

Locating true north in ancient China¹

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Abstract. Archaeological discoveries from the Chinese Bronze Age have demonstrated a dominant concern with achieving cardinal orientation that persisted throughout the Xià, Shāng, and Zhōu dynasties (ca. 2000 – 300 BCE). It has long been understood that cardinality is an index of the paradigmatic roles of “the center” and “the four quarters,” both core organizing principles of early Chinese cosmological thinking. Here, however, I focus on a very early practical technique used to identify the location of the pole in the absence of a pole star. This method takes advantage of the unique orientation of the Great Square of Pegasus (known as *Ding* in early China) and offers insight into a fundamental mindset that figured importantly in the formation of early Chinese Civilization.

1. INTRODUCTION

Study of the cosmological significance of the North Pole in ancient Chinese thought suggests that ritual specialists in Bronze Age China, like their earlier counterparts in ancient Egypt, used the circumpolar stars to find true north, a task complicated during the last two millennia BCE by the absence of a comparatively bright star near the pole.² Similarly, archaeological discoveries from the Xià, Shāng, and Zhōu periods show that it had become crucially important to achieve a cardinal orientation of the built environment—walls, palaces, temples, tombs, common burials, and even storage pits give evidence of a preoccupation with N-S axial alignment (Keightley, 2000, 8). There are, of course, nearly ubiquitous methods for achieving cardinality described in the growing literature on cultural astronomy, most involving observations of the sun’s shadow using a gnomon. Variations on these methods documented in Warring States period China (5th – 3rd c. BCE) have been known for some time, but here I wish to focus on recovering a much earlier solution to the problem of using the stars to correctly orient high value structures in the landscape. Until now, researchers

¹ Readers interested in the extended philological discussion and linguistic evidence which has been elided here may wish to consult the longer version of this article (Pankenier 2008).

² Despite this, by the mid-3rd millennium B.C.E. the ancient Egyptians were capable of aligning the great pyramids of Giza on true north with an accuracy of a fraction of a degree (Spence 2000, Rawlings 2001, Belmonte 2001, 2007, Miranda 2007). In 2004, still unaware of Spence’s posited “simultaneous transit” method or the method utilizing the alignment of stars in Ursa Major (Miranda 2007) possibly used by the Egyptians ca - 2500, I proposed that the Chinese employed very similar direct methods to locate the pole (Pankenier 2004).

have overlooked this method, which takes advantage of the unique orientation of the Great Square of Pegasus (known as *Dìng* in pre-Warring States China).

1.1. *Finding inspiration in the sky*

1.1.2. “*When Dìng has just culminated*”

Evidence for this technique designed to achieve precise alignment on the north celestial pole is provided by the ode *Dìng zhī fāng zhōng* in the “Airs of Feng” section of the *Book of Odes* (first half of the 1st millennium BCE). The theme of this ode is how Duke Wén of Wèy carried out the re-building of his destroyed capital:

When [the asterism] *Dìng* had just centered, he started work on the *Chǔ* Palace;
 when he had measured it by the sun, he started work on the *Chǔ* Hall.
 He planted it with hazel and chestnut, with *yì*-tree, *tóng*-tree, catalpa, and lacquer, so that they could fashion zithers.
 He ascended the tell in order to look out over *Chǔ*; he looked out over *Chǔ* and Tang; he measured hills and mounds by their shadow;
 He descended and inspected the mulberry grounds; the tortoise-shell oracle was auspicious, all through it was truly good . . . (Karlgren, 1950)

Pride of place among the activities described is the correct orientation of the main ancestral hall, here called *Chǔ* Palace. Commentators all agree that the time to commence work, *dìng zhī fāng zhōng* (lit. “when *dìng* was just centered”), refers to the moment when the asterism *Dìng* transited the local meridian due south in the evening. In the poem we also read that “when he measured it by the sun,” he started work on the hall. The *Chǔ* Hall is then surveyed from atop a hill, from which the location, presumably on the south-facing slope of an elevation, is gauged by means of shadows.

The earliest commentary (3rd – 2nd c. BCE) on the first of these lines reads as follows:

‘*Dìng*’ is *Yingshì* (lunar lodge #13, Peg). ‘*Fāng zhōng*’ [means] at dusk to rectify (*zhèng* 正) the four directions. ‘*Chǔ gōng*’ is the hall at *Chǔqiū* . . . ‘*Kuí*’ is to measure: to measure sunrise and sunset in order to ascertain east and west. Watching to the south [he] observes *Dìng*, and to the north he aligns on the pole, in order to rectify (正) south and north. (*Shísānjīng zhùshū* 1970, I, 59)

Since the sun and shadows are explicitly mentioned, we can guess at the method: a gnomon was used to measure the sun’s shadow at sunrise and sunset to lay out a proper east-west line. The method is later described in detail in a Warring States period technical manual called *Kao gong ji*, but it has nothing to do with the stars. What then did Máo Hēng’s comment above —“watching to the south [he] observes *Dìng*, and to the north he aligns on the pole, in order to rectify south and north” —refer to? Why not just bisect the E-W line established using the sun? How do you “align on the pole” when there is no pole star? Zhèng Xuán (127-200) expands on the Máo commentary:

‘*Chǔ gōng*’ means the ancestral temple. When asterism *Dìng* culminates on the meridian at dusk it is upright, so that one can use *Yíng*[-*shì*] to construct temples and halls. That is why [*Yíngshì*, a Peg] is called ‘Align the Hall.’ ‘When *Dìng* culminates on the meridian at dusk and is upright,’ means that at the time of Lesser Snow [i.e., 30 days before the solstice]; its [*Dìng*’s] shape and [that of] *Dōngbì* “Eastern Wall” join in rectifying the four directions (*Shisānjīng zhùshū* 1970, I, 59).



Zhèng Xuán has added some important clarification, which will become more meaningful shortly, but for now it is apparent that there is much more of a technical nature going on than meets the eye in this deceptively terse comment.

Figure 1: Asterism *Dìng*, the Great Square of Pegasus (center), due south on the local meridian at Luòyáng, 10 Nov 650 BCE. Note the exact alignment of the meridian and *Dōngbì*, the “Eastern Wall,” defined by Alpheratz – Algenib (*Starry Night Pro 5*).

We have seen from commentary on this ode that the asterism *Dìng* is none other than *Yíngshì*, conventionally known as the 13th of the 28 lunar lodges or nightly abodes of the moon.³ We saw above that *Yíngshì* means

something like “align the hall,” and *yíng* has this meaning in just such contexts in both the *Book of Documents* (early 1st millennium BCE) and the *Book of Odes*. So the asterism’s function is actually embodied in the name *Yíngshì*, which evidently had supplanted the name *Dìng* by Warring States times. The two bright stars of *Yíngshì* on the north and south are β and α Pegasi (*Scheat* and *Markab*), which form the western side of the eye-catching shape known to us as the “Great Square of Pegasus,” the body of the celestial horse. Immediately to the east of *Yíngshì* is *Dōngbì* or “Eastern Wall,” lunar lodge #14, comprising the two stars δ and γ Pegasi (*Alpheratz* [alt. α And] and *Algenib*) which form the eastern side of the square.

Looking at a star chart for the epoch one can see that *Yíngshì* and *Dōngbì* are located on the hour circles through the pole, so that the nearly parallel orientation of

³ The 3rd century BCE glossary of archaic usage, *Ēryǎ*, “*Explaining Heaven*” section, says, “*Yíngshì* is called *Dìng*.” Guō Pú’s (276–324 CE) comment reads: “*Dìng* is zhèng (正) ‘correct’. In building temples and halls all take *Yíngshì*’s culmination [on the meridian] to be straight and true” (*Shisānjīng zhùshū* 1970, vol. 2, 2609). My rendering of zhèng as “true” here is as in “straight and true.”

“Eastern Wall” also implicates *Dōngbì* in the alignment function ascribed to *Yíngshì*, as suggested by Zhèng Xuán in his comments above: “[*Dìng*’s] shape and [that of] *Dōngbì* ‘Eastern Wall’ combine in rectifying the four directions.” The accuracy of Zhèng Xuán’s comment is proven by careful examination of the earliest depiction of the entire scheme of twenty-eight lunar lodges, which appears on the lid of the famous lacquer hamper from the tomb of the Marquis Yī of Zēng, who died in 433 B.C.E. (Sun & Kistemaker 1996, 73, 158). Rather than representing the asterisms using the “dots and bars” method so familiar from later star maps, the relative positions of the lunar lodges are indicated using the actual names of the asterisms written in seal script. But in the case of *Yíngshì* and *Dōngbì*, in lieu of those later conventional names we find instead *Xīyíng* and *Dōngyíng* or “West Delineator” and “East Delineator” (Qiu 1979). So here we have not only proof of the parallelism between the two lodges, but also an indication that in some schemes at least the separation of the ancient asterism *Dìng* into two already occurred sometime before the system of twenty-eight lodges was systematized in the early Warring States period (Luo 1991). Once again, in the glossary *Ēryǎ*, “Heaven Explained,” where *Yíngshì* is defined as *Dìng*, the text goes on to say: “*Zōuzǐ*’s ‘mouth’ is *Yíngshì* and *Dōngbì*.” Now, *Zōuzǐ* is the late Warring States and Han period (206 BCE – 220 CE) designation for the twelfth hour-angle segment of the sky, chronogram *hài*, which comprises lunar lodges *Yíngshì* and *Dōngbì*, and *kǒu* 口 “mouth” in the gloss obviously refers to the Great Square of Pegasus.⁴

1.1.3 *Yíngshì-Dōngbì* as “Heavenly Temple”

In the 4th century BCE narrative history, *Guóyǔ* (Discourses of the States), “Discourses of Zhou” chapter, there is a passage describing how anciently at the beginning of spring, based on observations of natural phenomena, the *Tàishǐ* or Grand Astrologer-Scribe would declare the time was right for the initiation of farming activity (*Sībù bèiyào* 1975, 1.7a). One of the crucial seasonal indications was the culmination at dawn of the asterism known as *Nóngxiáng*, or “Farmer’s Auspice,” a colloquial appellation for lunar lodge #4 *Fáng* (marked by π Sco), in Scorpius: “when Farmer’s Auspice culminates at dawn and the sun and moon are beneath Heaven’s Temple, then the soil’s [*qì*] emerges in pulsations.” Wéi Zhào’s (204–273 CE) comment identifies “Farmer’s Auspice” as lodge *Fáng* in Scorpius, and he glosses “culminates at dawn” as follows: “that is to say, on the day *lìchūn* ‘Beginning of Spring’ (i.e., 45 days after the winter solstice), at dawn [the asterism] is centered on the meridian.” Wéi Zhào then explains the reference to the sun and moon: “‘Heaven’s Temple’ is *Yíngshì* (Align the Hall). In the first month of spring, the sun and moon are both in *Yíngshì*.” A check of the astronomical circumstances for early February in the late Warring States period shows this to be precisely correct—at dawn when lodge *Fang* is due south on the meridian, the sun is in *Yíngshì*, which is, of course, invisible as a result. This is also the

⁴ Guō Pú’s (276–324 CE) comment reads: “The four sides of asterisms *Yíngshì* and *Dōngbì* resemble a *kǒu* ‘mouth’, hence the name” (*Shísānjīng zhùshū* 1970, vol. 2, 2609). The memory of the unitary early history of asterism *Yíngshì-Dōngbì* persisted into the Táng, since the *Kāiyuán zhānjīng* (729; ch. 61) preserves a comment by the Eastern Han astronomer Xī Méng (fl. ca. 100) stating that “the two stars of *Yíngshì* are the west wall, and together with the two stars of *Dōngbì* they combine to form a foursome, their shape an open square resembling a mouth.”

earliest reference to *Yingshi* as a Heavenly Temple.

In *Shiji* (Records of the Grand Scribe; ca. 100 BCE), in the “Treatise on the Heavenly Offices” (*Shiji* 1959, 27:1309), the first alternative appellation given for *Yingshi* is *Qingmiao* “Pure Temple,” an allusion to the Grand Ancestral Temple for sacrifices to Zhou dynasty founder King Wén, whose august solemnity is also celebrated in the ode *Qingmiao* in the *Book of Odes*. Furthermore, in glossing *Yingshi* in *Shiji*, “Treatise on Harmonics and the Pitchpipes,” Sīmā Zhēn (fl. 8th century) says: “[It is] the asterism *Ding*; at *Ding*’s culmination one can build halls, hence it is called *Yingshi*. Its stars have the shape of a hall, so the “Treatise on the Heavenly Offices” makes it the ruler of temples” (*Shiji*, 25:1244). Clearly then, what we have in the two asterisms *Yingshi* and *Dongbi* are the eastern and western walls of a celestial temple, so that prior to the complete elaboration of the scheme of twenty-eight lunar lodges sometime before the late 5th century BCE the ancient Chinese also recognized the quadrilateral in Pegasus as a single asterism. It follows that in the first half of the 1st millennium BCE *Ding* ought to have referred to the Great Square of Pegasus as a whole. It also follows, of course, that there would not have been twenty-eight lodges when the usage *Ding* was current. Hence, the epoch of *Ding* likely marks the *terminus post quem* for the elaboration of 28 lunar lodges, making the full scheme an innovation of the mid-1st millennium BCE.

1.1.3.1 The Alignment Function of Asterism *Ding*

We saw above that the eastern and western walls of *Ding* are typically depicted as two parallel lines comprising two stars apiece. But they share an even more important characteristic in common. If one looks at the meridians in the chart in Figure 1, which reflects the situation in 650 BCE (around the date of the events described in the ode *Ding zhi fang zhong*), it is immediately apparent that the eastern and western walls of the Celestial Temple align perfectly with the meridians converging on the pole, over 70° to the north. Actually, the alignment of *Dongbi*, the eastern wall (i.e., Algenib to Alpheratz), is even more precise than that of *Yingshi* on the west. Calculation shows that in 1105 BCE the alignment of the former would have been exact, the deviation from true north being mere seconds of arc. At most, throughout the Shang and Zhou periods (ca. -1600 to -300) the deviation from true polar alignment of the two stars of the east wall (*Dongbi*) never exceeded about 2’ of arc. In the case of the west wall (*Yingshi*), the deviation did not exceed 13’ of arc, six times as much, but still less than half the moon’s apparent diameter. Such small deviations would probably have been overwhelmed by measurement errors introduced elsewhere in the sighting process, so that, for all intents and purposes, by early Zhōu at the latest (mid-11th c. BCE) the Chinese possessed a technique capable of precisely locating true north in the absence of a bright star at the pole.

Now, the large distance from the Celestial Temple to the pole means that it was not possible to observe the circumpolar sky in the north and the *Ding* asterism in the south at the same time. In addition, the diurnal and annual revolutions of Pegasus also mean that the Celestial Temple would only have been useful for the purpose of aligning on the pole at a particular moment—on transiting the meridian when the two parallel sides of *Ding* would have been perpendicular to the horizon and pointing overhead through the zenith to the pole at one’s back (Fig. 1). At other times of the year when *Ding* was either invisible or oriented at some oblique angle to the horizon, it could not

have served the stated purpose. Here, then, we have the true meaning of Máo Hēng’s obscure comment above:

‘*Dìng*’ is *Yíngshì*; ‘*fāng zhōng*’ [means] at dusk to rectify (正) the four directions . . . Watching to the south [he] observes *Dìng*, and to the north he aligns on the pole, in order to rectify (正) south and north.

Investigation reveals that the optimal time for such alignment observations in late Shang and Western Zhou would have been in early evening in late autumn. The precise date would have varied depending on the time of observation. In mid-November, *Dìng* would have been optimally oriented perpendicular to the horizon at nightfall right after sunset. Various sources confirm that it was in late autumn, after the end of the agricultural season, that this activity would have taken place. Once again, in *Guóyǔ*, “Discourses of Zhou” we read, “When *Yíng* palace is centered [on the meridian], the work of building begins” (*Guóyǔ* 1975, 2:9b). In the 4th century BCE narrative history, *Zuǒzhuàn*, (Duke Zhuāng, 29th year) it says, “as to the work of building, when the Dragon constellation [Vir through Sgr] appears, [farming] labors end, for [the Dragon] alerts to the work [to come]. When the Fire Star [Antares in Scorpius] appears, [the laborers] are set to building. When ‘Water’ culminates at dusk the foundations are built; at winter solstice [the work is] finished” (*Shīsānjīng zhùshū* 1970, II, 1782). Similarly, in the *Springs and Autumns of Master Lǚ* (3rd c. BCE), in the “Monthly Ordinances” chapter concerning the activities appropriate to mid-autumn, it says: “in this month construct inner and outer walls and build capitals and cities” (*Lǚshì chūnqiū xīn jiàozhèng* 1974, VII, 76). We may conclude then that the central axes of structures were preferentially laid out in late-autumn followed by construction during the lull in farming activity prior to winter solstice. Here then we have the full explanation of Máo Hēng’s entire commentary on *Dìng zhī fāng zhōng* as well as Zhèng Xuán’s amplification—implicit in the reference to the culmination of *Dìng* (*Guóyǔ*’s “*Yíng* Palace”) is that asterism’s identity as the prototypical Celestial Temple and its specialized function as an accurate guide for aligning sacred terrestrial structures on the pole. The Celestial Temple’s evening culmination precisely marks the season reserved for laying out walls and temples whose construction is to follow.

1.1.3.2 Discussion

Here and elsewhere (Pankenier 2004) we have traced the evidence of a persistent intentionality—a focus on the heavens, and especially the circumpolar sky—in symbolic representation, figurative language, and applied astronomy. There are innumerable references in classical Chinese literature to the vital necessity of maintaining conformity with the normative patterns of the cosmos. Before this core idea became axiomatic in late Warring States and Han thought, before it appeared in the metaphors of the earliest lyrics, the archaeological record clearly shows this noetic disposition was firmly established as fundamental already by the formative period of Chinese civilization in the early 2nd millennium BCE. The imperative to conform precisely to Heaven from the earliest times made it essential to devise practical methods of achieving that objective. The practice of divination is one modality that exemplifies this impulse. Divising a calendar is another. The accumulation of knowledge about the celestial “landscape” and its application to the orientation of sacred space on the ground

is still another. I have shown that the Bronze Age dynasts were intensely interested in the circumpolar region, and especially in the mysterious pole itself, from the very beginning of Chinese civilization. The alignment method described above, making use of the “Celestial Temple” asterism’s precise alignment on due north, is abundantly well documented beginning in mid-Zhōu dynasty, though it may have been exploited centuries earlier. A final question to consider, therefore, is how early can we trace this focus on *Dìng*, the Great Square of Pegasus, and its special attributes?

Earlier reference was made to the passage (*Guóyǔ* 1975, 2:9b) where the calendrical function of the Farmer’s Auspice (lunar lodge *Fáng* in Scorpius) was mentioned: that is, “when Farmer’s Auspice is ‘right’ on the meridian at dawn, the sun and moon are in the Celestial Temple.” Wéi Zhào’s commentary provides a detailed explication:

”Farmer’s Auspice is asterism *Fáng*. ‘Right’ at dawn means to say, on the day ‘Spring Begins,’ at dawn [*Fáng*] is on the meridian. [*Fáng*] is the harbinger of the agricultural season, so it is called ‘Farmer’s Auspice.’ ‘*Dì*’ is ‘to reach.’ ‘Celestial Temple’ is *Yingshì* (Align the Hall). In the first month of spring, sun and moon are both in *Yingshì*.”

Not only is the astronomy in *Guóyǔ* technically correct, the application of this calendrical maxim in Warring States times is confirmed by the inscription on still another a lacquer box from the tomb of Marquis Yī of Zēng (ca 433 BCE), the same tomb which yielded the famous lacquer hamper with a depiction of the entire scheme of twenty-eight lunar lodges on its lid. This second box bears the inscription: it is *Fang* to which the people sacrifice; when the syzygy (alt. ‘sun’s chronogram’) is at the [intercardinal] node, the ‘Heavenly Quadriga’ begins the year.” “Heavenly Quadriga” is another name for the array of four stars comprising lunar lodge *Fáng* (Wu 2001). The meridian passage near dawn of Farmer’s Auspice or Heavenly Quadriga (and by implication, the new moon marking the Beginning of Spring near the Celestial Temple), would have been serviceable as a harbinger of the arrival of spring throughout the Xià, Shāng, and Zhōu dynasties. Not to be overlooked is the allusion to the location of the sun in *Dìng* (*Yingshì-Dōngbì*) in the first, “regular” or *zhèng* month of the year.

Now, we know that ancient Chinese calendar priests of the Neolithic Táosi culture in Shānxī were observing sunrise daily at least as early as 2,100 BCE (Liu 2005, Pankenier, in press). Needless to say, they and their successors would also have paid attention to the regular sequence of asterisms rising in regular succession just prior to sunrise and after sunset during each month of the year. They could not have failed to notice the correlation of the Cerulean Dragon constellation (and lunar lodge *Fáng* near its center) with the arrival of spring and the all-important initiation of farming activity. No doubt, this is a principal reason why the Dragon came to figure so prominently in myth, iconography, and (as a constellation) as a seasonal indicator in popular astral lore (including the line texts of the very first hexagram *Qiān* in the *Book of Changes*). Ancient skywatchers awaiting sunrise in the 20th century BCE could also not have failed to notice still another dawn phenomenon. Elsewhere (Pankenier 1983-85, 1995) I have described the impressive massings of all five visible planets that are linked chronologically with the founding of the three earliest dynasties, including the earliest and most impressive of these rare phenomena, that of late February, 1953 B.C.E., in the longitude of the star α Peg.

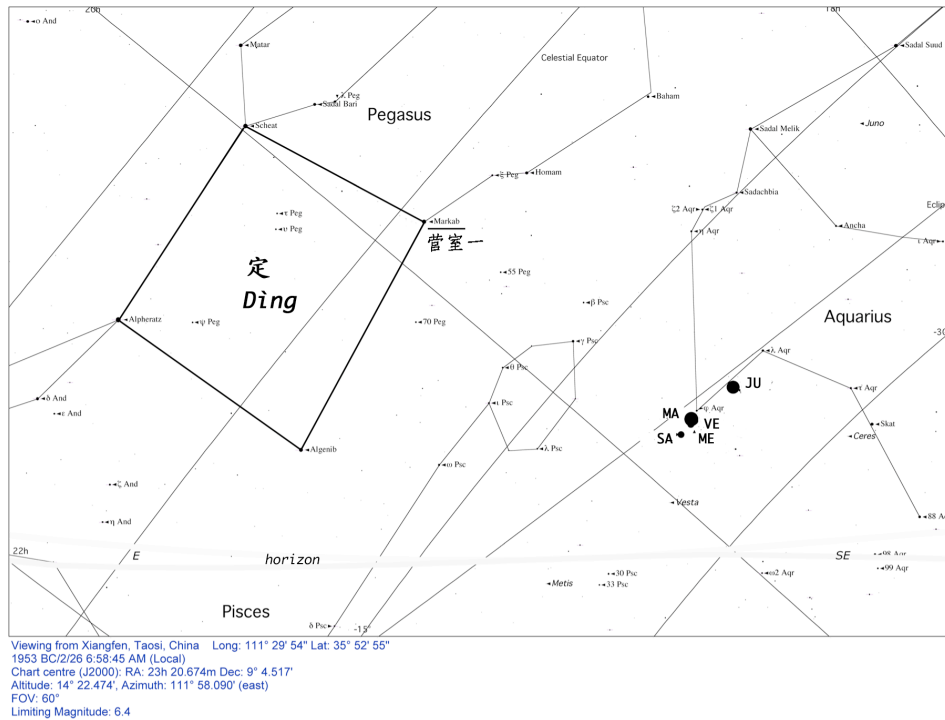


Figure 2: The cluster of the five planets in *Yingshi* near dawn on 26 February 1953 BCE (Mars is obscured by the disk of Venus in this view). Markab, α Peg, is near the center (*Starry Night Pro 5*).

Now, α Peg is none other than Markab, the determinative star of lunar lodge *Yingshi*—the Celestial Temple. Clearly, we have here a persuasive explanation for why the ancients' attention might have been intently focused on asterism *Ding* as early as the 20th century BCE. At the time it would have been understood that it was the “Celestial Thearch” himself who was drawing attention to that highly symbolic structural shape by means of a spectacular celestial revelation. This, together with the fact of *Ding*'s unique alignment pointing directly to the Thearch's heavenly abode, could well explain its subsequent role as the standard in architectural, calendrical, and ritual contexts.

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