

# Chinese records of the northern lights from the mid-10th century BC?

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## abstract

The oldest surviving datable record of a sighting of the polar aurora is currently held to be a Babylonian report for 12-13 March 567 BC. Here it is argued that Chinese observations of a ‘five-coloured light’, a set of nocturnal white rainbows and other ‘luminous emanations’ dating to the mid-10th century BC are earlier impressions of auroral displays. These records have only survived in secondary sources, but their authenticity and auroral import are supported by the scientifically reconstructed parameters of the geomagnetic field for the period in question.

*This article is composed of materials taken from van der Sluijs 2021: 28-29, 35-38, 48, 55-56.<sup>1</sup> Because it offers no new content, it would have been unethical to submit it to a peer-reviewed journal for publication.*

## introduction

Considering that ancient civilisations were far from the polar and subpolar regions, it is little wonder that the earliest attested aurorae all qualify as mid- to low-latitude aurorae, at least in terms of geographical latitude. On current knowledge, the oldest auroral record dated to the day and preserved in a primary source is an entry in the astronomical diary of the Babylonian king Nebuchadnezzar II (c634-c562 BC) that reports a “red glow” (*akukūtu*) to the west for the night of 12-13 March 567 BC.<sup>2</sup> However, Chinese chronicles contain some citations from documents now vanished that are suggestive of even earlier observations of aurorae. These seem to have been overlooked in the literature on auroral physics, with a single exception for only one such case.

## the Bamboo Annals

The primary witness is a collection known as the *Zhúshū Jìnián* (*Bamboo Annals*), which was composed in the late 4th century BC. Although the original text is no longer available in full, scholars pieced together a partial reconstruction from fragments quoted in early, authentic sources. For a clear night (*yè qīng*) in the final year of king Zhāo of the Western Zhōu dynasty (c957 BC), this ‘ancient text’ (*gǔběn*) listed a ‘five-coloured light’ (*wǔ sèguāng*) that passed through Zǐwēi (‘Purple Tenuity’), the circumpolar division of the sky.<sup>3</sup> Only one group of modern researchers appears to have categorised this light as an aurora, though without comment.<sup>4</sup>

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<sup>1</sup> The book is available at <https://www.lulu.com/en/ca/shop/marinus-anthony-van-der-sluijs/on-the-origin-of-myths-in-catastrophic-experience-vol-2-the-earths-aurora/paperback/product-zndv7q.html?page=1&pageSize=4>.

<sup>2</sup> VAT 4956, reverse, 10', trs. Sachs & Hunger 1988: 50-51, accepting Neugebauer & Weidner's (1915: 32, 37, 55; cf. Weidner 1912: 6) emendation of A-ḪA-ḪA-ḪA-TUM to a-kú-kú-(kú)-tum. Cf. Hayakawa et al. 2017: 2; 2016b: 2-5, 6 table 1 #2; Guskova et al. 2010: 333; Silverman 2006: 203; Stephenson et al. 2004: 615; Stephenson & Willis 2002: 421.

<sup>3</sup> *Zhúshū Jìnián* (*gǔběn*), in Lǐ Fǎng (ed.), *Tàipíngyùlǎn* (*Imperial Readings of the Tàipíng Era*; AD 977-983), 674. 4b, and Chén Mèngléi & Jiǎng Tíngxí (eds.), *Gǔjīn Túshū Jíchéng* (*Complete Collection of Illustrations and Writings from the Earliest to Current Times*; AD 1726), 102; cf. Zürcher 2007: 286. On Zǐwēi, see Xu et al. 2000: 10-11.

<sup>4</sup> Xu et al. 2000: 188, translating “multi-colored light”.

The ‘current text’ (*jīnběn*) was a heavily revised edition of the same annals, which was printed in the 16th century AD. This added seasonal information to the passage and changed the phenomenon to a comet (*xīng bèi*): ‘In year 19, in the spring, there was a comet in Zǐwēi.’<sup>5</sup> The researchers just mentioned accorded an equal status to this variant as to the one featuring the ‘five-coloured light’ and even identified the object as Halley’s comet (1P/Halley).<sup>6</sup> More realistically, the variants compete and the philological principle of *lectio difficilior potior* (‘the more difficult reading is the stronger’) suggests that a later editor unfamiliar with aurorae substituted a comet for the original wording.

### the *Zhōushū Yìjì*

The auroral explanation is buttressed by a fuller narration of the same event in another historical compendium now lost, which was cited by the Buddhist monk Tánmózuì in AD 520. For exactly the 8th day of the 4th month in the 24th year of Zhāo’s reign, this account reported flooding, an earthquake and the heavenly display:

In that night a luminous emanation of five colours went through (the constellation) *taiwei* and spread all over the western part (of the sky), which became all blue and red.<sup>7</sup>

One problem is that Zhāo’s rule is now believed to have been limited to about 20 years. Theoretically, this and the other points of difference with the *Zhúshū Jìnián* could again be blamed on imaginative editing, but the additions apply so well to the northern lights that this option beggars belief. More likely, the texts shared a source and the name of the relevant portion of the sky was miscopied in one; *tàiwēi* was composed of parts of the constellations Leo and Virgo.<sup>8</sup>

Tánmózuì followed this up with other citations from the same source, detailing celestial spectacles that occurred in the reign of Zhāo’s successor Mù (d. c920 BC). For that king’s 32nd year (c944 BC), he stated that “several times luminous emanations were visible in the western part (of the sky).”<sup>9</sup> Two decades later (c924 BC), “twelve white rainbows” (*bái hóng shí èr*) would have graced the winter sky towards the west (*xī*):

In the 52nd year of king Mu, in the year *renshen*, on the 15th day of the second month at dawn, a fierce wind suddenly rose, tearing down the houses of men and damaging and breaking trees; the mountains and rivers and the great earth were all moved by an earthquake. After noon the sky was covered with black clouds, and in the West there were twelve white rainbows going from North to South, which even at night did not fade away.<sup>10</sup>

<sup>5</sup> *Zhúshū Jìnián (jīnběn)*; cf. Zürcher 2007: 426 note 1, 427 note 5; Legge 1865: 149.

<sup>6</sup> Xu *et al.* 2000: 110. In Pankenier *et al.* 2008: 12, the authors dated the object to 974 BC and dropped the identification with Halley’s comet, translating “a star became fuzzy in ZIWEI”.

<sup>7</sup> *Zhōushū Yìjì (Supplement to the Zhōu History)*, cited by Tánmózuì in AD 520, according to Fǎlín (AD 572–640), *Pòxié Lùn (Treatise Destroying the Evil)*; AD 622), 478. 2. 6, in Dào xuān (AD 596–667), *Xù Gāosēng Zhuàn (Continued Biographies of Eminent Monks)*, 23. 624. 3. 26; *Guǎng Hóngmíng Jí (Expanded Collection on the Propagation and Clarification)*; AD 664), 1. 100. 3. 10, tr. Zürcher 2007: 273. Compare the citation of this passage from the *Zhōushū Yìjì* in Dào shì (ed.), *Fǎyuàn Zhūlín (Forest of Pearls from the Dharmā Garden)*; AD 668), 12 (5. 14), 378b, tr. Shinohara 2019: 227; C, 1028. 1–2; anonymous, *Zǔtángjí (Anthology of the Patriarchal Hall)*; AD 952), tr. Jorgensen 2005: 98; Gakhun (ed.), *Haedong Goseungjeon (The Lives of Eminent Korean Monks)*; AD 1215), tr. Lee 1969: 20.

<sup>8</sup> Lee 1969: 20 note 15.

<sup>9</sup> as above, tr. Zürcher 2007: 273. The extracts of the *Zhōushū Yìjì* in the *Fǎyuàn Zhūlín* and *Zǔtángjí* omit this statement.

<sup>10</sup> as above, tr. Zürcher 2007: 273. The extract of the *Zhōushū Yìjì* in the *Fǎyuàn Zhūlín* dates this event to Mù’s 53rd year and reduces the heavenly omen to: “To the west twelve rainbows appeared.” (tr. Shinohara 2019: 228) From the *Zǔtángjí*, Jorgensen (2005: 103) translated: “In the west there were twelve white rainbows which coursed across the

No one seems as yet to have linked the celestial glows of Mù's rule to the aurora, but the connection seems almost indisputable, even if the associations with tempest and earthquake would have to have been coincidental. Actual white rainbows exist, to be sure. 'White rainbows' or 'fog bows' form by day when the drops in the air are very small, can be accompanied by one or two supernumerary bows, and – like normal rainbows – can themselves be double. A 'moon rainbow' or 'moon bow' is produced by light reflected from the moon and practically always appears single and colourless on the opposite side of a full moon a few hours before sunrise or after sunset.<sup>11</sup> However, twelve nocturnal 'white rainbows' drifting from north to south can hardly have been anything other than parallel homogeneous auroral arcs rising in succession, at an intensity too weak for the human eye to detect much colour.<sup>12</sup> Although common at high geomagnetic latitudes,<sup>13</sup> such sets of pale arcs can also appear at lower latitudes during strong geomagnetic storms. An example is this observation made at Drexel (Nebraska) between 21.00 and 21.40 on 14 May 1921:

It gradually advanced in a series of great arcs, passing beyond the zenith and toward the southern horizon.<sup>14</sup>

Tánmózui's purpose in citing these entries was to date the Buddha's birth and death by the portents in Zhāo's 24th and Mù's 52nd year.<sup>15</sup> While these synchronisms are almost certainly false, it is essential to note that the celestial marvels themselves were not just Buddhist fantasies. They first appeared in non-Buddhist texts and represent recurrent types of celestial signs in official Chinese, Korean and Japanese literature.<sup>16</sup> If anything, it was rather the appearance of genuine aurorae to the west of China, in the direction of northern India, that Buddhist astrologers centuries later seized upon as a means of determining the Buddha's placement in time.

### **palaeo- and archaeomagnetic support**

Modern reconstructions of the path of the north geomagnetic pole in its secular variation undergird this conclusion, revealing a pronounced southeastern inclination for 1050-550 BC (fig. 1).<sup>17</sup> As for the strength of the geomagnetic dipole, there appears to have been "a broad maximum between 1000 and 3000 years ago".<sup>18</sup> It has been claimed that "magnetic storms can have significantly higher transpolar potentials when the dipole is stronger".<sup>19</sup> As "undeniably a tendency exists for low-latitude auroral displays to be more active as transpolar potential increases", it

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land, and which did not cease throughout the nights." From the *Haedong Goseungjeon*, Lee (1969: 22) translated: "Twelve white rainbows appeared and stayed night after night in the sky."

<sup>11</sup> Minnaert 1954: 183-184, 189-190.

<sup>12</sup> See especially Hayakawa *et al.* 2016a.

<sup>13</sup> *e.g.*, Bone 2007: 87; Falck-Ytter 1999: 16; Petrie 1963: 32-33; Tromholt 1885: 204, 230; Weyprecht 1881: 38-40; 1878: 294-295, 303, 351; 1875: 347; Loomis 1868: 174, 179; von Humboldt 1858: 153-154. Compare van der Sluijs 2019: 360 figure 82.

<sup>14</sup> Herbert L. Choate, in Lyman 1921: 407.

<sup>15</sup> Zürcher 2007: 273-274, 287.

<sup>16</sup> See Schove & Ho 1959: 302 for a Chinese record of a "five-coloured cloud" that appeared "after sunset" on 9 August AD 1069 and is interpreted as an aurora. Historical examples of auroral 'rainbows' from eastern Asia, both white and coloured, are in Xu *et al.* 2000: 191-192, 196, 198-200, 208, 217-218, 225, 233-234.

<sup>17</sup> Korte & Stolze 2016: 169; Nilsson 2011; Nilsson *et al.* 2011: 299, 301, 303-304; 2010: 1, 3, 9 figure 5a, 11; Silverman 2006: 205; Liritzis & Vassiliou 2006: 14, 16-17; Siscoe *et al.* 2002.

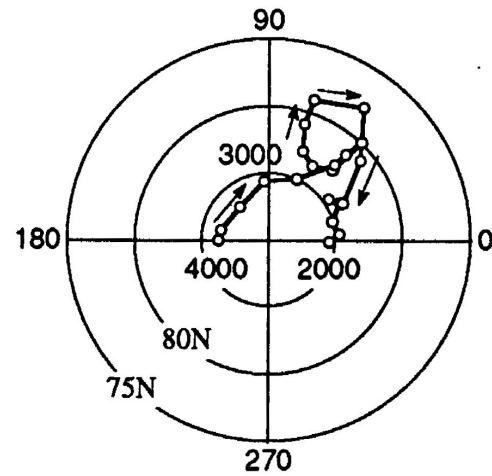
<sup>18</sup> Siscoe & Siebert 2002: 1906; *cf.* Siscoe *et al.* 2002; Dergachev *et al.* 2004: 674 figure 4e; Merrill *et al.* 1996: 129 figure 4.8; Barton 1989: 572; McElhinny & Senanayake 1982: 44 figure 2.

<sup>19</sup> Siscoe & Siebert 2002: 1906; *cf.* Korte & Stolze 2016: 167, 173.

follows that “low-latitude auroral displays might have been more like higher-latitude displays today” at that time.<sup>20</sup>

Consistent with the global findings mentioned above, archaeomagnetic measurements obtained in recent years from Near Eastern sites reveal a strong geomagnetic virtual dipole moment and substantial deviations from the dipole field direction for the early 1st millennium BC. However, the researchers attributed these conditions to a transient local feature of the non-dipole field. They compared this ‘Levantine Iron Age geomagnetic anomaly’ (LIAA) to the presently active South Atlantic anomaly.<sup>21</sup> Other ongoing research indicates that such magnetic anomalies, past or present, can serve as independent auroral foci.<sup>22</sup>

Either way, it seems feasible that aurorae characteristic of higher geomagnetic latitudes could have been repeatedly observed to the west or northwest of China during the mid-10th century BC. If this interpretation be correct, the Chinese records examined above supersede the cited Babylonian passage as the oldest extant witnesses to potentially datable observations of the aurora, exceeding it by almost 400 years but regrettably somewhat harder to date precisely.



1. Secular migration of the north geomagnetic pole from c2050 to 50 BC (4000 to 2000 BP). North-polar projection. Ohno & Hamano 1992: 1717 fig. 2 e; cf. 1993: 1460 fig. 5e.

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<sup>20</sup> Siscoe et al. 2002; cf. Siscoe & Siebert 2002: 1907; Silverman 2006: 205.

<sup>21</sup> Shaar et al. 2017; 2016.

<sup>22</sup> He et al. 2021; 2020.

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