is a *choice* on our part, and so too is what we do with it. Gautama, at least, leaves us on a note of pluralism; perhaps we, in the twenty-first century, could strive to do better by the Chinese cosmos.

### **Abbreviations**

- T Taishō Tripitaka edition. *Taishō shinshū daizō-kyō* 大正新脩大藏經. Edited by Takakusu Junjirō 高楠順次郎 and Watanabe Kaigoku 渡邊海旭. Tōkyō: Taishō issaikyō kankō-kai, 1924–34.
- X Xuzangjing Tripitaka edition. *Dainippon zoku zōkyō* 大日本續藏經. Edited by Maeda Eun 前田慧雲 and Nakano Tatsue 中野達慧. Kyoto: Zōkyō Shoin, 1905–12.

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<sup>47</sup> *Jin shu*, 11.280; *Sui shu*, 19.508.

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