

The dynamic celestial Native American calendar of Devil's Den Gettysburg, Pennsylvania, USA

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Abstract

Gettysburg's legacy is a well-chronicled highlight of American history. However, its significance as a revered battleground overshadows a forgotten Iroquoian group (Susquehannock) that occupied the region. The battlefield contains a diabase outcrop known as Devil's Den that displays rounded blocks and weathered rectangular joints. Field reconnaissance identified a leaning rock slab that forms openings aligned to the summer and winter solstices. Moreover, the rock openings align with the rising and setting of Pleiades and Sirius, respectively, stellar objects tracked by northeastern Native Americans for agricultural and religious purposes. A petroglyph-bearing rock shadowed by the slab is the first known occurrence of petroglyphs in Adams County and only the 22nd documented case in Pennsylvania. Petroglyphs relating to select cardinal directions, Ursa major, and Manitou (Great Spirit manifestations) were situated for sunlight to interact with them during certain times of the year. The discovery of an Iroquoian calendar implies the region was utilised by a sedentary society.

Introduction

Devil's Den lies within a fertile valley of the Gettysburg battlefield. Site canvassing performed in September 2013 resulted in the discovery of a potential Native American calendar. Iroquoian groups (*i.e.*, Susquehannock) occupied this region (Cadzow, 1936); however, it is unclear whether the calendar was constructed by Susquehannock or members of the Iroquois Confederacy. Susquehannock comprised a semi-sedentary agricultural group that occupied the Susquehanna watershed before being driven into Maryland by members of the Iroquois Confederacy (*e.g.*, Richter, 1990; Jennings, 1968). Gettysburg is located only 65 km east of Lancaster County and 8 km north of Maryland; thus, a Susquehannock community at Gettysburg would be congruent with records indicating that the Iroquois Confederacy

expanded into this region in the years leading up to and following a war between these rivals that ended in 1675 (*e.g.*, Richter, 1990). The Iroquois also practiced horticulture and, like the Susquehannock, relied on certain celestial bodies for tracking time (Ceci, 1978). Thus, for the sake of discussion and because of paucity of artifacts, the site is tentatively assigned to Susquehannock and unspecified members of the Iroquois Confederacy.

Materials and Methods

Photographs of Devil's Den and literary resources regarding Iroquoian groups were available through public domain and reviewed. A typical 12 megapixels digital camera documented outcrop features including the calendar. The calendar's orientation and associated features were determined using a Brunton compass and the 2013 United States Geological Survey (USGS) Topographic Quadrangle of Gettysburg (USGS, 2013). Azimuths of celestial objects were obtained from software referenced throughout this paper. A clay model was also constructed to provide insights on how special elements of the calendar operated.

Theory

In order to test whether a Native American celestial calendar existed at Devil's Den, there would have to be a clear indication that a rock structure is aligned with a solstice and/or equinox. The alignment of the rock structure with stellar objects revered by Native Americans would further bolster a calendric interpretation.

Results and Discussion

Canvassing identified a diabase slab that eroded from a boulder immediately to its west. The slab leans against its source rock and produces a triangular opening (Figure 1). Field measurements conducted in November 2013 confirmed the opening strikes $\sim 61^\circ$ NE and $\sim 241^\circ$ SW after correcting for the local 7° magnetic declination per the referenced USGS quadrangle. Field measurements documented these openings face the azimuth of the rising and setting sun at Gettysburg around summer and winter solstice, respectively. The calendar's height is 1.2 m at its mid-point and its basal widths are 1.42 m and 0.66 m at the northeasterly and southwesterly openings. The celestial viewing angle was calculated for the calendar openings given the length of the diabase slab (~ 2.5 m) where it contacts grade.

The maximum viewing angle is calculated to

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be $\sim 25^\circ$ if a calendar user lies on grade and observes celestial bodies from the opposite calendar opening. However, the northern limb of Little Round Top, a nearby hill, obscures part of the sky such that the maximum view angle is actually both $\sim 7^\circ$ high and wide (58 to 65° SE). A rock wall cuts the maximum viewing height and width of setting celestial objects in the southwestern direction to $\sim 7^\circ$ high and wide (236° to 243° SW). Even so, the entire $\sim 25^\circ$ of vertical view toward the south is possible if the viewing position is skewed off-center (westward) - such a position *removes* the rock wall from view by shifting the focal point eastward. The significance of the calendar openings is their azimuth with respect to rising or setting celestial bodies; therefore, the width rather than the height of the viewing angle is what matters in terms of calendar alignment. It is also stressed, that while a celestial body may be visible in the calendar openings for relatively short periods beyond a given date or event (*e.g.*, solstice), the object will only be centered along the horizontal axis (bottom) of the openings on a specific date making the calendric orientations reasonably precise for tracking select celestial objects.

Constraining the upper date of the diabase slab emplacement

Although field measurements documented the calendar openings align to the solstices, it was requisite to establish that the slab's position is not recent. The earliest photograph of Devil's Den located during this study dates to 1857 and depicts Carlisle Indians at the site. Even though the leaning rock was being stood

on by individuals and is not observable, the cleft from which it was derived is evident. Therefore, the slab's configuration pre-dates the Civil War. Future radiometric carbon dating of soil below the contact of diabase slab with grade may yield an absolute age estimate of when the rock fell or was positioned into place on a presumed vegetated surface.

Assessing the mode of the diabase slab placement

The diabase slab and parent boulder were inspected to evaluate whether Native Americans took advantage of a well-placed rock to establish a calendar or manually emplaced it into position. Weathering on the parent boulder's surface is expressed as fairly parallel striations that follow the boulder's contours. These striations are orientated perpendicular to grade just above where the diabase slab contacts the parent boulder suggesting the slab slid a short distance straight down to grade. However, matching points of contact between the slab and cleft indicates the slab's position is shifted more than a meter northward. Geologic processes cannot account for the slab's displacement following its fall. Although this is an intriguing observation, there is insufficient data to determine whether the diabase slab was intentionally positioned.

Tracking Pleiades and Sirius using the calendar

The calendar may have been used for more than marking the solstices. Ceci (1978) indicated Iroquois and Algonquian groups tracked Pleiades, a loose star cluster in Taurus. Pleiades' position approximates the beginning of the frost season when it rises as the sun sets in November (Ceci, 1978). Therefore, the calendar's orientation was further investigated using software (Simulation Curriculum Corporation, 2009; United States Naval Observatory (USNO), 2013) and determined to be aligned with the rising of Pleiades about a half an hour after sunset in mid-November. The cited software was also used to investigate whether the southwestern calendar opening allowed Sirius to be tracked. Sirius, the brightest star in the sky, is the luminary of *Canis major*, Orion's companion dog and was worshipped by Iroquoian groups (e.g., James, 2006). The results indicated that the calendar is aligned with the setting of Sirius after midnight around spring equinox. Sirius passes through the southwestern facing window $\sim 7^\circ$ above the horizon at that time. Sirius' position on the summer solstice was also considered to assess whether it could have been used to mark a calendar date. The results indicate Sirius is visible in the calendar opening $\sim 12^\circ$ above the horizon shortly after sunset on May 20. However, solar glare obscures Sirius in the

ensuing weeks; thus, its usefulness as a calendar item lessens markedly after mid-May. Sirius' appearance in the calendar window after sunset in mid-May correlates well with the end of the frost season and compliments Ceci's (1978) work regarding Pleiades.

Petroglyphs

A red sedimentary rock bearing petroglyphs was discovered with the calendar (Figure 2). The finding is intriguing because The Pennsylvania Historical and Museum Commission (PHMC) had not hitherto documented the discovery of petroglyphs in Adams County. Petroglyphs are not typically found in

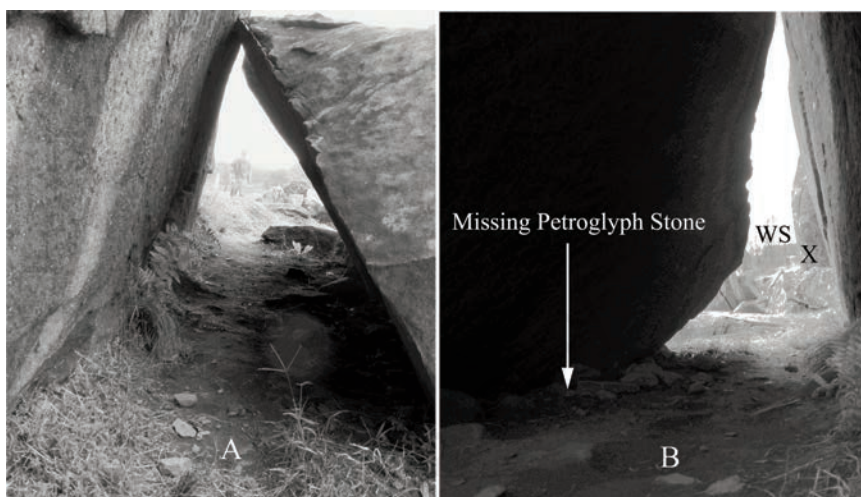


Figure 1. A) The slab makes an angle of 60° with grade and the opening is ~ 1.3 m high. The diabase slab opening is orientated to $\sim 61^\circ$ NE. Sunrise on summer solstice at Gettysburg occurs at an azimuth of $\sim 58.3^\circ$ NE according to the United States Naval Observatory. However, the lower limb of Little Round Top (in distance) blocks the sun until it has an azimuth of 60.4° NE. B) The opposite calendar opening faces 241° SW. This photograph, taken on a slightly skewed angle, shows more of the background. The X indicates the rock face receiving sunlight at sunrise on the summer solstice. This rock face partially obscures the southwestern view. The position of the former petroglyph stone is outlined in dew and was illuminated by the setting sun's position (WS) on the winter solstice.

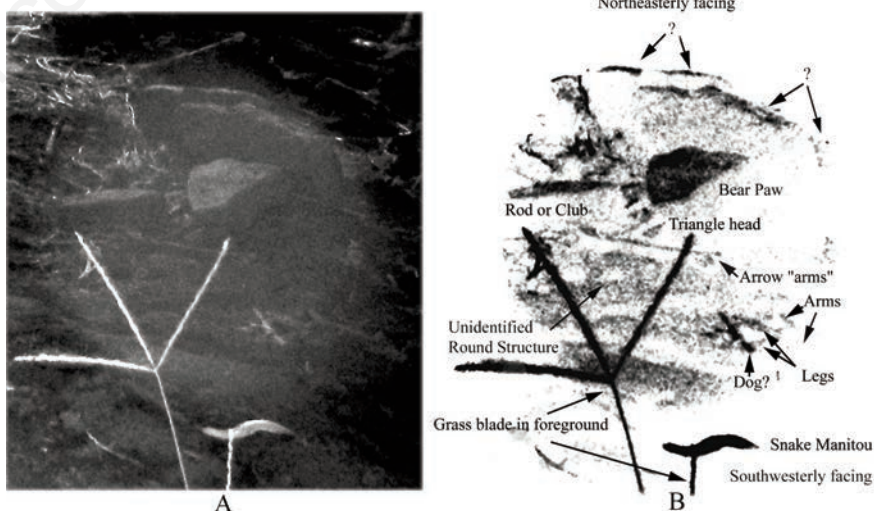


Figure 2. Petroglyphs on the shadowed rock are clearly visible (A). B) is a negative of the original photograph that was darkened using Adobe Photoshop Elements 12. The bear paw and club face northward. The figure with the triangular head has its extended arms (arrow) pointing north and southward. An arrow typically refers to hunting. A serpent (bold stroke on the side of the rock) faces southwest. Other figures may depict humans or animals.

uplands (PHMC, 2007) which add to the significance of their discovery and association with the calendar. The finding, assigned catalogue number 36AD0542 by the PHMC in April 2014, is only the 22nd known petroglyph site in Pennsylvania. The decorated rock was located directly under the leaning diabase slab with its relatively flat surface several centimeters above soil. The long-axis of the petroglyph-covered rock (<1 m) was aligned sub-parallel to the base of the diabase slab overshadowing it. The petroglyph-covered rock was positioned in close proximity to where the leaning diabase slab contacts the ground, hiding the petroglyphs from normal view. The placement of the shadowed petroglyph-covered rock allowed sunlight to *interact* with it on certain dates as discussed later. The rock's position and petroglyphs were documented in September 2013 allowing for their relevance to be discussed despite the removal of the petroglyph-covered rock by an unknown party in November on the same day the discovery was going to be discussed in detail with a top park official.

The most distinct petroglyphs were a bear paw with a rod-like extension that pointed approximately west/northwest; a human-like figure with a triangular head, basket-like abdominal region and arms stretched north and southward; and last, a serpent on the west/southwestern side of the rock (Figure 2). The first and last icons mentioned hold religious significance to the Susquehannock and Iroquois since they represent Manitou (*e.g.*, Lattin, 1896). Although the human-like figure with the triangular head and outstretched arms may represent a spirit, its arms may denote cardinal directions. The arms, decorated at their ends, represent an arrow pointing due north (*e.g.*, toward Polaris) when the photograph presented as Figure 1A is corrected from a slightly oblique view (~8° based on the clockwise deviation of the long axis of the petroglyph-bearing rock with respect to the direction the photograph was taken). The triangular head is an inverted form of those depicted in Susquehannock and Iroquois pottery recovered from Safe Harbor and Washington Borough, Lancaster County (*e.g.*, Cadzow, 1936). Other forms on the stone appear human-like and fauna not specifically recognisable but possibly identifiable in the future.

The bear paw and rod appear to be linked to the direction that *Ursa major* (*i.e.*, Great Bear or Big Dipper) assumes in late fall or winter at twilight (Figure 2). The rod extending from the paw may represent a club, the preferred manner of dispatching bear among Iroquois (Hallowell, 1926). The Iroquois, Algonquian, and other Native Americans (*e.g.*, Micmac) envisioned several stars composing the *handle* of the Big Dipper to be warriors hunting the celestial bear and performing related activities (Shepard and Sanders, 1985; Stokley, 1936;

Hagar, 1900). The slayed bear's blood was believed to cause autumnal color (Hagar, 1900). The relationship between religion and color occurs among Native American groups (Shepard and Sanders, 1985) even though this has not yet been documented for Susquehannock. Nonetheless, the selection of red shale as the medium for recording petroglyphs rather than the abundant diabase could have tied into their religion and it would have made the icons more visible.

The northwesterly orientation of the bear paw is intriguing in that if the petroglyph-maker was indicating the direction of *Ursa major* in mid-November, it is the time of the year when the *bear* stands on the horizon following sunset. Additionally, Bushman, (1884) reported that a Native American was purportedly mauled by a bear at Devil's Den, but retaliated by placing his arm down its throat to asphyxiate it. Although this event is not verifiable, it is compelling circumstantial evidence that may also explain the inclusion of the depiction of the bear paw among the petroglyphs. It may also be the reason an arrow is depicted below the paw to signify *hunt*. Equally important, the account alludes to Native American use of the area encompassing Devil's Den. Newspapers, such as the New Oxford Item (1906), also reported the discovery of a worn tomahawk among the crevices of Devil's Den lending further credence to the use of this area by Native Americans.

Some resources document that a Native American group occupied the Devil's Den area based on thousands of artifacts recovered in the early to mid-19th century from a field located ~400 m southwest of Devil's Den now occupied by the Slyder Farm (*e.g.*, New York Times, 1869; Bushman, 1880; Nasby, 2005). The artifacts consisted principally of Indian weaponry, but included beads, pottery and bone and were interpreted by some to archive a large battle (*e.g.*, Bushman, 1880). Although the *battle* interpretation is speculative, the presence and number of artifacts indicates the environs in the immediate vicinity of Devil's Den were utilised by Native Americans. Unspecified artifacts found at the base of the western side of nearby Big Round Top confirm that this area was a campground utilised by Susquehannock and other tribes (Nasby, 2005). Records also indicate that William Penn's family purchased the land now comprising Adams County from Iroquois Indians (Nasby, 2005). Thus, the newly discovered calendar and its petroglyphs add to the reconstruction of Gettysburg's history and lend further support to the belief that a sedentary Native American society occupied the region and may have charted socially-significant events.

If petroglyphs served as event markers, then it is likely that when the sun reached certain positions on specific dates, the triangular

structure of the calendar would have produced a lit *arrowhead* that pointed into the shadowed space under the leaning diabase slab highlighting them. As the sun moved, the *arrowhead* illuminated particular petroglyphs or portions of them, such as the contact of the distal end of the bear paw with the rod, on precise dates. The position of the petroglyphs favored illumination from the south since sunlight enters into the shaded portion of the calendar obliquely from that direction for a greater period of the year, but only from the northeasterly direction during the weeks immediately preceding and following the summer solstice. Thus, the timing of the summer solstice was reasonably well-defined. Because the petroglyph-bearing rock was removed, one cannot precisely determine which dates petroglyphs or portions thereof were lit. However, the calendar was reconstructed using modeling clay to delve deeper into the workings of the real calendar (Figure 3) as discussed later.

There are no obstructions between the calendar and rising sun on the summer solstice other than the lower limb of Little Round Top, but it was uncertain whether local topographic features prevented light from the setting sun to pass through the southwestern calendar window on the winter solstice. This was field tested on December 19, 2013, two days before the winter solstice, because inclement weather was predicted for December 20 and 21. The difference in solar azimuth at sunset between December 19 and 21 is minor (~0.2°) based on referenced USNO software. Field data verified light from the setting sun on the winter solstice passes entirely through the calendar opening (Figure 4A). As the solar angle (altitude) decreased, sunlight entered the shadowed area in the form of the 'arrowhead' that lengthened, expanded eastward, and eventually illuminated the entire shadowed area, including the location formerly occupied by the petroglyph-covered rock. This confirmed the diabase slab opening is orientated toward the setting sun on the winter solstice. Likewise, a field test performed on June 20, 2014 (one day prior to summer solstice due to inclement weather) confirmed the calendar is also orientated towards the rising sun on the summer solstice (Figure 4B).

It is pertinent to mention that the petroglyph-covered rock was a special but independent calendar component that provided insights to the culture of the indigenous people who constructed it. Its removal by an unknown party does not diminish efforts to demonstrate that the diabase slab was used as a calendar because its openings are aligned to solstices as well as the rising and setting of Pleiades and Sirius, respectively, two celestial objects of cultural significance among the subject Native Americans. Nonetheless, a clay model constructed to replicate the calendar provided

insights on how the sun could have interacted with the petroglyph-covered stone.

The clay model (Figure 3) mimics the calendar's construction. The diabase slab's profile and the angles involved (*e.g.*, the 60° slab lean angle and 75° dipping parent boulder) were maintained to correspond to the real calendar's construction. A clay tablet was fashioned to approximate the shape, placement, and decoration of the petroglyph-bearing rock based on September 2013 photographs. A protractor fastened to the base of the modeled parent boulder allowed the solar angle to be duplicated at a fixed location in line with the southwestern calendar opening. The USNO's (2013) software provided site-specific solar altitude and corresponding dates at a fixed azimuth of 241°. Two dates (March 21 and June 22) and two angles (40°, 50°) were selected for modeling purposes. The dates fall on spring equinox and summer solstice when the solar altitude is 30.7° and 62.6°, respectively. Since the solar altitude approximates 30° and 60° on the referenced dates and because the exact placement of the petroglyph stone was estimated, the reconstruction was performed in 10° increments beginning at 30° and terminating at 60°.

The simulation results are presented as Figure 3. As expected, the model indicates the solar arrowhead lengthened and shortened in concert with cooler and warmer seasons, respectively, and that its tip pointed to petroglyphs. For instance, all petroglyphs were exposed when the solar angle was low (winter solstice sunset, summer solstice sunrise). But when the sun reached a maximum altitude of 63° on the summer solstice and passed the southwestern calendar opening, the arrowhead of light shortened and pointed at the Snake Manitou. The model also suggests the right boundary of the lit arrowhead may have contacted the intersection of the club and bear paw for the first time sometime in March, potentially around spring equinox or to mark the end of bear hibernation. Although the model is interpretative, it demonstrates that sunlight entered the shadowed area as a lit arrowhead that highlighted or pointed to individual petroglyphs and that its interaction was a time-constrained phenomenon potentially denoting special events.

Conclusions

Devil's Den has been a visually distinctive feature in an agriculturally-sustainable area long before the Civil War bloodbath occurred in the nearby Wheatfield portion of the battlefield. The fertile valley and nearby Plum Creek may have been prime resources to sustain Susquehannock driven from traditional riverine settings and into uplands by members of the Iroquois Confederacy. A calendar would have been a useful item for keeping track of

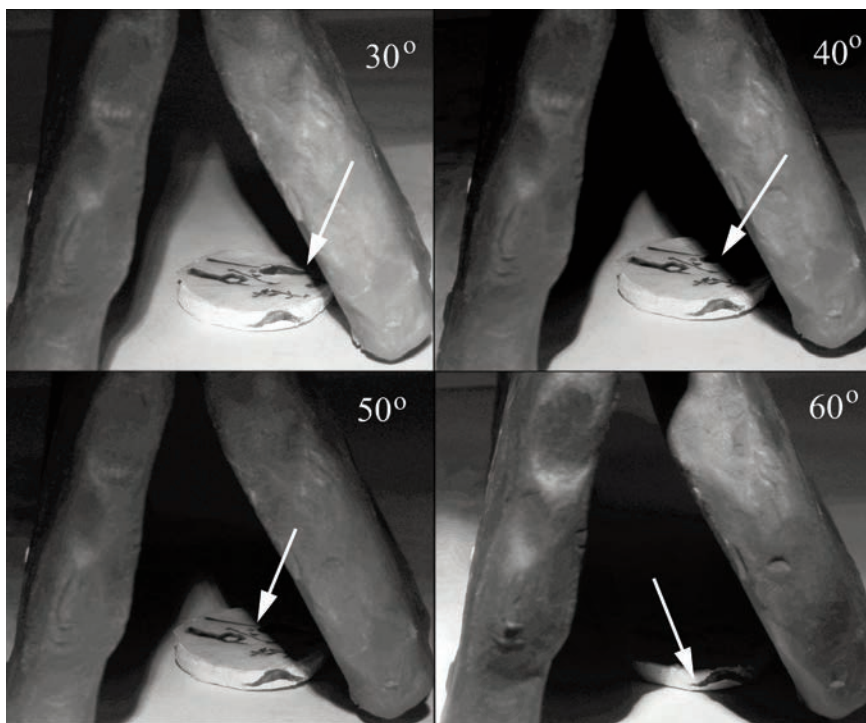


Figure 3. Simulations approximating the solar altitude at 241° azimuth. The location and size of the petroglyph-bearing rock is approximate. The sunlit arrowhead shortens as the summer solstice approaches since the sun's altitude is highest during that time of the year. White arrows point to the potential interaction of sunlight with petroglyphs. On spring equinox (~30°), the entire bear paw is illuminated. The lit arrowhead bisects the paw before the solar altitude reaches 40°. When the sun's altitude is 50°, the north-orientated arrow and unidentified structure below it are highlighted. In addition, the contact between the bear paw and club is bisected by the right side of the lit arrowhead (white arrow). On the summer solstice, the lit arrowhead points at the Snake Manitou.



Figure 4. Sunset on December 19, 2013 (A) and sunrise on June 20, 2014 (B) seen through the calendar rock in opposite directions. The difference in the solar azimuth between these dates and the actual solstices (December 21, June 21) is $\leq 0.2^\circ$.

time, particularly in regard to agricultural practices and cultural events. The calendar is a complex feature aligned with the rising and setting of the sun on summer and winter solstice, respectively, the rising of Pleiades and setting of Sirius marking the timing of the frost season, and had associated petroglyphs linked to select cardinal directions, folklore, and at least two Manitou symbols. Although the interpretations of petroglyphs cannot be fully verified or the nuances regarding why positions of luminaries on particular dates may have borne societal significance, the construction of a dynamic calendar alludes to an established Native American community, one that maintained a functional time-keeping mechanism. The calendar is a rare finding but suggests that related features may be present in plain sight at Gettysburg.

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