Decoding European Palaeolithic Art: Extremely Ancient knowledge of Precession of the Equinoxes

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A consistent interpretation is provided for zoomorphic artworks at Neolithic Göbekli Tepe and Çatalhöyük as well as European Palaeolithic cave art. It appears they all display the same method for recording dates based on precession of the equinoxes, with animal symbols representing an ancient zodiac. The same constellations are used today in the West, although some of the zodiacal symbols are different. In particular, the Shaft Scene at Lascaux is found to have a similar meaning to Pillar 43 at Göbekli Tepe. Both can be viewed as memorials of catastrophic encounters with the Taurid meteor stream, consistent with Clube and Napier's theory of coherent catastrophism. The date of the likely comet strike recorded at Lascaux is 15,150 ± 200 BC, corresponding closely to the onset of a climate event recorded in a Greenland ice core. A survey of radiocarbon dates of these animal symbols from Chauvet and other Palaeolithic caves is consistent with this zodiacal interpretation with an extraordinary level of statistical significance. Finally, the Lion Man of Hohlenstein-Stadel, circa 38,000 BC, is also consistent with this interpretation, indicating this knowledge is extremely ancient and was widespread.

Introduction

This work concerns our understanding of the astronomical knowledge of ancient people. This knowledge, it seems, enabled them to record dates, using animal symbols to represent star constellations, in terms of precession of the equinoxes. Conventionally, Hipparchus of Ancient Greece is credited with discovering this astronomical phenomenon. We show here that this level of astronomical sophistication was known already within the last ice- age, and very likely by the time Homo sapiens entered western Europe around 40,000 years ago.

We use the scientific method to arrive at this conclusion. The basis of all empirical science is the statistical analysis of measurements combined with logical deduction. Our measurements for precession of the equinoxes are made using an established and accurate software, Stellarium[1], able to predict the positions of stars and their constellations in earlier epochs. These measurements are compared with calibrated radiocarbon dating measurements of the age of European cave art. Through this comparison of predicted and measured dates, we verify our scientific hypothesis to an extraordinary level of statistical confidence, far surpassing the usual demands for publication of scientific

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1. "Stellarium 0.18.0," http://stellarium.org/.

results. Therefore, in a scientific sense, we prove our hypothesis is correct. Essentially, our statistical result is so strong that, unless a significant flaw in our methodology is found, it would be irrational to doubt our hypothesis. It follows that any proposition about these artworks that is inconsistent with our hypothesis can automatically be rejected – it is almost certainly wrong, since our hypothesis is almost certainly correct.

The evidence used to verify our hypothesis is accumulated from many of the most famous Palaeolithic cave art sites across Europe, representing dates up to 38,000 BC including;

- Hohlenstein-Stadel cave, southern Germany circa 38,000 BC
- Chauvet, northern Spain circa 33,000 BC
- Lascaux, southern France circa 15,000 BC
- Altamira, northern Spain circa 15,000 BC

Moreover, this system of representing dates is fully consistent with our interpretation of Neolithic sites in Anatolia, namely;

- Göbekli Tepe, southern Turkey circa 10,000 BC
- Çatalhöyük, southern Turkey circa 7,000 BC

The key to cracking this ancient code for writing dates is provided by Pillar 43, a.k.a. the Vulture Stone, at Göbekli Tepe, constructed at the Palaeolithic-Neolithic boundary in southern Anatolia. In previous work[2], it was shown how this ancient megalithic pillar can be viewed as a memorial to the proposed Younger Dryas event[3], a collision with cometary debris recorded by a platinum 'spike' in a Greenland ice core[4] at 10,940 BC (Greenland ice core chronology), which likely triggered the Younger Dryas period, with all its catastrophic consequences.

The next clue to this ancient code is provided by Neolithic Çatalhöyük, also in southern Anatolia. We show how animal symbolism at this ancient site can be interpreted using the same method and zodiac as at Göbekli Tepe. It appears we continue to use the same zodiacal constellations today in the West, although some of them are no longer represented by animal symbols and a few of the remaining animal symbols have switched places.

The same method and zodiac can also be used to decode much of the animal symbolism displayed by European Palaeolithic cave art, from the Aurignacian Lion Man of Hohlenstein-Stadel cave[5], southern Germany,

2. M.B Sweatman and D. Tsikritsis, "Decoding Gobekli Tepe with Archaeoastronomy: What Does the Fox Say?," *Mediterranean Archaeology and Archaeometry* 17, no. 1 (2017).

3. R. B. Firestone et al., "Evidence for an Extraterrestrial Impact 12,900 Years Ago That Contributed to the Megafaunal Extinctions and the Younger Dryas Cooling," *Proceedings of the National Academy of Sciences of the United States of America* 104, no. 41 (2007).

4. M. I. Petaev et al., "Large Pt Anomaly in the Greenland Ice Core Points to a Cataclysm at the Onset of Younger Dryas," Ibid.110, no. 32 (2013).

5. C.J. Kind et al., "Tbe Smile of the Lion Man. Recent Excavations in Stadel Cave (Baden-Wurttemberg, South-Western Germany) and the Restoration of the Famous Upper Palaeolithoc Figurine," *Quartar* 61 (2014).

through to Magdalenian Altamira in northern Spain[6]. The final piece of the logic puzzle is provided by the famous Shaft Scene at Lascaux, which has an almost identical interpretation to the Vulture Stone at Göbekli Tepe. They differ only in the date of the catastrophe memorialized and the recorded radiant of the cometary strike.

This exercise in decoding prehistoric art is entirely logical and quite simple. Like a crossword puzzle, solving one problem provides a clue to the next. Therefore, we begin our account in section 2 with a brief summary of published findings for Göbekli Tepe and especially Pillar 43, the famous Vulture Stone. We then describe our interpretation of artworks at Çatalhöyük in section 3, and the Lascaux Shaft Scene in section 4. In section 5 we test our hypothesis using the most accurate radiocarbon dating data for European Palaeolithic cave art, finding an extraordinary level of statistical support. Section 6 summarizes this work and describes some of its implications for our understanding of prehistory. In this work we use the widely-known term BC in preference to BP, or 'Before Present'. Technically, the difference between BC and BP is 1950 years (i.e. 1950 AD = 0 BP).

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Decoding Göbekli Tepe

In previous work several stone pillars at Göbekli Tepe, an ancient hill-top site probably constructed after the Younger Dryas event and before the so-called Neolithic revolution, circa 10,000 BC, were decoded. Pillar 43 provided the statistical key for this interpretation; it is our 'Rosetta Stone' (see Figure 1). Essentially, Pillar 43 can be viewed as a memorial to the proposed Younger Dryas event. The date carved into the Vulture Stone is interpreted to be 10,950 BC, to within 250 years. This date is written using precession of the equinoxes, with animal symbols representing star constellations corresponding to the four solstices and equinoxes of this year.

The scientific case supporting this view is based on a statistical analysis of the probability that the animal symbols on Pillar 43 could have appeared in their respective positions by pure chance, given they match their associated star constellations so well. For details of this statistical analysis please see our previous work. Appendix A of this work revisits and updates this analysis. It shows that the probability that the animal patterns on the Vulture Stone could have been placed in their respective positions by pure chance is in the region of 1 in 140 million. As this is such a small chance, we claim to have correctly interpreted this pillar.

This probability estimate is based on ranking how well the animal symbols match each potential constellation, shown in Table 1, and is therefore open to criticisms of subjectivity. To dispute this statistical case, one would need to argue that the ranking shown in Table 1 is significantly flawed[7], and that for

6. H. Valladas et al., "Radiocarbon Ams Dates for Paleolithic Cave Paintings," *Radiocarbon* 43, no. 2B (2001).

7. M.B. Sweatman and D. Tsikritsis, "Comment On "More Than a Vulture: A Response to Sweatman and Tsikritsis"," *Mediterranean Archaeology and Archaeometry* 17, no. 2 (2017).

each associated constellation there are several animal symbols at Göbekli Tepe that provide a better fit than the ones actually appearing on Pillar 43.

Furthermore, using the animal pattern – constellation associations shown in Table 1, Pillar 2 at Göbekli Tepe can be interpreted as the path of the radiant of the Taurid meteor stream at the time the site was occupied, and Pillar 18 can be interpreted as indicating the Younger Dryas event was caused by an encounter with Taurid meteor stream debris from the direction of northern Aquarius, in accordance with Clube and Napier's theory of coherent catastrophism[8]. See our earlier work for details of this analysis. On this basis, the probability that Gobekli Tepe is *not* related to the Younger Dryas impact event is estimated in Appendix B of this present work. We obtain a value of around 1 in 200,000, which although very small is not small enough to declare a scientific discovery (for example, probability estimates for the null hypothesis of less than 1 in 2 million are usually sought in the field of particle physics). Once again, this probability estimate is subject to some uncertainty due to the ranking of animal patterns against constellations shown in Table 1.

Figure 1. *Comparison of Pillar 43 (copy in Sanliurfa museum) with Constellations around Scorpius (left image from Stellarium)*

8. S. V. M. Clube and W. M. Napier, "The Microstructure of Terrestrial Catastrophism," *Monthly Notices of the Royal Astronomical Society* 211, no. 4 (1984).

Decoding Çatalhöyük

Çatalhöyük is thought to be the first Neolithic town in Southern Anatolia[9], with maximum population perhaps as much as 8000. Radiocarbon dating has established that its lowest occupation layers date to around 7250 BC. It appears to have been largely destroyed by an intense fire around 6400 BC, with later occupation layers dating to around 6250 BC on the eastern site. The younger western site was likely occupied by a different culture, given that symbolism on pottery and methods of house construction are quite different, between 6200 and 6000 BC. Çatalhöyük is therefore several millennia younger than Göbekli Tepe, forming a bridge in time between the date represented by Pillar 43 and the Bronze Age.

Many different types of animal motif appear at Çatalhöyük[10], from boar tusks to bear claws, expressed either as paintings, wall 'inclusions', or 'installations'. The most prominent and significant, by far, are the many installations found in rooms interpreted to be religious shrines by the site's archaeologists. These consist of large wall and floor features that appear to have been re-plastered and re-painted every year. Only four types of these large installation are known, each appearing frequently in Çatalhöyük shrine rooms, corresponding to the following animals; aurochs, ram, leopard and another symbol that has been interpreted as either a goddess figure or a bear. So far, the reason why only these specific animals are represented in shrines, and therefore the basis of their religion, is unknown. We show here that their symbolism is probably identical to that displayed at Göbekli Tepe.

To show that the same symbolic code is used at Çatalhöyük as at Göbekli Tepe we need to locate the corresponding solstices and equinoxes. Taking the representative date 7000 BC corresponding to earlier occupation levels, we find using Stellarium that the constellations corresponding to the solstices and equinoxes are (see Figure 2);

- Summer solstice = Virgo
- Autumn equinox = Capricornus
- Winter solstice = Aries
- Spring equinox = Cancer

If we convert these constellations to the symbols used at Göbekli Tepe, using Table 1, we find;

- Summer solstice = down-crawling quadruped
- Autumn equinox = aurochs
- Winter solstice = unknown
- Spring equinox = unknown

9. J. Mellaart, *Catal Hoyuk: A Neolithic Town in Anatolia* (Thames and Hudson Ltd., 1967).

10. I. Hodder, *Catalhoyuk: The Leopard's Tale: Revealing the Mysteries of Turkey's Ancient 'Town'* (London: Thames and Hudson Ltd., 2011).

Let's consider these associations in turn. The down-crawling quadruped appears at the top-right of Pillar 43 at Göbekli Tepe (see Figure 3a), although the symbol is difficult to identify precisely. Given that we are decoding an ancient form of proto-writing, which would not have used symbols that are too similar to each other to avoid confusion, it is likely that this symbol is the same as a similar symbol on display at Sanliurfa museum, shown in Figure 3b, recovered from Göbekli Tepe. Now compare with a drawing of a Çatalhöyük shrine room, shown in Figure 4. It is clear a similar symbol appears in this room above the central bucrania, although it is the other-way-up. The face drawn on this symbol at Çatalhöyük is the artist's interpretation – no face can be discerned on the actual installations as they were normally deliberately destroyed when a house was abandoned. However, the circular symbol on the animal's belly is correctly drawn.

Figure 2. *Summer Solstice (top left), Winter Solstice (bottom left), Autumn Equinox (top right), and Spring Equinox (bottom right), at 7000 BC, Southern Anatolia in 7000 BC, Corresponding to Virgo, Aries, Capricornus and Cancer Respectively (Images from Stellarium)*

Figure 3. *Comparison of Ancient Anatolian bear Symbols. Left (a): the Symbol on the top-right of Pillar 43 at Göbekli Tepe. Middle (b): a Symbol on Display at Sanliurfa museum, Recovered from Göbekli Tepe. Right (c): Bear Seal Stamp Found at Çatalhöyük (from www.Çatalhöyük.com)*

This cultic symbol has caused some confusion among the site's excavators. The site's original excavating director in the 1960s, James Mellaart, described it as a Goddess symbol, with splayed legs, perhaps pregnant and giving birth. This contributed to the development of a Goddess Cult focussed on the site[11]. With more recent excavations, directed by Ian Hodder, it has become clear this symbol is probably a splayed bear with a stubby tail. This is because a seal stamp, or similar item, has been discovered at Çatalhöyük with the same overall profile, but also with sufficient details to identify it as a bear – see Figure 3c.

According to our interpretation, this symbol should represent the summer solstice, and therefore the circle on its belly likely represents the mid-day sun, just like the circle on Pillar 43 above the vulture/eagle's wing at Göbekli Tepe. Therefore, the 'down-crawling quadruped' identified at the top-right of Pillar 43 is now identified as a bear. Table 1 is updated to reflect this.

The aurochs symbol at Göbekli Tepe appears at the top of Pillar 2, and has been interpreted to indicate the constellation Capricornus. Therefore, we should find aurochs installations in Çatalhöyük shrine rooms, this time representing the autumn equinox. And indeed, we see several bucrania in the Shrine Room, shown in Figure 4. Indeed, bucrania are some of the most common installations in Çatalhöyük shrine rooms, indicating a special reverence for this particular constellation, possibly because of its earlier association with the Taurid meteor stream.

According to our interpretation, we should also find installations representing Aries in Çatalhöyük shrine rooms. Unfortunately, we have yet to identify the animal symbol representing Aries. Several animal symbols found at Göbekli Tepe have yet to be associated with any constellation, and are therefore candidates. Given today's association of Aries with the Ram, which appears at Göbekli Tepe on Pillar 1, Enclosure A, as well as on at least one other pillar at

11. J. Marler and H. Haarmann, "The Goddess and the Bear Hybrid Imagery and Symbolism at Çatalhöyük," *The Journal of Archaeomythology* 3, no. 1 (2007).

Göbekli Tepe, it is tempting to make this association. And indeed, a ram installation is apparent in the Çatalhöyük Shrine Room (see Figure 4). This strongly suggests that the Ram = Aries also at Göbekli Tepe. Like Aries, other constellations with their associated animal symbols also appear to have survived the millennia to modern times, such as the scorpion (Scorpius) and dog/wolf (Lupus, see Table 1).

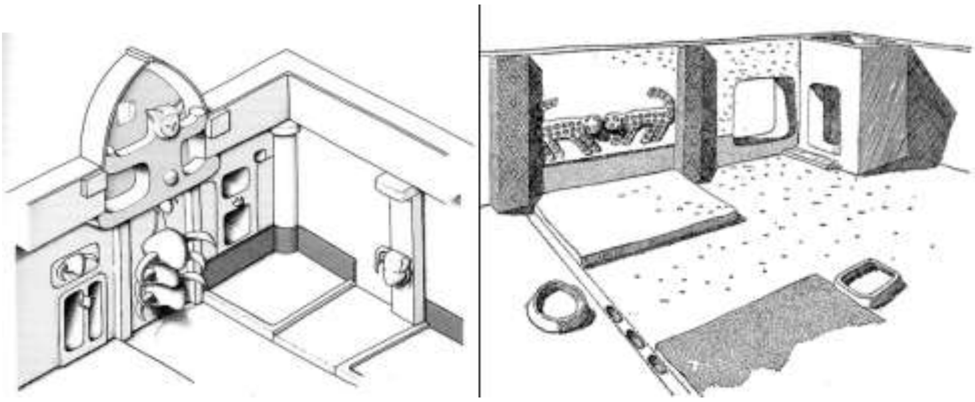

Figure 4. *Artists impression of Shrine Rooms at Çatalhöyük (from). Left (a): a Shrine Room with Aurochs Bucraniums, Rams Heads, and a Bear Symbol. Right (b): a Shrine Room with Twin Leopards (from Mellaart[12], Courtesy of Alan Mellaart)*

Finally, according to our interpretation, we should seek symbolism associated with Cancer. Today's symbol, the Crab, is unknown at either Göbekli Tepe or Çatalhöyük. Therefore, this is likely a more modern association, and we should instead seek another animal symbol prominent at Çatalhöyük, that also appears at Göbekli Tepe, but has yet to be associated with any constellation and would provide a good fit to the Cancer constellation. The only remaining installation type at Çatalhöyük is the leopard. Leopard symbolism at Çatalhöyük appears in several prominent locations, including an installation with a pair of leopards facing each-other in another shrine room (see Figure 4). At Göbekli Tepe, a lion or leopard appears on Pillar 51, Enclosure H, and has yet to be linked to any constellation. Moreover, Cancer at sunset can be viewed as a leopard or lion pouncing or running. Indeed, at Çatalhöyük twin leopards are found facing each other, further emphasizing the symmetry of the Cancer constellation. We therefore suggest it is likely that leopard or lion symbolism represents Cancer. It is tempting to narrow this association to leopards only, but this is not yet known with certainty. It might well have been the case that Cancer was represented by any large feline.

Therefore, animal symbolism at Çatalhöyük is perfectly consistent with our interpretation of Göbekli Tepe, and we have been able to deduce two new animal symbols: Aries = ram and Cancer = large feline. These new animal symbols are listed in Table 2.

12. Mellaart, *Catal Hoyuk: A Neolithic Town in Anatolia*.

Decoding the Lascaux Shaft Scene

The caves at Lascaux are famous across the world for their remarkable Palaeolithic cave art. In reality, they are just one particularly splendid example among many different caves in Europe[13]. Indeed, Chauvet is even more extraordinary given its extreme age, being around 20,000 years older than Lascaux and yet displaying a similar level of artistry[14].

Dating of the Lascaux cave system is uncertain. Estimates range from around 17,000 to 13,000 BC. Unfortunately, it has not been possible to radiocarbon date the art itself because its pigments are not organic. The animals displayed at Lascaux are very similar to those displayed at the Neolithic sites discussed above. But there also a few additions, including many horses, several stags, and a single rhinoceros in the Shaft Scene.

There has been a great deal of speculation about the meaning and purpose of all these Palaeolithic artworks in the research literature and in other forums[15,16]. The first reading of cave art goes back to its first discovery in the 1860s. Then, researchers interpreted rock art as the expression of primitive hunting magic whereby hunters drew a picture of the animal they wished to kill. Others viewed the art as fertility magic or as art for art's sake, among many other ideas. In the 1960s, the French anthropologist André Leroi-Gourhan devised a more abstract theory that suggested the art followed an organisational structure which divided the Ice Age world into binary opposites such as light or dark, closed or open, male or female[17]. Although popular at the time, like other speculative interpretations Leroi-Gourham's theory eventually fell into disfavour.

Figure 5. *The Lascaux Shaft Scene. Left (a): Main Panel with Rhino, Duck/ Goose and Disembowelled Aurochs/Bison with Dying Man on the Main Wall. Right (B): Horse on Rear Wall*

13. H. Valladas et al., "Dating French and Spanish Prehistoric Decorated Caves in Their Archaeological Context," *Radiocarbon* 55, no. 2-3 (2013).

14. J. Clottes et al., "The Paleolithic Paintings of the Chauvet-Pont D'arc Cave, at Vollon-Pont-D'arc (Ardeche, France) - Direct and Indirect Radiocarbon Datings," *Comptes Rendus De L Academie Des Sciences Serie Ii* 320, no. 11 (1995).

15. J. Clottes, *What Is Paleolithic Art?* (University of Chicago, 2016).

16. A.J. Lawson, *Painted Caves* (Oxford University Press, 2012).

17. A. Leroi-Gourhan, *The Dawn of European Art* (Cambridge University Press, 1982).

Parkington critiqued Leroi-Gourhan's binary system, but nevertheless noted the animal paintings appear to be grouped[18]. Rather than male-female opposites, he noted groups such as rhino/bear/feline; reindeer/ibex/hind and bison/ox/horse, and suggested these grouping were due to the similar behaviour of these animals or their apparent hunting risk/reward ratio. Although these organising principles are quite speculative, observation of these groupings does at least represent the first step towards their decipherment.

A more recent and substantial departure from these systematic approaches instead sees cave art as the product of shamanic or altered states of consciousness[19]. This view focusses on the many geometric painted shapes, rather than the painted animals, some of which are thought to represent 'entoptic' forms, i.e. neurologically generated shapes seen in the mind's-eye during 'trance visions'. But this shamanic interpretation has been critiqued by von Petzinger, largely because the neurologically relevant symbols do not appear consistently across these cave sites[20]. Moreover, this idea neither adequately explains the many other geometric shapes unrelated to entoptic forms, or the numerous animal paintings which would likely have required great skill, planning and fully-conscious artists. Yet another speculative view suggests that cave art was placed acoustically in cave spaces and that drawings represent particular sounds that people generated in those spots[21].

From the 1970s an alternative direction was created by the research of the American science writer Alexander Marshack. Sceptical about the foregoing interpretations that rely on competing ideas in cognitive theory, Marshack instead suggested that prehistoric man explained the workings of the world by story, image and symbol, and that these artistic expressions were essentially an early form of scientific understanding[22]. By analysing a large catalogue of Upper Palaeolithic plaques and figurines, Marshack proposed that symbolic notches and lines incised into them were notation systems that recorded time, lunar phases, and seasonally relevant information in their design. Marshack did not focus on cave art, but nevertheless had opened the door to astronomical interpretations that saw cave art as a symbolic information storage system, or 'proto-script', dove-tailing with von Petzinger's more recent analysis of painted geometric forms. His approach created a lasting influence which has strengthened alongside a reappraisal of the intellectual capacities of Upper Palaeolithic people over the past 40 years.

From this perspective, the beasts and symbols painted in caves likely correspond to figures from a mythology in which astronomical observation and mythical thought likely mixed. Consequently, the 1990s saw a surge of scholarly interest in interpreting Palaeolithic cave art as star maps. For example, Congregado published her doctoral dissertation on the cultural evolution of the

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18. J. Parkington, "Symbolism in Palaeolithic Cave Art," *The South African Archaeological Bulletin* 24 (1969).

19. D. Lewis-Williams, *The Mind in the Cave* (London: Thames and Hudson, 2002).

20. G. von Petzinger, *The First Signs* (Simon and Schuster, 2017).

21. J. Fazenda, "Cave Acoustics in Prehistory: Exploring the Association of Palaeolithic Visual Motifs and Acoustic Response," *The Journal of the Acoustical Society of America* 142 (2017).

22. A. Marshack, *The Roots of Civilisation* (Littlehampton Book Services Ltd., 1972).

constellations. This included an analysis of seven dots (two dots are merged) above the shoulder of an aurochs painting in Lascaux's 'Hall of the Bulls' which appear to mimic the position of the Pleiades cluster relative to the Taurus constellation[23]. She also suggested that a scene incorporating three bulls at Altamira represented the three stars of the Summer Triangle; Deneb, Vega and Altair. Likewise, Rappenglüeck suggested the three stars of the Summer Triangle correspond to the eyes of the man, bison, and bird respectively in the Lascaux Shaft Scene, and devised a shamanistic cosmology for this scene as a whole[24]. Later still, Jegués-Wolkiewiez suggested the Hall of the Bulls was a prehistoric zodiac, and argued the star Antares (of the Scorpius constellation) was shown amid another aurochs painting. However, while these particular astronomical correlations can't be ruled out, they are difficult to sustain on this evidence alone, as they lack statistical support. That is, they are highly speculative.

Nevertheless, through recording astronomical correlations Jegués-Wolkiewiez demonstrated that many Ice Age cave sites, including Lascaux, were purposefully chosen because the sun shone into their entrances at astronomically significant times of the year. Indeed, out of 130 Palaeolithic caves she visited, she found that 122 were aligned to the solstices or equinoxes, statistically an extremely strong result[25]. It is therefore highly likely that complex hunter-gatherer societies of the Upper Palaeolithic had calendar experts who would organize feasting, rituals and ceremonies at these astronomically significant times of the year[26].

With these interpretations, based on solid empirical observations rather than cognitive theory, we are approaching the correct understanding. The combination of animal groups, noted by Parkington, and solsticial alignments, noted by Jegués-Wolkiewiez, is highly significant. However, we will show that the key to decoding Lascaux, and therefore other Palaeolithic art, is interpretation of its Shaft Scene. This well-known scene is quite separate from all the other artwork at Lascaux, being situated at the bottom of a deep shaft, suggesting it has a special status. It is also unique among Palaeolithic artworks in that it depicts a man, apparently falling in a manner suggesting injury or death – see Figure 5.

Another clue to the meaning of the Shaft Scene is provided by the fact that only four different animal symbols are displayed here; a bison/aurochs, duck/goose, and rhinoceros (to the left of the falling/dying man) on the main wall with a horse on the rear wall. The bison is particularly striking, apparently pierced by a spear. It also seems to be dying, given its entrails are hanging

23. L.A. Congregardo, "A*rte Y Astronomia: Evolucion De Los Dibujos De Las Constelaciones*" (Madrid, 1991).

24. M.A. Rappengluck, "Possible Astronomical Descriptions in Franco-Cantanrian Palaeolithic Rock Art."

25. C. Jegues-Wolkiewiez, "Chronologie De L'orientation Des Grottes Et Abris Ornés Paléolithiques Français" (paper presented at the Symposium 2007 d'Art Rupestre, Val Camonica, 2007).

26. B. Hayden and S. Villeneuv, "Astronomy in the Upper Palaeolithic," *Cambridge Archaeological Journal* 21 (2011).

underneath. The horse on the back wall is not often described as being part of this scene, but it is central to the interpretation described next.

Similarities with Göbekli Tepe's Vulture Stone are striking. Both display a man, possibly dead or dying, and both display four prominent animal symbols. On the Vulture Stone the four animals are the vulture/eagle, bear, ibex/gazelle and tall bending bird corresponding to the four solstices and equinoxes at the date of the Younger Dryas event (see Table 1 for the corresponding constellations). It is therefore sensible to enquire whether the Shaft Scene at Lascaux is equivalent to the Vulture Stone of Göbekli Tepe and can therefore be decoded using the same method.

Noting the bison/aurochs and duck/goose symbols in the Shaft Scene, and using Table 1 and Stellarium we immediately find the following;

- Bison/aurochs = Capricornus = summer solstice between 15,350 and 13,000 BC
- Duck/goose = Libra = spring equinox between 15,700 and 14,100 BC

Therefore, this scene might represent a date anywhere between 15,350 and 14,100 BC. To narrow down this range we need to consider the other two animal symbols. Unfortunately, neither of these symbols has previously been decoded. But logically, they are unlikely to correspond to constellations that have already been decoded. When we consider this date range we see the following possibilities;

- Autumn equinox: Taurus 15,350 to 14950 BC, or Aries 14950 to 14,100 BC
- Winter solstice: Leo 15,350 to 14,800 BC, or Cancer 14,800 to 14,100 BC

Given that in Tables 1 and 2, Aries is represented by the ram and Cancer is represented by a large feline, and that rams and felines are recorded in Palaeolithic art, it is likely the date range is limited to between 15,350 and 14,950 BC, and therefore the rhinoceros and horse likely represent Taurus and Leo. When we consider these constellations at sunset (see Table 3), which is the convention for this system, we find that the rhinoceros and horse are good fits to their respective constellations (Taurus and Leo), which provides further confidence in this interpretation. We therefore suggest the Shaft Scene encodes the date 15,150 ± 200 BC, and we have now completed our ancient zodiac.

Tables 1, 2 and 3 together list the entire zodiac so far deciphered. As there are a few other animal symbols apparent in Palaeolithic art, such as the deer/megaloceros and the mammoth, it is likely there are some regional and temporal variations of this zodiac that remain to be decoded, but they are not investigated further here.

Now that we have a date, we can try to interpret the scene. What should we make of the falling/dying man and the speared/dying bison? Given that the Vulture Stone at Göbekli Tepe very likely refers to the Younger Dryas event and, according to Napier and Clube's theory of coherent catastrophism, this is unlikely to be an isolated incident, could the Shaft Scene represent another encounter with the Taurid meteor stream? At Göbekli Tepe, the fox features on the largest central pillars of the largest enclosure yet uncovered, indicating the event dated by the Vulture Stone refers to a cosmic event from the direction of northern Aquarius (represented by the fox). Instead, the Shaft Scene displays an injured aurochs, representing Capricornus, not a fox. Is the aurochs here equivalent to the fox at Göbekli Tepe, i.e. does it represent a damaging cosmic event from the direction of Capricornus? To answer this, we need to consider the precession of the Taurid meteor stream.

As described in earlier work[27], the longitude of the ascending node of the Taurid meteor stream is expected to precess at the rate of one zodiacal sign every six thousand years. Today, the Taurid meteor stream radiant is centred (and hence maximal) over Aries/Taurus. Therefore, at the time of the Younger Dryas event, around 13 thousand years ago, it would have been centred over Aquarius, described at Göbekli Tepe in terms of the fox. However, on the date depicted by the Shaft Scene, around 17 thousand years ago, its centre would have been over Capricornus. Therefore, the injured aurochs in the Shaft Scene is consistent with its interpretation as a Taurid meteor strike from the direction of Capricornus. Hence the injured or dying man might indicate a catastrophic encounter with the Taurids, as for the Vulture Stone of Göbekli Tepe.

Clearly, we should seek independent evidence of a catastrophic comet strike at this time. The Younger Dryas event is known as a millennial-scale climatic fluctuation. Clearly, we should first investigate if there is any strong climatic fluctuation at the time indicated by the Shaft Scene. Figure 6 shows that, very interestingly, there is a fairly strong climatic fluctuation at precisely this time recorded by a Greenland ice core[28]. Indeed, when we take into account the fact that the Greenland ice core chronology is expected to differ from the radiocarbon chronology by at least 70 years at this time[29], we can see that the onset of the climatic fluctuation at 15,300 BC agrees very well with our interpretation of the Lascaux Shaft Scene. However, there are many fluctuations in this temperature profile, so this is hardly convincing evidence.

27. Sweatman and Tsikritsis, "Decoding Gobekli Tepe with Archaeoastronomy: What Does the Fox Say?."

28 D.A. Meese et al., "Preliminary Depth-Agescale of the Gisp2 Ice Core," *Special CRREL report 94-1, US* (1994).

29 R. Muscheler, F. Adolphi, and M.F. Knudsen, "Assessing the Differences between the Intcal and Greenland Ice-Core Time Scales for the Last 14,000 Years Via the Common Cosmogenic Radionuclide Variations," *Quaternary Science Reviews* 106 (2014).

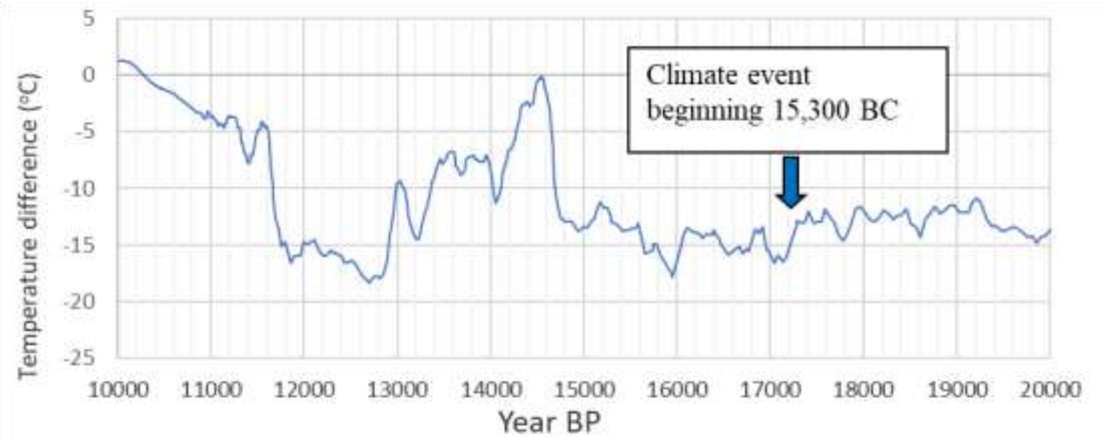


Figure 6. *Greenland Temperature Variation Reconstructed from the GISP2 Ice Core[30]. Year BP Indicates the Number Of Years Before 1950 AD*

Of course, there remains the possibility that this interpretation of the Shaft Scene is wrong, and any similarity with symbols at Göbekli Tepe and Çatalhöyük is coincidence. To this end, in the next section our ancient zodiac and the methodology described here are compared with the known dates of reliable radiocarbon evidence obtained directly from animal symbols and figurines at Palaeolithic cave sites across Europe.

Decoding European Palaeolithic Cave Art

Thousands of examples of Palaeolithic art have been uncovered across Europe. Unfortunately, relatively few of these have been dated directly by high quality radiocarbon assays. Nevertheless, there are now a sufficient number of reliable dating exercises published to statistically test the hypothesis of this work. As we are comparing accepted descriptions of these Palaeolithic animal symbols, such as bison, horse etc., with their corresponding published radiocarbon dates, this statistical test is entirely objective and scientific. It does not suffer from any degree of subjectivity.

In the following test, we use *all* reliable radiocarbon dates for Palaeolithic cave art animal symbols published in English-language peer-reviewed research journals[31,32,33,34,35,36]. This includes 23 dates corresponding to animal symbols

30. Ibid.

31. H. Valladas et al., "Direct Radiocarbon-Dates for Prehistoric Paintings at the Altamira, El-Castillo and Niaux Caves," *Nature* 357, no. 6373 (1992).

32. Valladas et al., "Radiocarbon Ams Dates for Paleolithic Cave Paintings."

33. H. Valladas et al., "Dating French and Spanish Prehistoric Decorated Caves in Their Archaeological Context," Ibid.55, no. 2-3 (2013).

34. "Radiocarbon Dating the Decorated Cosquer Cave (France)," Ibid.59, no. 2 (2017).

35. A. Quiles et al., "A High-Precision Chronological Model for the Decorated Upper Paleolithic Cave of Chauvet-Pont D'arc, Ardeche, France," *Proceedings of the National Academy of Sciences of the United States of America* 113, no. 17 (2016).

36. N.J. Conard, "Palaeolithic Ivory Sculptures from Southwestern Germany and the Origins of Figurative Art," *Nature* 426 (2003).

found in 9 caves in France and Spain, and 4 dates corresponding to zoomorphic figurines found in 3 German caves. Table 4 details each entry, compiled from these six research papers. We acknowledge there might be more data available in other sources, but none of these, to the best of our knowledge, are peer-reviewed English-language sources.

For each animal symbol in Table 4, we find the appropriate solstice or equinox corresponding to that animal, whichever is nearest to the calibrated radiocarbon date. We then determine the difference between the radiocarbon date of the art and the solstice or equinox date of the centre of the corresponding constellation. We round all dates to within 10 years.

Only the most reliable data can be used for this exercise. To statistically test our hypothesis we can only use data for which the uncertainty in the radiocarbon date is much less than the maximum difference of 3221.5 years (i.e. 1/8th of the precessional period of 25772 years) between a zodiacal prediction and the radiocarbon date. For example, consider a compass needle; the maximum angle between the needle and any cardinal direction is 45 degrees, or 1/8th of 360 degrees. Therefore, we pre-screen all the data from these six research papers, rejecting any samples for which the uncertainty (at 1 standard deviation, or 1σ) in the calibrated radiocarbon date exceeds 1074 years (which is 1/3rd of the maximum difference in radiocarbon and predicted dates). A threshold much larger than this would not be useful for testing our hypothesis. Likewise, a threshold much lower than this would eliminate too much data. It is clear from Table 4 that our choice of threshold is sensible, and our conclusions are insensitive to small changes in this value.

Furthermore, for some animal paintings several radiocarbon assays have been performed. Considering that each animal symbol is expected to have been painted by a single artist in one go, we treat these cases as follows. Where multiple radiocarbon assays of the same animal painting agree to within 2 standard errors (2σ) we take their average. In other words, if the uncertainty ranges at the level of 2σ for a pair of measurements overlap, they are considered to be consistent and can be averaged. It is important to take this step, because the alternative process of including every individual measurement in the analysis would unduly bias the statistics towards that particular symbol. For example, consider the hypothetical case where 100 individual measurements of a single animal symbol are made; clearly, these 100 measurements should be reduced to a single measurement. However, where two or more measurements for the same animal symbol do not agree, it is very likely that one or more of these measurements is in error. As we cannot know which, if any, of these inconsistent measurements are reliable *a priori*, we must reject them all. We use the usual process for propagation of errors to estimate the uncertainty in the calculated averages, i.e. for an average of two data points we use the propagated uncertainty $\sqrt{(\sigma_1^2 + \sigma_2^2)}/2$ where σ_1 and σ_2 are the respective uncertainties in these two data points.

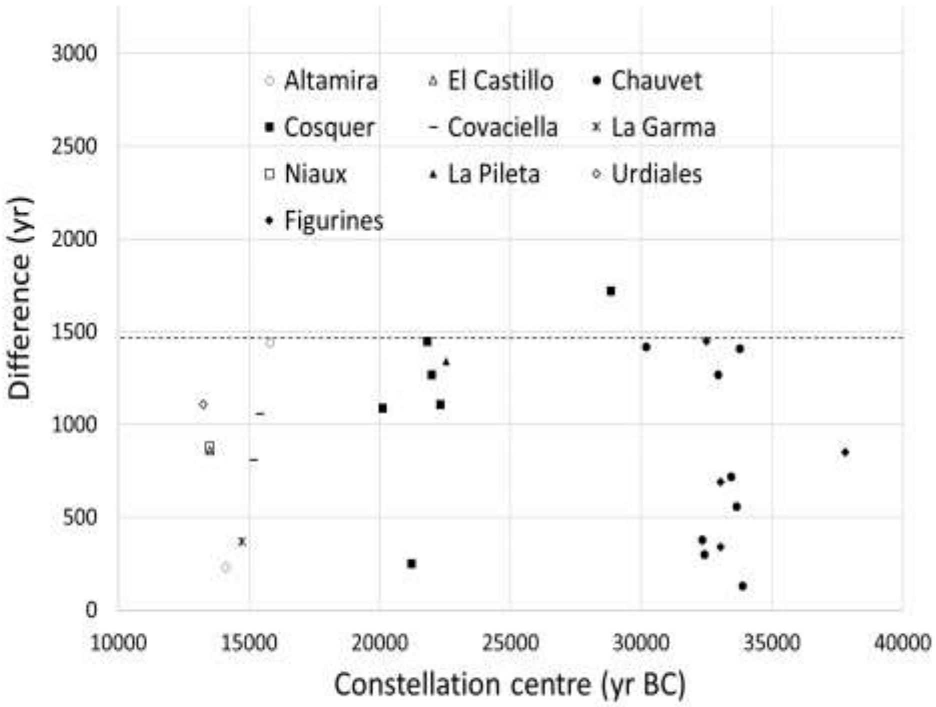


Figure 7. *Correlation between the Dates of Solstice/Equinox Constellations and the Radiocarbon Dates of the Corresponding Animal Symbols. Data in Table 4*

Finally, we do not include any data from Cosquer Cave, a coastal cave which is now partly below sea level, for paintings that are below the high-tide mark, as these paintings are likely to be contaminated and their radiocarbon dates are therefore unreliable. This is clearly demonstrated by the 'horse1' symbol from Cosquer (see Table 4), for which the radiocarbon ages of pigments above and below the high-tide mark differ by around 7,000 years.

Table 4 lists all the data for recognisable animal symbols from these six research papers. In some cases, the animal symbols do not feature in our zodiac – the mammoth for example. These data points are also rejected, as we cannot use them. Very likely, these symbols represent local changes in the zodiac, which would not be surprising given the timescale and geographical ranges involved. The constellations corresponding to these particular animal symbols can be decoded in future work.

If our hypothesis is false, there should be no correlation at all between these specific solstices and equinoxes and the radiocarbon dates of animal figures in Palaeolithic caves, i.e. the measured difference in zodiacal and radiocarbon dates should be evenly distributed across 3,221.5 years. But, Table 4 and Figure 7 show, in fact, there is an extremely strong correlation. That is, the radiocarbon dates of the animal symbols listed in Table 4 are extremely highly correlated with the dates of their associated equinoxes and solstices. Considering that each zodiacal constellation, on average, represents 25,772/12 years, if our hypothesis is correct we should expect a roughly uniform distribution of differences up to half of this value, i.e. 1074 years, tailing off beyond this due to uncertainty in the radiocarbon dates. This is precisely what is observed.

It is possible to estimate the probability that this correlation is due to chance. We see that all samples, except one from Cosquer Cave, have separations of at most 1450 years. The Cosquer outlier has a separation of 1720 years. This distribution of points is highly skewed, considering these data points are expected to be randomly distributed (according to the null hypothesis) between 0 and 3,221.5 years. We ask, what is the probability of achieving a set of points that is at least as skewed as the one observed? There are two possibilities we need to consider. First, there is the possibility that all points fall within 1450 years. This probability is simply $(1450/3221.5)^{27}$. Second, we need to consider the possibility that all but one of the points fall within 1450 years, with the final point falling within 1720 years. Taking a specific data point as the outlier, the chance of this sample happening randomly is $((1720 - 1450)/3221.5) \times (1450/3221.5)^{26}$. However, there are 27 ways in which this can happen, since in principle any of the data points could have been the outlier. Therefore, our final probability is $(1450/3221.5)^{27} + 27 \times ((1720 - 1450)/3221.5) \times (1450/3221.5)^{26}$, which is equivalent to a chance of 1 in 380 million. As this chance is so small the null hypothesis can be rejected, and our hypothesis is therefore accepted with an extraordinary level of confidence.

Summary and Conclusions

We have defined a zodiac that is consistent with the Lascaux Shaft Scene, Çatalhöyük shrines and Göbekli Tepe using precession of the equinoxes.

When we use it to work out the date of the Lascaux Shaft Scene, we find it is 15,150 BC to within 200 years, which agrees with proposed dates for the paintings at Lascaux. In addition, the wounded bull at Lascaux describes a damaging cosmic event from the direction of Capricornus, which corresponds to the position of maximum intensity of the Taurids when Lascaux was occupied.

When we use it to work out a date range for when Çatalhöyük was occupied, we find it is 7,400 – 6,500 BC, which agrees with the main occupation phase of Çatalhöyük.

And, when we use it to work out the date of Pillar 43, the Vulture Stone, at Göbekli Tepe, we find it is 10,950 BC to within 250 years, which agrees with the known date of the Younger Dryas event. Moreover, we also find that Pillar 2 at Göbekli Tepe corresponds to the path of the radiant of the Taurid meteor stream when Göbekli Tepe was occupied, and the fox on Pillar 18 corresponds to the position of the maximum intensity of the Taurids.

We get all this from a single zodiac, using precession of the equinoxes. The evidence to support this view, is:

- The probability that the Vulture Stone could match the relevant parts of the sky is extremely tiny; around 1 in 140 million by pure chance according to the calculations in Appendix A. This estimate is subjective according to the rankings in Table 1.

- The probability that the Vulture Stone describes the date of the Younger Dryas event, at the same time that Pillar 2 describes the path of the radiant of the Taurid meteor stream, at the same time that Pillar 18 describes the position of its maximum intensity, is around 1 in 200,000 by pure chance, according to the calculations in Appendix B. Again, this estimate is subjective according to the rankings in Table 1.
- The probability that this zodiac could match by pure chance the radiocarbon dates of Palaeolithic cave art shown in Figure 4 is 1 in 380 million.

We emphasize that our final statistical test for the Palaeolithic cave art is completely objective. We have used all the available data that meet our unbiased quality criteria. By itself, the resulting probability of 1 in 380 million of obtaining this data set by pure chance validates our hypothesis, i.e. animal symbols were used in very ancient times to write dates using precession of the equinoxes. Clearly, this result is at odds with the conventional view that astronomy began in Mesopotamia a few millennia BC and that precession of the equinoxes was discovered by Hipparchus in the 2nd Century BC. These assumptions must now be seen as unsafe.

When we combine the outcome of this objective statistical test with our subjective statistical estimate of the pattern matches on Göbekli Tepe's Vulture Stone, we find that the probability that all these correlations could have occurred by pure chance is around 1 in 140 million x 380 million, which is 1 in 53 quadrillion. This is completely negligible. Even though this particular figure is open to a degree of subjectivity according to the rankings in Table 1, this uncertainty is trivial compared to this overwhelming statistical result. Therefore, we have undoubtedly cracked this ancient zodiacal code.

This code was likely used for many tens of thousands of years, from at least the time Homo sapiens migrated into Western Europe, around 40,000 years ago, until comparatively recently. Its origin, distribution and evolution are presently unknown, although it appears to span Europe into Anatolia. Clearly, this zodiac is not fixed, either temporally or geographically. There are likely many local variations, including those that probably occurred between the end of Çatalhöyük's occupation and today. For example, the bull appears to have moved from Capricornus to Taurus and the feline symbol appears to have moved from Cancer to Leo. We can be very certain that this code was used in Late Palaeolithic Western Europe, and it appears almost certain to have been used at Gobekli Tepe as well. Given the extreme timespan and geographical range of this custom, we can also be quite confident this code was also used at Çatalhöyük, considering its shrines appear to be consistent with this zodiac. However, as this site has only four shrine types, statistically we cannot be so sure of this.

Two of the ancient sites discussed here, Göbekli Tepe and Lascaux, appear to both represent specific moments in time that involve catastrophic encounters with the Taurid meteor stream. This is because they both display prominent artworks that exhibit a dead or dying man together with four highlighted animal symbols representing the date of a cosmic event. We saw that the probability that Göbekli Tepe is unrelated to the Younger Dryas event is around 1 in 200 thousand (see Appendix B). Given that the Lascaux Shaft Scene also appears to implicate the Taurid meteor stream from the direction of Capricornus, we can reduce this by a factor of 12, the probability of choosing Capricornus at random, to yield a probability of 1 in 2.4 million that the Taurids are not involved in either Gobekli Tepe or Lascaux. On this basis we claim that Napier and Clube's theory of coherent catastrophism is almost certainly correct. Given the climate oscillation beginning around 15,300 BC (GISP2 chronology), there is good motivation to search for geochemical evidence corresponding to this event.

The theory of coherent catastrophism predicts such events should not be isolated. We should, therefore, enquire whether other examples of fine Palaeolithic art, such as Chauvet, signal further such encounters. For example, recent work that analysed megafaunal remains in Alaskan and Yukon 'muck' indicates similar events, of unknown scale, possibly occurred around 18, 30, 37, 40 and 48 thousand years ago[37].

Accepting this new viewpoint, it appears the intellectual capabilities of ancient people have been severely underestimated, at least as far as astronomy is concerned. Although the artistic achievements of Late Palaeolithic humans are generally accepted, for instance their ability to create music[38] and fine paintings, we should now also revaluate their scientific and mathematical understanding considering that this knowledge of precession of the equinoxes requires very long timescale observations, and records, of the natural world. Indeed, the level of astronomical knowledge uncovered here at such an ancient time also calls into question standard models of diffusion and migration of humans in general. For instance, if ancient people could also estimate longitude via the lunar method, a not unreasonable expectation for someone with knowledge of precession of the equinoxes, then they might have navigated the oceans as soon as sufficiently robust vessels could be built. In summary, it appears the potential 'impact' of the Taurid meteor stream on the evolution, dispersal and development of mankind, and other animals, through the Late Palaeolithic and Neolithic periods in general require some revision[39].

37. J.T. Hagstrum et al., "Impact Related Microspherules in Late-Pleistocene Alaskan and Yukon "Muck" Deposits Signify Recurrent Episodes of Catastrophic Emplacement," *Scientific Reports* 7 (2017).

38. N. J. Conard, M. Malina, and S. C. Munzel, "New Flutes Document the Earliest Musical Tradition in Southwestern Germany," *Nature* 460, no. 7256 (2009).

39. W. M. Napier, "Palaeolithic Extinctions and the Taurid Complex," *Monthly Notices of the Royal Astronomical Society* 405, no. 3 (2010).

Appendix A

It is worth revisiting the statistical case for Pillar 43 at Göbekli Tepe developed earlier[40]. This pillar displays eight animal symbols that we suggest represent known constellations. Although only one animal symbol of each kind appears on this particular pillar, other pillars at Göbekli Tepe display multiple versions of the same animal symbol. For example, Pillar 33 exhibits at least two birds standing next to each other, while Pillar 56 is a complex collection of many similar animal symbols. Therefore, we cannot *a priori* assume that each Pillar can only display one instance of any specific animal symbol. In other words, any statistical analysis of these pillars must allow for repeated animal symbols of the same kind. Previously[41], two statistical estimates for Pillar 43 were produced; one allowing for multiple animal symbols of the same kind, and another that eliminates this possibility. Clearly, our new statistical framework for Pillar 43 must use the former approach.

We ask the question, 'What is the probability that the animal symbols on Pillar 43 could appear in their respective places, matching constellations in the night sky so well, if they were chosen and placed at random?'. In other words, assuming the null-hypothesis (that these are just random animal symbols), what is the probability that Pillar 43 could represent a date using precession of the equinoxes?

We tackle this problem as follows. The total number of different possible animal symbol combinations on Pillar 43 is simply 13^8 = 816 million, since there are 13 animal symbols at Göbekli Tepe to choose from, shown in Tables 1 and 2, and 8 symbols on Pillar 43 to choose. Of course, many of these different potential animal symbol permutations will involve repeated symbols of the same kind. This is fine according to the argument presented above. According to our ranking of the animal symbols in Table 1, the probability of choosing at random, assuming all the different combinations are equally likely, a set of animal symbols as good as the one that actually appears on the pillar is just 2 in 816 million. This is because, according to Table 1, the combination of symbols actually appearing on Pillar 43 is one of the best two possible permutations. However, the three small animal symbols at the top of the pillar could have been ordered left-to-right or right-to-left without changing the meaning of the pillar. Therefore, we are now at a probability of 4 in 816 million.

In fact, this is likely an overestimate, and the true probability of choosing this particular combination is actually much lower. This is because the most common animal symbols uncovered at Göbekli Tepe so far are the fox, aurochs, crane and boar[42] (ignoring the snake, which does not seem to represent a constellation). Yet, only one of these (the crane) appears on Pillar 43. The

40. Sweatman and Tsikritsis, "Decoding Gobekli Tepe with Archaeoastronomy: What Does the Fox Say?."

41. Ibid.

42. Joris Peters and Klaus Schmidt, "Animals in the Symbolic World of Pre-Pottery Neolithic Göbekli Tepe, South-Eastern Turkey: A Preliminary Assessment," *Anthropozoologica* 39, no. 1 (2004).

other symbols appearing on Pillar 43 occur only rarely at Göbekli Tepe, at least on the pillars so far excavated. Indeed, for all the other animal symbols (the vulture/eagle, dog/wolf, scorpion, bending bird with fish, duck/goose, ibex/ gazelle, and down-crawling quadruped), their only appearance is on this special pillar. Therefore, it is fair to say that the combination that actually appears on this pillar is highly unlikely relative to most other combinations if the animal symbols are selected according their appearance frequency at Göbekli Tepe. Nevertheless, for convenience, we continue to assume all combinations are equally likely.

But, this estimate of 4 in 816 million is not our final one. There are two more factors we need to take into account, that roughly cancel. The first involves the presence of the scorpion. Rather than finding the probability that any combination of animal symbols on pillar 43 could match any region of the sky, in terms on the western constellation set in Stellarium, we have so far found the probability that any combination of animal symbols on Pillar 43 could match the region of sky surrounding Scorpius. As this is a more restrictive premise, our current probability estimate is too low. To obtain a better estimate we can simply eliminate Scorpius from consideration. In other words, we assume the scorpion = Scorpius on Pillar 43 is a given. We therefore need to multiply by a factor of 13, giving 52 in 816 million.

However, our analysis of permutations of animal symbols on Pillar 43 has so far not considered the probability of their precise positioning, given a specific combination, on the pillar. For example, the angle subtended by the dog/wolf – scorpion – bird triplet is very similar to the angle subtended by Lupus – Scorpius – Libra in the sky. To take account of this strong ‘positional’ correlation we can divide Pillar 43 into several regions within which only one animal pattern can appear (see Figure A1). Here, we are mainly interested in that part of the pillar where there is some freedom to choose the position of the animal symbols, i.e. on the main part which constitutes four animal symbols surrounding the scorpion. By dividing this part of the pillar into 8 regions surrounding the scorpion, each region defines an arc of 45 degrees. We suppose that the four animal symbols around the scorpion could have appeared in any of these 8 regions, providing their clockwise order is fixed. As it is, they appear to be in almost exactly the correct positions around Scorpius to match the relative positions of the constellations in the sky, except that the bending bird with down-wriggling fish (which we match to Ophiuchus) is about 45 degrees (i.e. one region) out of place. It should be in region 3, not 2, in Figure A1.

We now ask, ‘What is the probability that these 4 symbols could almost match the correct positions of the 4 corresponding constellations in the sky by pure chance, keeping their order around the scorpion fixed?’.

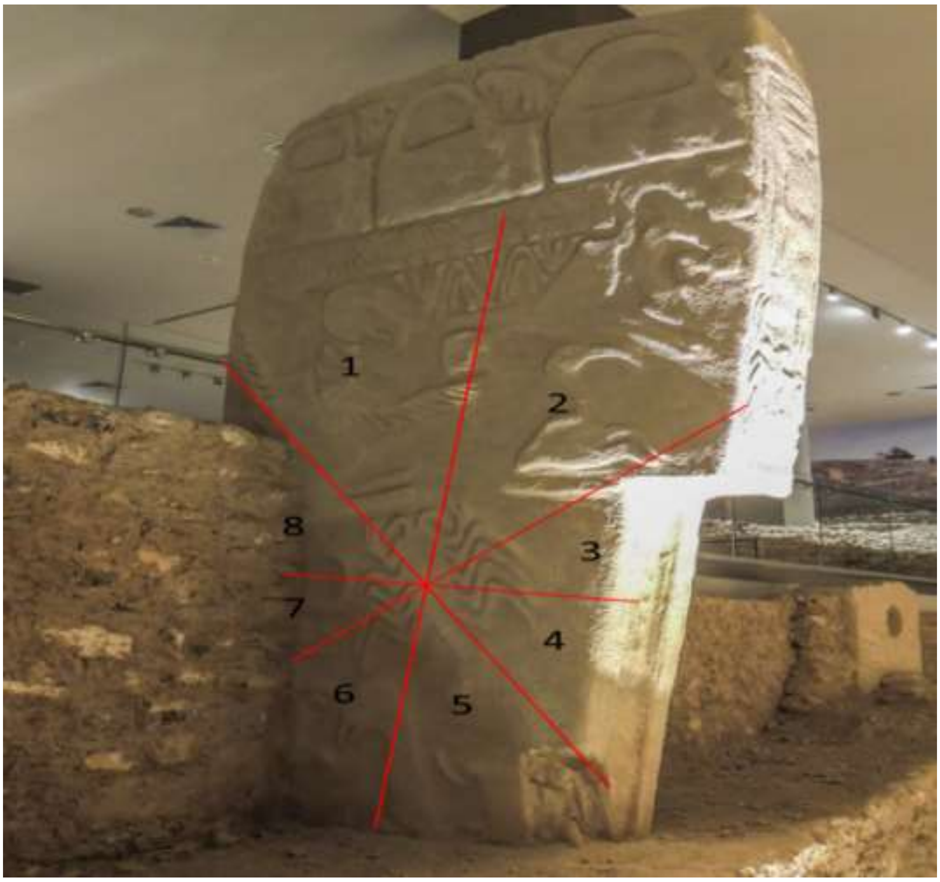


Figure A1. *Division of Pillar 43 into Regions to Enable Analysis of the Spatial Correlation of its Main Panel*

If we define the first region chosen as region 1, with the remaining regions labelled 2 to 8 clockwise, then the remaining 3 animal symbols can be placed, in clockwise order, in regions 2, 5, 6, or in 3, 5, 6 or in 2, 5, 7 or in 2, 4, 6. Any of these 4 situations could be deemed to be as good, or better, than the one that actually occurs on Pillar 43, as they are all wrong by at most one position. The total number of different configurations available without changing the clockwise order of the animal symbols is 5 + (4 x 2) + (3 x 3) + (2 x 4) + 5 = 35. Therefore, the good positional correlation of these 4 animal symbols on the main part of Pillar 43 around the scorpion has a chance of around 4 in 35 of occurring by pure chance. Essentially, if these 4 animal symbols were placed into these 8 regions by pure chance, keeping their orientational order fixed, there would be only 4 possible choices out of a total of 35 different combinations that are as good as the one that actually appears on the pillar.

Thus, we are now at a chance of around (4 x 52) / (35 x 816), which is equivalent to 1 in 140 million. This is our final estimate that the animal symbols on Pillar 43 could have matched their respective constellations by pure chance. To dispute this result, one would need to make the case that there are at least 140, and not just 2, different combinations of animal symbols that fit the suggested constellations as well as the combination that actually appears on the pillar. This would then render a final probability estimate over 1 in 2 million, which is the usual threshold required to claim a scientific discovery. That is, one would need a very different ranking of the symbols than the one we supply in Table 1. However, recall that Pillar 43 mainly displays animal symbols rarely found at Göbekli Tepe (i.e. neither the fox, aurochs nor boar are included), and therefore our estimate is likely an overestimate of the true probability. We suggest this observation accounts for, and effectively eliminates, any uncertainty in our ranking in Table 1, and we can therefore be quite confident that our final result of 1 in 140 million is a fair estimate.

Appendix B

There are three potential coincidences at Göbekli Tepe that we need to address. Multiplying their probabilities together, presuming their independence (according to the null-hypothesis), will provide an overall estimate of the probability they could have occurred together;

1. The date written on the Vulture Stone is extremely close to the accepted date of the Younger Dryas impact event.
2. Pillar 2 describes the path of the radiant of the Taurid meteor stream at the time Göbekli Tepe was occupied, the same meteor stream thought to be responsible for the Younger Dryas impact event according to Clube and Napier's theory of coherent catastrophism.
3. Pillar 18, the central dominant pillar of Enclosure D, refers to the northern portion of Aquarius, which would have been at the centre of the northern Taurid meteor stream, its point of maximum intensity, at this time.

Let's consider each point in turn.

1. The earliest radiocarbon date for Enclosure D at Göbekli Tepe is for the mortar of the rough stone wall, at 9530 BC to within a few hundred years[43]. The date written on the Vulture Stone is 10,950 BC to within a few hundred years, while the Younger Dryas event, according to a Greenland ice core occurred at 10,940 BC to within 10 years, which is about 10,870 BC according to the radiocarbon chronology. The chance of finding a date on the Vulture Stone that is within 100 years of the Younger Dryas event date, and yet is over 1,400 years before the earliest accepted radiocarbon date, is about 100/1400 = 1 in 14.
2. Pillar 2 has the sequence (crane, fox, aurochs) representing the northern Taurid radiant path (Pisces, northern Aquarius, Capricornus). There are 13^3 = 2197 different possible animal symbol combinations for this pillar. But, according to the rankings in Table 1, the sequence of animal symbols chosen is the best possible for representing this radiant path. The chance of this occurring randomly is 2 in 2197 (since the pillar

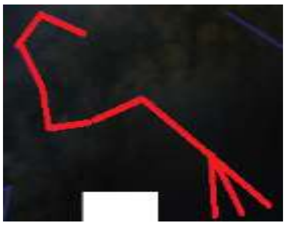
43. Oliver Dietrich et al., "Establishing a Radiocarbon Sequence for Göbekli Tepe. State of Research and New Data," *Neo-Lithics. The Newsletter of Southwest Asian Neolithic Research (1/13)* (2013).

might have been encoded up-down or down-up without changing its meaning). To dispute this result, one would need to find many other combinations of animal symbols that are a better match to the constellations than those that actually appear on Pillar 2.

3. The chance of choosing the animal symbol that represents the constellation at the peak intensity of the northern Taurids, the fox, is simply 1 in 13, as there are currently 13 animal symbols known.

Multiplying all these probabilities together gives a chance of 1 in 200 thousand that Göbekli Tepe does not implicate the Taurid meteor stream in the Younger Dryas impact event.

Tables

Symbol	Asterism	Rank
 Scorpion	 Scorpius	1
 Bending bird	 Pisces	1
 Duck/goose	 Libra	1
 Dog/wolf?	 Lupus	1

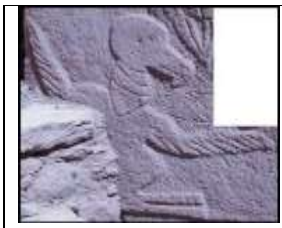
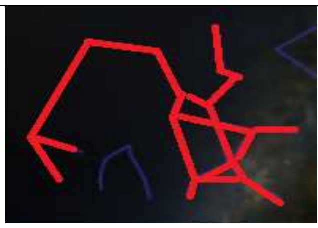
 Eagle/vulture	 Sagittarius	1
 Bending bird with fish	 Ophiuchus	1
 Bear	 Virgo	1
 Charging ibex/gazelle	 Gemini	=2 with lion/ leopard
 Aurochs	 Capricornus	1
 Fox	 Northern Aquarius	1
 Boar	Unknown. It is suggested in Sweatman and Tsikritsis, 2017, that the boar symbol represents the southern portion of Aquarius, but this is quite uncertain.	

Table 1. *Animal Symbol – Asterism Associations identified at Göbekli Tepe, along with their Ranking supplied in Earlier Work*[44]

44 Sweatman and Tsikritsis, "Decoding Gobekli Tepe with Archaeoastronomy: What Does the Fox Say?."

Symbol	Asterism
 Ram	 Aries
 Pouncing lion/leopard	 Cancer

Table 2. *Animal Symbol – Asterism Associations deduced from Çatalhöyük*

Symbol	Asterism
 Rhinoceros at Chauvet (from ‘Inocybe’ via French Wikipedia)	 Taurus
 Horse at Lascaux (By ‘Ownwork’ via Wikipedia)	 Leo

Table 3. *Animal Symbol – Asterism Associations deduced from the Lascaux Shaft Scene*

Reference	Sample	C14 BP	Cal14 BC	Cal14 1σ (yr)	solstice/ equinox	centre BC	symbol	Difference	reject?
Valladas et al., 1992	**Niaux GifA 91319**	**12890 +- 160**	**13470**	**240**	**summer**	**14350**	**bison**	**880**	
	El castillo GifA 91172	**12910 +- 180**	**13490**	**270**	**summer**	**14350**	**bison18b**	**860**	
	El castillo GifA 91004	13060 +- 200	13670	300	summer	14350	bison18a	680	inconsistent
Valladas et al., 2001	El Castillo Gifa 96079	12620 +- 110	13010	230	summer	14350	bison18a	1340	inconsistent
	El Castillo GifA 96068	13520 +- 130	14340	270	summer	14350	bison18a	10	inconsistent
	Altamira GifA 91181	14330 +-190	15480	260	summer	14350	bison33	1130	
	Altamira GifA 96071	14820 +- 130	16090	160	summer	14350	bison33	1740	
	average		**15790**	**150**	**summer**	**14350**	**bison33**	**1440**	
	Altamira GifA 91178	13570 +- 190	14410	280	summer	14350	bison44	60	
	Altamira GifA 96067	13130 +- 120	13820	200	summer	14350	bison44	530	
	average		**14120**	**170**	**summer**	**14350**	**bison44**	**230**	
	Altamira GifA 91179	13940 +- 170	14940	270	summer	14350	bison36	590	inconsistent
	Altamira GifA 96060	14800 +- 150	16080	190	summer	14350	bison36	1730	inconsistent
	Covaciella GifA 95281	**14060 +- 140**	**15160**	**230**	**summer**	**14350**	**bison25**	**810**	
	Covaciella GifA 95364	**14260 +- 130**	**15410**	**190**	**summer**	**14350**	**bison26**	**1060**	
	El Castillo GifA 95227	13520 +- 120	14350	180	summer	14350	bison19	0	inconsistent
	El Castillo GifA 95226	13570 +- 130	14410	200	summer	14350	bison19	60	inconsistent
	El Castillo GifA 98152	13710 +- 140	14600	230	summer	14350	bison19	250	inconsisent
	El Castillo GifA 98151	14090 +- 150	15210	230	summer	14350	bison19	860	inconsistent
	El Castillo GifA 95136	10510 +- 100	10560	130			bison18c		inconsistent
	El Castillo GifA 95146	11270 +- 80	11190	70			bison18c		inconsistent
	El Castillo GifA 96077	10720 +- 100	10700	70			bison18c		inconsisent
	El Castillo GifA 96078	10740 +- 100	10710	70			bison18c		inconsistent
	Cosquer GifA 95135	19340 +- 200					megaloceros		not in zodiac
	Cosquer GifA 98188	19290 +- 340					deer		not in zodiac
Quiles et al., 2016	Chauvet GifA 95132	32410 +- 720	34510	930	winter	34200	rhino223	310	
	Chauvet GifA 95133	30790 +- 600	32770	550	winter	34200	rhino223	1430	
	average	**31600 +- 810**	**33640**	**540**	**winter**	**34200**	**rhino223**	**560**	
	Chauvet GifA 95126	**30940 +- 610**	**32930**	**580**	**winter**	**34200**	**rhino222**	**1270**	
	Chauvet Gifa 95128	**30340 +- 570**	**32400**	**470**	**autumn**	**32700**	**bison1**	**300**	
	Chauvet GifA 13034	**31950 +- 460**	**33870**	**490**	**spring**	**34000**	**horse214**	**130**	
	Chauvet GifA 13030	27100 +-1700					deer185		not in zodiac
	Chauvet GifA 13031	33400 +-3800					deer187		not in zodiac
	Chauvet GifA 13032	31500 +-3000					bison180		high uncertainty
	Chauvet GifA 11115	24900 +-1300					horse188		high uncertainty
	Chauvet GifA 13094	30100 +-2600					lion41		high uncertainty
	Chauvet GifA 13093	31500 +-1200					rhino179		high uncertainty
	Chauvet GifA 13095	31830 +-450					mammoth493		not in zodiac
	Chauvet GifA 13096	32400 +-1300					mammoth493		not in zodiac
	Chauvet GifA 96063	31350 +-620					megaloceros246		not in zodiac
	Chauvet GifA 11130	33100 +- 3600					megaloceros334		not in zodiac
	Chauvet GifA 13133	33000 +- 1500					mammoth446		not in zodiac
	Chauvet GifA 11129	31900 +- 3100					horse344		high uncertainty
	Chauvet GifA 11517	26070 +- 180					lion548		inconsistent
	Chauvet GifA 11018	25640 +- 200					lion548		inconsistent
	Chauvet GifA 13102	32090+- 470					lion548		inconsistent
	Chauvet GifA 13104	31800 +- 990	33780	1090	autumn	32700	bison193	1080	high uncertainty
	Chauvet GifA 96065	**30230 +- 530**	**32320**	**430**	**autumn**	**32700**	**bison53**	**380**	
	Chauvet GifA 11126	**28170 +- 730**	**30170**	**770**	**spring**	**28750**	**rhino551**	**1420**	
	Chauvet GifA 13134	**31830 +- 450**	**33760**	**510**	**spring**	**32350**	**lion197**	**1410**	
	Chauvet GifA 13105	**31490 +- 430**	**33420**	**440**	**autumn**	**32700**	**bison196**	**720**	
Valladas et al., 2013	**La Pileta GifA 98162**	**20310 +- 350**	**22540**	**460**	**spring**	**21200**	**bison**	**1340**	
	Urdiales GifA 11454	**12750 +- 110**	**13240**	**190**	**summer**	**14350**	**bison**	**1110**	
	La Garma GifA 102581	**13780 +- 150**	**14720**	**240**	**summer**	**14350**	**bison**	**370**	
Conard, 2003	**Stadel figurine**	**35185 +- 270**	**37800**	**340**	**winter**	**38650**	**lion**	**850**	
	Hohle Fels figurine	**30500 +- 500**	**32500**	**420**	**spring**	**33950**	**horse**	**1450**	
	Hohle Fels figurine	32000 +- 1000	33990	1150	summer	33100	duck	890	high uncertainty
	Hohle Fels figurine	32000 +- 1000	33990	1150	spring	32350	lion	1640	high uncertainty
	Geisenklosterle figurine	32000 +- 2000					mammoth		not in zodiac
	Geisenklosterle figurine	32000 +- 2000					bear		high uncertainty
	Geisenklosterle figurine	32000 +- 2000					bison		high uncertainty
	Vogelherd figurine	**31000 +- 1000**	**33040**	**960**	**spring**	**32350**	**lion**	**690**	
	Vogelherd figurine	**31000 +- 1000**	**33040**	**960**	**autumn**	**32700**	**bison**	**340**	
	Vogelherd figurine	33000 +- 3000					mammoth1		not in zodiac
	Vogelherd figurine	33000 +- 3000					mammoth2		not in zodiac
	Vogelherd figurine	33000 +- 3000					horse		high uncertainty
	Vogelherd figurine	33000 +- 3000					lion1		high uncertainty
	Vogelherd figurine	33000 +- 3000					lion2		high uncertainty
	Vogelherd figurine	33000 +- 3000					lion3		high uncertainty
Valladas et al., 2017	Cosquer GifA 92416	18,840 +-250	20764	473	autumn	23250	horse1	2486	under sea, inconsistent
	Cosquer GifA 92417	18,820 +-310	20769	340	autumn	23250	horse1	2481	under sea, inconsistent
	Cosquer GifA 13481	25450 +- 190	27580	270	summer	29000	horse1	1420	inconsistent
	Cosquer GifA 96072	24730 +- 300	26830	500	summer	29000	horse5	2170	inconsistent
	Cosquer GifA 13479	22440 +-130	24810	470	spring	23250	horse5	1560	inconsistent
	Cosquer GifA 13480	22920 +- 160	25320	430	spring	23250	horse5	2070	inconsistent
	Cosquer GifA 14003	18610 +- 100	20521	98	spring	23250	horse17	2729	under sea
	Cosquer GifA 92419	18010 +- 200	19870	440	spring	21200	bison1	1330	inconsistent
	Cosquer GifA 92492	18530 +-190	20440	220	spring	21200	bison1	760	inconsistent
	Cosquer GifA 14155	16590 +- 90	18070	130	spring	21200	bison1	3130	inconsistent
	Cosquer GifA 96069	26250 +- 350	28560	410	winter	27100	bison2	1460	
	Cosquer GifA 95195	27350 +- 430	29310	370	winter	27100	bison2	2210	
	Cosquer GifA 14157	26240 +- 270	28590	380	winter	27100	bison2	1490	
	average		**28820**	**470**	**winter**	**27100**	**bison2**	**1720**	
	Cosquer GifA 14159	**18200 +- 110**	**20110**	**340**	**spring**	**21200**	**bison4**	**1090**	
	Cosquer GifA 14160	**20120 +-510**	**22310**	**640**	**spring**	**21200**	**bison5**	**1110**	
	Cosquer GifA 92418	**19200 +- 240**	**21200**	**300**	**autumn**	**20950**	**lion1**	**250**	
	Cosquer GifA 98186	**19720 +-210**	**21800**	**410**	**autumn**	**23250**	**horse7**	**1450**	
	Cosquer GifA 98188	19290 +- 340					stag		not in zodiac
	Cosquer GifA 95135	19340 +- 200					megaloceros1		not in zodiac
	Cosquer GifA 14164	**19890 +- 130**	**21980**	**330**	**autumn**	**23250**	**horse57**	**1270**	

Table 4. *Radiocarbon data compared with zodiacal measurements using Stellarium. Radiocarbon data is calibrated using the Calib704 software*[45] *and the IntCal13 calibration curve*[46]*. No distinction is made between bison and aurochs, or lion and leopard etc. Data rejected by the authors of these papers is not included in this table. Only the data in bold typeface meets our quality criteria (see text) and is therefore included in our statistical analysis and Figure 7*

45. Calib Radiocarbon Calibration Program Ver. 7.0.4.

46. P.J. Reimer et al., "Intcal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years Cal Bp," *Radiocarbon* 55 (2013).

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