



## Debate Article

# Archaeoastronomy and the alleged ‘Stonehenge calendar’

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In a recent *Antiquity* article, Darvill (2022) proposed that the mid third-millennium BC Stage 2 sarsen settings of Stonehenge (comprising the Trilithon Horseshoe, Sarsen Circle and the Station Stone Rectangle) were conceived in order to represent a calendar year of 365.25 days—that is, a calendar identical in duration to the Julian calendar. In the present article, the authors argue that this proposal is unsubstantiated, being based as it is on a combination of numerology, astronomical error and unsupported analogy.

Keywords: Prehistoric Britain, Stonehenge, archaeoastronomy, Egyptian calendar, numerology, analogy

## Introduction

Stonehenge is an astonishingly complex monument, which can be understood only by taking into account both its landscape context and the long chronology of its successive phases of construction and use (Gaffney *et al.* 2018; Parker Pearson *et al.* 2020, 2022). There is, however, no doubt that the most spectacular and best known of these phases, defined by the monumental ‘sarsen’ settings, exhibits a clear astronomical alignment; due to the flat topography and good visibility of the horizon from the site, this setting refers both to the summer solstice sunrise and to the winter solstice sunset. Consequently, Stonehenge Stage 2 (2620–2480 BC) attests to the clear interest of the builders in the symbolism of the solar cycle, most probably related to connections between the afterlife and the winter solstice (Ruggles 1997, 2015). Recognition of this interest, however, is very far from saying that the monument was used as a giant calendrical device, as proposed in a recent *Antiquity* article (Darvill 2022). In that article, Stonehenge is interpreted as the representation of a calendar year of 365.25 days—that is, a calendar identical in duration to the Julian calendar, adopted approximately two millennia after Stonehenge Stage 2 (González-García & Belmonte 2007). The aim of the present article is to show that this proposal is unsubstantiated, being based as it is on a combination of forced interpretations, numerology and unsupported analogies.

## The alleged Stonehenge calendar

The ‘Stonehenge calendar’ as presented in Darvill (2022) can be summarised as follows. The sarsen settings of the monument (the Trilithon Horseshoe, Sarsen Circle and the ‘Station Stone’ Rectangle) represent a calendar based on a 365-day year divided into 12 months of

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30 days each, plus five ‘epagomenal’ days, with the addition of a leap year every four years. The number of days per month is obtained by multiplying the 30 sarsen lintels (probably) present in the original project by 12 (although the number 12 is not recognisable in any specific feature of the monument) and adding to the resulting 360 days the number of the standing trilithons of the Horseshoe, which is five. The addition of a leap year every four years is derived from the number—four—of the so-called Station Stones, which define a rectangular setting around the central circle. According to Darvill, the calendar was maintained using the principal solstitial alignment of the (north-east to south-west) axis and ultimately derived from an Egyptian model. In doing so, however, the builders must also have refined the Egyptian civil calendar, because the leap year correction is not attested in Egypt until the Roman period. We therefore see that the proposal relies on three distinct lines of reasoning: 1) a numerological argument; 2) an archaeoastronomical argument; and 3) an argument by cultural astronomical analogy. Let us analyse these three points in turn.

## **Numerological argument**

Numerology is a pseudo-scientific form of reasoning that seeks hidden but meaningful relationships between numbers and concepts. These numbers are generated in various ways, from attributing numerical values to the letters of a text to measure the dimensions of a building. This form of reasoning spans a full spectrum of significance, from the acceptable to the nonsensical (Dudley 1997). The foundations of the so-called Temple of the Inscriptions at Palenque in Mexico, for example, contain the tomb of the Mayan king Pakal; the temple features nine stepped levels, as does the Maya underworld. This is a numerological observation that has a cultural basis, and which might be considered meaningful (Aveni 2001). Conversely, many fringe publications assert that Angkor Wat in Cambodia sits at 72° east of the Great Pyramid of Giza ‘because’ 72 is the number of years required for the Earth to complete one degree of axial precession. This is a form of numerological reasoning that requires no further comment.

Let us establish where exactly on this spectrum of numerological reasonableness we should locate the proposed ‘Stonehenge calendar’ (Darvill 2022). As outlined above, the scheme combines the (reconstructed) number of lintels of the Sarsen Circle (30), the five trilithons of the Horseshoe and the four Station Stones. These three numbers lead the author to interpret Stonehenge as a ‘calendar in stone’, a symbolic representation of a solar calendar identical in length to the average year of the Julian calendar. The proposed calendar is divided into 12 months of 30 days (although the number 12 is unattested at the site), plus five epagomenal days (incorrectly labelled as an ‘intercalary month’) and one additional day every four years.

The first documented elaboration of such a calendar dates to two millennia later, when an unsuccessful attempt to implement it was made in Ptolemaic Egypt, with the so-called Canopus Decree (Belmonte 2003; Hannah 2008). No such calendar, therefore, was in use before Julius Caesar’s reform of the Roman calendar (46 BC; González-García & Belmonte 2007), and even this Julian calendar kept anomalous lengths for the months inherited from the Republican calendar tradition. It was only later, under the reforms of Augustus, that the Alexandrian calendar was developed in Egypt (*c.* 25 BC), using a similar structure (with an

additional epagomenal day every four years) to that proposed by Darvill (2022) for third-millennium BC Britain.

Operationally, as we understand Darvill's argument, some device or marker would have been used at Stonehenge to indicate the day of the 'month' represented by the corresponding stone in the Sarsen Circle and another marker used on an unidentified set of 12 stones (or another potential set of features) to indicate the month. The marker was then transferred to the trilithons of the Horseshoe in the epagomenal days; yet another marker was used on the Station Stones to progressively count four-year cycles. Finally, no marker, stone or other feature is proposed to account for the extra day inserted every four years.

As noted above, any tentative interpretation of the 'numbers in a monument' should be firmly grounded on a directly relevant cultural basis; this is all the more important when astronomical observations come into play. We explore this issue further below. In concluding our evaluation of the numerological argument, however, we note that the proposed calendar suffers from two classical problems of numerology: arbitrariness and the selection effect (e.g. Fagan 2006). Arbitrariness is intrinsic to the division of the proposed calendar into 12 equal months of 30 days, because the number 12 is entirely absent from the monument; the possibility that "the poorly known stone settings in and around the north-eastern entrance ... somehow marked this cycle" (Darvill 2022: 327) provides no actual evidence.

Selection, meanwhile, is fully at play in the discarding of other numbers: for example, the trilithons comprise three stones, and the Heel Stone was probably once accompanied by a second stone to create a portal. Besides this, there is an indeterminate number of 'blue stones' that apparently did not play any role. Finally, the proposed months are divided into 'decans' of 10 days (the correct term should be 'weeks' or 'decades', because decans apply to a series of stars or asterisms in ancient Egypt used to keep track of nightly hours; see e.g. Neugebauer & Parker 1960; Belmonte 2002). The supporting evidence cited for this decanal structure is the difference in the sizes of stones S11 and S21. Something goes wrong here, however, as it is physically impossible that the small S11, as it is today, sustained a lintel together with the much taller S10 (Darvill (2022: 322) speculates the former to have been broken off). Moreover, almost half of the pillar stones of the Sarsen Circle are missing or no longer *in situ*, and it is possible that they may also have been small, thus breaking the magic of the hypothesis.

## Archaeoastronomical argument

The archaeoastronomical argument used by Darvill (2022) takes the following form: the correctness and alignment of the proposed calendar with the solar cycle (which would anyway be only approximate, as the tropical year is slightly shorter than the average Julian year) was controlled by using the solstitial alignment of Stonehenge. Some confusion is apparent here concerning the behaviour of the sun at the solstice. The astronomical solstice is simply the instant of maximal declination, and not "five days of standstill" (Darvill 2022: 329). The slow movement of the sun at the horizon during these days therefore makes it impossible to control the correct working of the calendar. This issue becomes more significant with greater distance from the equator—especially in the absence of an uneven reference horizon—because the sun rises lower in the sky and becomes less perpendicular to the horizon. The consequence of this is that the Stonehenge alignment, although being accurate in space, cannot be accurate in time.

In order to understand this point, let us suppose that we know the correct day of the solstice in a certain year (a supposition which is not easy to envisage) and then we start counting periods of 365 days. In the fourth period, to fine-tune the calendar, we should be able to see that the solstice is occurring a day early. To do this, however, we should be able to distinguish positions as accurate as a few arc minutes—a possibility which is clearly excluded. Therefore, we would require many years to notice the misalignment. Even then, we would not know how by many days our calendar is out of sync. This can be explained in less technical terms by stressing that the sarsen-phase solstitial axis is inaccurate in time because of the minuscule difference between the sunrise/sunset position for several days either side of either solstice. While the existence of the axis can therefore be taken to demonstrate a ‘calendrical’ function in the very broad sense, the mere existence of the solstitial axis provides no evidence whatsoever for inferring that the builders counted the number of days in a year or conceived years as comprising a set number of days, be that 360, 365 or 365.25.

## **Cultural astronomical analogy**

A third line of argument on which the proposed ‘Stonehenge calendar’ relies is based on cultural astronomical analogies. In isolation, this kind of argument is risky, because it assumes the existence of cognitive similarities and understandings of astronomy across different, often distant, societies. This issue is compounded if the analogy itself is flawed. Darvill (2022) draws a parallel with the Egyptian calendar (for an overview of the Egyptian calendar and archaeoastronomy, see Belmonte 2012 and Magli 2013), making several simplistic statements. The starting date of the civil calendar, for example, is much debated and it would be far-fetched to fix such a precise date as 2773 BC (Darvill 2022: 330). No Egyptologist would accept such an assertion (see Belmonte 2003, 2012: 27–48). Furthermore, the argument that the 12 months of the Egyptian calendar were named after the constellations that form the signs of the Zodiac is wrong. The relationship between the rise of the solar cult and the development of the civil calendar (Darvill 2022: 330) has been previously suggested, but it is far from having been demonstrated (Quirke 2001; Krauss 2011).

As we have argued above, the Egyptian civil calendar is not the same as the Julian calendar, in that the former is composed of strictly 365 days. It therefore rapidly went out of sync. It is not a solar calendar; indeed, this is why it is often called a ‘wandering calendar’. As Darvill observes, the Egyptians probably understood this, or detected the problem after some years of use, but they did not feel the necessity of changing the calendar until “much later” (Darvill 2022: 330), in other words, some 27 centuries later. The Egyptians did perhaps reflect the drift of the calendar through the seasons in their architecture (see e.g. Belmonte 2009), presumably in a symbolic manner, but we have no evidence that they ever erected a monument to control time. Hence, the argument that “materialising a time-reckoning system in the structure and form of a major monument ... is a common practice amongst non-literate and semi-literate societies” (Darvill 2022: 330) is surprising. In 30 years of research in the field, we have found no compelling evidence for such a monument before the advent of scientific astronomy and the construction of true observatories. Moreover, such monuments have not been found in Egypt, the supposed source of inspiration for the practice, and

there is not a single piece of evidence to support the claim of an independent development in third-millennium BC Britain (Belmonte 2015; Ruggles & Cotte 2017).

For Darvill, the builders of Stonehenge were the recipients of not only a 365-day calendar, but also of the associated knowledge of the Egyptian astronomers that their calendar was not anchored to the solar cycle; the builders therefore decided to resolve this problem in a similar (or even better) way than the Roman astronomers of Julius Caesar's day. Such a transfer and elaboration of the Egyptian calendar *c.* 2600 BC resembles old ideas of diffusionism that we believed had been discarded and happily forgotten. As noted by Darvill (2022: 330), there is only a one-off case of a long-distance visitor to Stonehenge, travelling moreover only from the Alps not the Eastern Mediterranean, and a single debated case of one object dated to a millennium later than Stonehenge Stage 2. In our view, this is far from demonstrating that "the pendulum of interpretation is swinging back in favour of long-distance contacts and extensive social networks" (Darvill 2022: 330). It goes without saying that using the proposed calendar as a proof is a circular argument. Reference to late medieval accounts, written down some 3600 years after the monument's construction, is equally debatable.

## Conclusions

Here, we have assessed the recently proposed 'Stonehenge calendar' (Darvill 2022) with reference to its three lines of argument. We conclude that the alleged 'Neolithic-Julian' calendar is a purely modern construct whose archaeoastronomical and calendrical bases are flawed. Moreover, from a strictly cultural point of view, the justification for a solar-anchored calendar at Stonehenge is not as well sustained as Darvill (2022) assumes. With the exceptions of the ancient Egyptians (and by influence, the Romans) and the Maya in Mesoamerica, most peoples in antiquity (and even today) used lunisolar calendars (Stern 2012; Belmonte *et al.* 2019; Belmonte 2021). Having more or less precise solar alignments could perhaps be used to anchor lunar New Year's Eves but would hardly be sufficient to develop an operative solar calendar. For this, before the invention of the telescope, one would have needed devices as precise as the sundial at the Jantar Matar in Jaipur. Stonehenge is, evidently, not such a device.

Archaeoastronomy has endured decades of difficult development in order to become the respected scientific discipline that it is today (see e.g. Aveni 2008; Magli 2020; Boutsikas *et al.* 2021). We believe that matters such as ancient calendars, astronomical alignments and cultural astronomy should be reserved to specialists, trained in the subject, and not left to researchers from other disciplines, however renowned and knowledgeable in their own fields. Multidisciplinary and collaboration offer the most effective way forward.

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