The Chinese comet observation in AD 773 January

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The strong 14C increase in the year AD 774/5 detected in one German and two Japanese trees was recently suggested to have been caused by an impact of a comet onto Earth and a deposition of large amounts of 14C into the atmosphere (Liu et al. 2014). The authors supported their claim using a report of a historic Chinese observation of a comet ostensibly colliding with Earth’s atmosphere in AD 773 January. We show here that the Chinese text presented by those authors is not an original historic text, but that it is comprised of several different sources. Moreover, the translation presented in Liu et al. is misleading and inaccurate. We give the exact Chinese wordings and our English translations. According to the original sources, the Chinese observed a comet in mid January 773, but they report neither a collision nor a large coma, just a long tail. Also, there is no report in any of the source texts about dust rain in the daytime as claimed by Liu et al. (2014), but simply a normal dust storm. Ho (1962) reports sightings of this comet in China on AD 773 Jan 15 and/or 17 and in Japan on AD 773 Jan 20 (Ho 1962). At the relevant historic time, the Chinese held that comets were produced within the Earth’s atmosphere, so that it would have been impossible for them to report a collision of a comet with Earth’s atmosphere. The translation and conclusions made by Liu et al. (2014) are not supported by the historical record. Therefore, postulating a sudden increase in 14C in corals off the Chinese coast precisely in mid January 773 (Liu et al. 2014) is not justified given just the 230Th dating for AD 783 ± 14.

1 Introduction: The AD 774/5 event

Miyake et al. (2012) found a strong increase in the 14C to 12C isotope ratio in two Japanese trees from the year AD 774 to 775. They excluded supernovae as a possible cause due to the lack of any historic observations and of any young nearby supernova remnants, and they also excluded solar super-flares as a cause, because their spectra would not sufficiently explain the 14C to 10Be production ratio observed for that time. Then, Usoskin & Kovaltsov (2012), Melott & Thomas (2012), Thomas et al. (2013), and Usoskin et al. (2013) suggested that a solar super-flare beamed with only ≥ 24° degree beam size could have caused the event (Melott & Thomas 2012), in particular if four to six times less 14C was produced than calculated in Miyake et al. (2012) due to a different carbon circulation model (Usoskin et al. 2013). Hambaryan & Neuhäuser (2013) suggested that a short hard Gamma-Ray-Burst could have caused the event, because all observables including the 14C to 10Be production ratio are consistent with such a burst. Eichler & Mordecai (2012) argued that a large solar flare cannot explain the event (as also argued in Miyake et al. 2012), but an impact of a massive comet onto the Sun may be able to explain the energetics.

Liu et al. (2014) recently obtained additional 14C measurements of corals off the Chinese coast, which have a much higher time resolution of, e.g., two weeks, while tree rings have a one-year time resolution. They found strong variations and a spike in 14C at around AD 783 ± 14 (230Th dating), i.e. possibly near AD 774/5. Liu et al. (2014) claim that the first rise in 14C seen in their data correlates with the sighting of a comet collision with the Earth’s atmosphere recorded during the Tang dynasty (AD 618-907), on AD 773 Jan 17. Given this dating, they then conclude that the variations seen in their corals are consistent with the 14C variations seen in the Japanese and German trees from AD 774 to 775.

Even more recently, Usoskin & Kovaltsov (2014) show that such a large amount of 14C could not be deposited in the Earth by a comet nor by an asteroid, unless by a very large body, which would cause severe devastation; however, Usoskin & Kovaltsov (2014) also fall short of questioning the presumed observation presented by Liu et al. (2014) and whether the Chinese observation really could have been a collision of a comet with Earth.

Therefore, we clarify here the observation made by the Chinese in the 12th month of the 7th year of the Dali reign period, AD 773 January. We present the original Chinese texts and their sources together with our English translations in Sect. 2 and conclude with our results in Sect. 3.

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2 The original Chinese text

Liu et al. (2014) present their supposedly historic text in Chinese and English in their figure 2. Their English translation is as follows:

A comet collided with the Earth’s atmosphere from the constellation of Orion on 17 Jan AD 773 with coma stretched across the whole sky and disappeared within one day, with ‘dust rain’ in the daytime.

(Liu et al. 2014).

Liu et al. (2014) attribute this quotation to a certain Old Tang Dynasty Book. This book title is a misleading and inaccurate translation of the title of Liu Xu’s (AD 887-946) The Old History of the Tang Dynasty (Jiu Tang shu 舊唐書), which does not date to the Tang dynasty (AD 618-907), but was compiled during the Later Jin (Hou Jin), between AD 618-907.

The precise Chinese quotation presented in Liu et al. (2014) is not found in any pre-modern Chinese text. Rather, it is an amalgam of several quotations traceable to two sources, namely Liu Xu’s The Old History of the Tang Dynasty (AD 887-946) and Ouyang Xiu’s (AD 1007-1072) The New History of the Tang Dynasty (Xin Tang shu 新唐書; compiled AD 1043-1060).

These two sources relate the events as follows (Chinese texts given in Fig. 1):

Those in the earlier history compiled by Liu Xu read:

1) On the bingyin day of the twelfth month (AD 773 Jan 17), a dust storm occurred. That night, a long star emerged in Shen.

2) On the jiazi day of the twelfth month (AD 773 Jan 15), Venus entered Yulin. On the bingyin day (AD 773 Jan 17), a dust storm occurred. That night, a long star emerged in Shen.

The quotations in the New History of Ouyang Xiu, compiled AD 1043-1060, read:

3) On the bingyin day of the twelfth month (AD 773 Jan 17), a dust storm occurred, and there was a long star that emerged in Shen.

4) On the bingyin day of the twelfth month of the seventh year (AD 773 Jan 17), there was a long star beneath Shen. Its length extended across the sky. Long stars belong to the class of comets. Shen is the constellation corresponding to the Tang.

Each of the two dynastic histories records the event twice, first in its basic annals, which serve primarily as a chronicle of political history, and second in its astronomical treatise. The sparser records, quotations number 1 and number 3, belong to the basic annals, while the astronomical treatises present the more detailed records, quotations number 2 and number 4.

In addition to the two standard histories of the Tang, the comet is also mentioned in two medieval Chinese sources that Liu et al. (2014) do not cite, respectively Wang Pu’s (AD 922-982) Essential Records of the Tang Dynasty (Tang Huiyao 唐會要), number 5 below, and Ma Duanlin’s (ca. AD 1254 to ca. 1323) Comprehensive Investigation of Historical Documents (Wenxian tongkao 文獻通考).

1 Jiu Tang shu (Beijing: Zhonghua, 1975): 11.301. The asterism Shen corresponds to seven bright stars in Orion: α, β, γ, δ, ε, ζ, and κ Ori.

2 Yulin is a large asterism containing numerous stars in Austrinus, as well as the northern portion of Piscis Austrinus.

3 Jiu Tang shu: 36.1327

4 Xin Tang shu (Beijing: Zhonghua, 1975): 6.176

5 Xin Tang shu: 32.838

Fig. 1 Original Chinese texts about the comet of AD 773 Jan 17, see Sect. 2 for details and English translation.
cuments (Wenxian tongkao), number 6 below.

(5) On the twentieth day of the twelfth month of the seventh year (AD 773 Jan 17) a long star appeared\(^6\)

(6) See quotation number 4 above; the sole difference between these two quotations is a single orthographic variant: Both texts have characters pronounced gen and meaning extend across\(^7\).

This particular comet is also listed in Ho (1962), which is not cited by Liu et al. (2014). Ho (1962) gives the date of the comet as AD 773 Jan 15, but also remarks that the New History of the Tang gives the date of AD 773 Jan 17. This error is likely due to an eye-skip, in which Ho (1962) attributes the jiazi date of the immediately preceding entry, concerning the location of Venus on AD 773 Jan 15, to the appearance of the comet, only a few characters later in the text. Both the Old and New History of the Tang Dynasty give the date as a bingyin day in two separate chapters. We have verified that this is in fact the case not only in the current standard Zhonghua edition of the Old History of the Tang Dynasty, but also in the very edition that Ho Peng Yoke cites\(^8\). Hasegawa (1980)\(^9\) repeats Ho’s (1962) error regarding the dating of the comet, despite having cited earlier catalogues that give the date as Jan 17 including Pingre (1784) and Williams (1871).

In addition to the aforementioned sources, Ho (1962) also cites an appearance of the comet in chapter 359 of the Dai Nihon shi (Great History of Japan) dated to the 23rd day of the 12th month of the 3rd year of the Hoki reign period, AD 773 Jan 20, and as previously published by Kanda (1934, 1935)\(^10\). The Japanese observations are not inconsistent with the Chinese reports, but report a different date. This may be due to a true sighting on a different night, a few days later than the Chinese sighting.

3 Result: A normal comet

There are several parts of the translation in Liu et al (2014) that are unjustifiable in light of the historical texts on which it is supposed to be based. The opening phrase of the translation (A comet collided with the Earth’s atmosphere) can only be described as an anachronistic interpolation. The texts never use any word meaning atmosphere, collide, nor coma. Moreover, while Liu et al. (2014) create the impression that a text from the Tang Dynasty described a coma that stretched across the whole sky, the earliest textual evidence to support such a claim in fact dates to AD 1060, nearly three hundred years after the event, and it speaks about a comet tail (long star ... its length traversed the sky), not a coma.

As for the claim that the comet came from the constellation Orion, this is perhaps best dismissed as an infelicitous translation of the preposition yu, which sometimes does mean from, but here clearly means in or at. Nor is there anything in any of the historical records to support the claim that the comet disappeared within one day. The texts give the date for the initial appearance of the comet, but do not specify the duration of time for which it was visible. If the Japanese reports are credible, this indicates that the comet would have been visible for at least three days under clear conditions.

Pre-modern Chinese astronomy does not warrant the claim that comets are located outside the Earth’s atmosphere or orbit the Sun (or the Earth). They were generally thought to be part of the Earth’s atmosphere itself. Hence, it would not have been imaginable for Chinese at that time, that a comet would collide with the Earth’s atmosphere.

Finally, the phrase yu tu, which Liu et al. (2014) translate as dust rain and believe to refer to cometary material in the Earth’s atmosphere, occurs no fewer than thirty-five times in the two Tang histories, where it is frequently associated with high winds and inclement weather, and means simply dust storm. Of the six remaining references to yu tu in the Old History of the Tang Dynasty, for instance, two specify that the dust storms occurred in the context of heavy winds (da feng), while a third reference occurs in a chronicle of thunderclaps and violent rainstorms (leizhen baoyu). Three of the six references also specify the capital city (jing shi) as the location where dust storms occurred. None of these references mention any connection between yu tu and comets. Dust storms and other meteorological phenomena, such as rainbows, oddly shaped clouds, and unseasonable weather, are included in Chinese treatises on astronomy, or more precisely, celestial patterns, because the early and medieval Chinese did not distinguish between meteorology and astronomy.

The claim that an event where a comet collided with the Earth’s atmosphere would be well established (Liu et al. 2014) in the historical record is entirely unwarranted.

We conclude that the Chinese just observed a more or less normal comet, possibly with an unusually long tail, on (or beginning on) the night of AD 773 Jan 17 - after a day on which a dust storm occurred. In Japan, the comet was also observed, probably on AD 773 Jan 20; therefore, it may have been visible for several nights. If the comet was observed in Japan on AD 773 Jan 20, then it cannot have collided with the Earth’s atmosphere before.

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\(^6\) Tang hui yao, 3 Vols. (Shanghai: Shangwu, 1935): 2.43.767

\(^7\) Wenxian tongkao, 2 Vols. (Beijing: Zhonghua, 1986): 1.286.2270b

\(^8\) See Jiu Tang shu in Bonai ben eroshiishi (The Hundred Patches Edition of the Standard Twenty-Four Histories), 820 vols., 1930-37, Vol. 365.11.20b and Vol. 372.36.10a.

\(^9\) Hasegawa (1980) also cites Kanda (1935), but does not mention the Jan 20 date.

\(^10\) Jiu Tang shu 19B.710; 20A.779; 37.1362

\(^11\) Jiu Tang shu 37.1362: 7.145; 13.373. The final occurrence of yu tu gives a date when a dust storm occurred, but does not specify a location (Jiu Tang shu 3.44).
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