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Title
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Permalink
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Journal
Journal of Astronomy in Culture, 4(1)

ISSN
2473-4888

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Publication Date
2026-10-30

DOI
10.5070/AC3.69210

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ARCHAEOASTRONOMY AND LANDSCAPE ARCHAEOLOGY AT SERPENT MOUND

William F. Romain

Abstract:
Built by ancient Native Americans, Serpent Mound is one of the most recognizable effigy earthworks in the world. The effigy appears to represent a massive earthen Serpent about to strike an oval-shaped feature. In this paper several recent archaeoastronomic alignment theories as well as the Lepper-frog interpretation are reviewed. Also presented is an explanation for the shape of the oval embankment based on an observable phenomenon. Following that, new data generated using Stellarium and PeakFinder are presented showing how the effigy incorporates solar, lunar, and stellar alignments. Landscape associations are also discussed. The paper concludes with an interpretation for the effigy consistent with Native American beliefs.

Keywords: Serpent Mound, solstice, lunar standstill, Milky Way, Scorpius, Antares

Serpent Mound (Figures 1 and 2) is located in Adams County, southern Ohio, USA (lat. 39.025770 N, 83.430304 W). The site is located within a narrow corridor of the un-glaciated Lexington Plain or “Ohio Bluegrass” region, bordered by the glaciated Till Plain region roughly 4 km west of the Serpent Mound and the un-glaciated Appalachian Plateau and escarpment about 7 km east of Serpent Mound. Topography in Adams County is rugged and varies from 149 m above mean sea level (MSL) along the Ohio River to about 381 m above MSL in the hilly eastern part of the county.



Figure 1. Aerial view of Serpent Mound. Photo by the author.

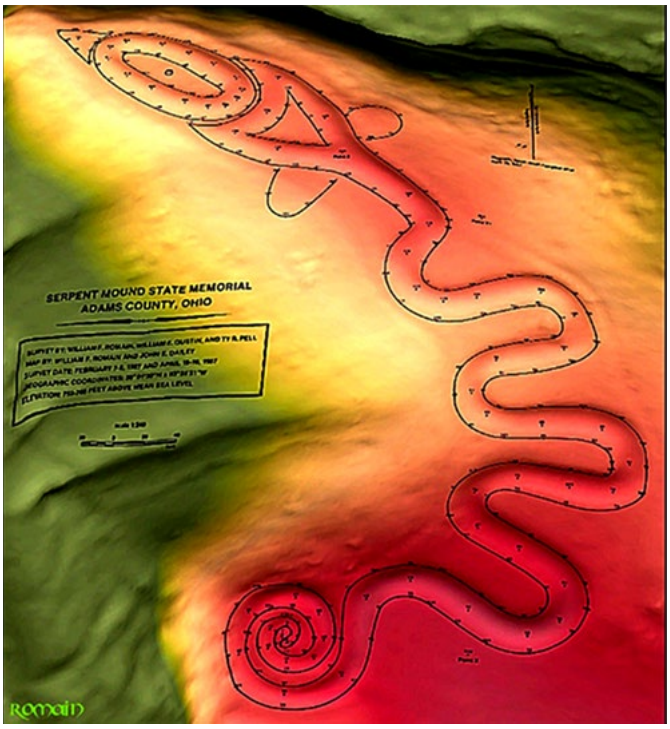


Figure 2. Ground survey map of Serpent Mound (Romain, 1987) superimposed over LiDAR image. Images by the author.

Since its documentation in 1848 by Ephraim Squier and Edwin Davis, Serpent Mound has intrigued those who have considered it. The tail of the Serpent coils around in a posture common to many snake species. From the tail the effigy stretches along a promontory overlooking Brush Creek with the creature's body undulating in a series of curves or convolutions. The curve closest to the head is reminiscent of the S-shape posture that certain snakes assume prior to a strike. The Serpent terminates in what appears to be the side view of the snake lunging with open mouth about to strike or swallow the oval-shaped embankment. If the body of the serpent were to be stretched-out, then from the end of its north jaw to the tip of its tail its length would measure 380 meters (1,247 ft). Its width ranges from 5 – 9 meters; its height varies but is mostly less than 1 meter.

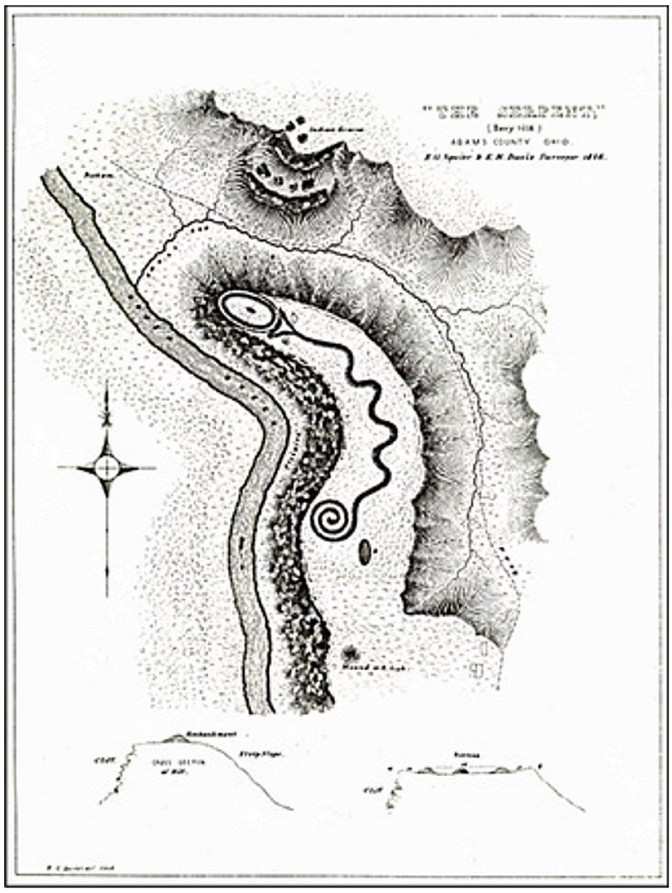


Figure 3. Squier and Davis (1848, pl. XXXV) map of Serpent Mound. Note the cross-sections at the bottom of the map – with nothing resembling encircling frog legs. Also shown are multiple "Indian Graves" to the northeast of the oval embankment.

The hypothesis present here is that Serpent Mound incorporates alignments to the Sun, Moon, Antares in the constellation Scorpius, and the Milky Way. In support of this hypothesis new data are provided based on computer assessments using Stellarium (Zotti et al., 2021) and PeakFinder (Soldati, 2026). Additionally, an explanation for the shape of the oval embankment is presented. Lastly, an interpretation for the effigy based on historic-period Native American beliefs is discussed.

Before beginning, however, there has been so much misinformation published about Serpent Mound that it might prove useful to address some of the more problematic issues including unlikely models for astronomic alignments.

Radiocarbon Dates

The date when Serpent Mound was constructed has been debated for years (Fletcher et al., 1996; Herrmann et al., 2014; Lepper et al., 2018; Romain, 2018; Romain et al., 2017; Romain and Herrmann, 2018). There are two interpretations based on radiocarbon data. The first was offered by Fletcher et al., (1996, p. 133) who argued for a “Late Prehistoric or Early Fort Ancient” construction date around 1070 ±70 CE. The Fletcher team based their assessment on two radiocarbon dates from charcoal fragments recovered from within convolution 3. A third sample that was retrieved by the Fletcher team by coring yielded a date of about 970 BCE at a depth of 132 cm (Fletcher et al., 1996, p. 133).

An alternative interpretation advanced by Herrmann et al., (2014) was that the effigy was built around 320 BCE. The 320 BCE date is based on 7 radiocarbon dated bulk sediment samples retrieved by Geoprobe coring from 5 different locations. I will return to a discussion of the 320 BCE date below. Before that, however, it will be useful to explain why the Fort Ancient date probably does not reflect when the effigy was built.

A factor that will become important in what follows is that in the 1800s, Frederic W. Putnam restored the effigy by piling earth on top of its embankments to bring it to a height he believed reflective of its original condition. (Putnam [1839-1915] was an anthropologist and archaeologist affiliated with the Peabody Museum of American Archaeology and Ethnology at Harvard University.) Exactly how much earth was added is difficult to determine with certainty. However, Figures 4a and 4b give us an idea.



Figure 4a. Pre-restoration view of Serpent Mound looking to the southeast from near convolution C1. Putnam is the gentleman on the right wearing the top hat. Corn surrounds the cleared effigy
Figure 4b. Post-restoration photo (ca. 1987) of Serpent Mound taken from about the same location as pre-restoration photo. Photo by author.

In an effort to determine when Serpent Mound was built, the Fletcher team opened a trench that had previously been made by Putnam. The Putnam trench extended across convolution 3. Fletcher et al., (1996) expanded the north face of the Putnam trench northward until they reached what they believed to be just beyond the margin of Putnam's trench. Their radiocarbon dated samples came from within the north face of the expanded trench.

Prior to Putnam's restoration, the serpent effigy was impacted by several damaging factors. According to Putnam (1890, p. 872), when Squier and Davis visited the earthwork in 1846 "it was covered with a thick forest, from which many a noble tree has been cut, as indicated by stumps still standing at the time of our visit." Putnam (1890, p.

872) goes on to explain that “Thirteen or fourteen years after their visit a tornado swept its path directly along the serpent hill, and with the exception of a few saplings, the forest was laid low.” According to Putnam (1890, p. 872) the tornado damage “led to clearing the land, and to the cultivation for a few years of the portion occupied by the serpent.” Putman (1890, p. 875) reports that “several plowings” [sic] had taken place.

At a lecture given by Putnam (quoted in Wright, 1892, p. 180), Putnam reportedly said: “But repeated visits had shown that it was fast going to destruction. Its surface had been repeatedly ploughed, and successive crops of grain had been grown upon it.” Elsewhere, Putnam (1888, p. 316) said: “Several years since these earthworks were ploughed over and cultivated for a few years, and holes were dug by seekers for buried treasures; paths and washouts have also injured the embankment, but all these injuries will be repaired and *the earth ploughed from the top of the embankment down its sides* will be replaced…” (emphasis added by present author).

In addition to ‘washouts’ and pot holes by looters, animal disturbances affected the site. In fact Fletcher et al., (1996, Figure 10) show what they interpret as two animal disturbances in their trench profile drawing. The most problematic animal disturbance is located about 8 cm (3 in) from their sample 4a and 12 cm (5 in) from their sample 5a. The close proximity of a major animal disturbance to their samples does not inspire confidence. Burrow-digging animals such as ground hogs and chipmunks are known for their proclivity to bring all kinds of things down into their underground nests.

On another matter and perhaps anticipating that the issue of ploughing might be problematic, Fletcher et al., (1996, p. 110) note that during a visit to the Serpent in 1885, Putnam (1890, p. 872) reached an agreement with property owner John Lovett that the effigy “should remain intact for a year” pending its purchase.

However, more than two decades had passed between the 1859 tornado and the Putnam-Lovett agreement. How many times the effigy was actually ploughed during those intervening years is not known.

Plow depths in the 1800s were between 15 cm – 25 cm (6 – 10 in). Repeated ploughing before restoration could have introduced Fort Ancient surface charcoal into the pre-restoration mound fill. (Fort Ancient refers to an archaeological tradition dating to ca. 1000 CE – 1750 CE.)

There is another problem with the Fletcher team findings, however – and that relates to the depths of their samples relative to the base of the mound.

Fletcher et al., do not provide coordinate data for the precise location of their work. However, I was able to establish that location by review of magnetic gradient survey data provided by Jarrod Burks (2012, 2014) as part of The Serpent Mound Project. The Burks report includes imagery showing the magnetic signature where the Fletcher team excavated and identifies their backfilled trench as ‘anomaly 34’ at grid coordinates: 1087.35 Northing, 1010.78 Easting. (Coordinates are for Burks’ grid map tied to Romain’s 1987 datums.)

Using these data the Fletcher trench was plotted on a lidar image. The plotted location is near the apex of convolution 3 and corresponds to the location shown by Fletcher et al., (1996, Figure 10).

The next step was to create a lidar profile through the body of the effigy where the Fletcher team made their trench (Figure 5a). Once this was done, the depths of the Fletcher samples were plotted (Figure 5b).

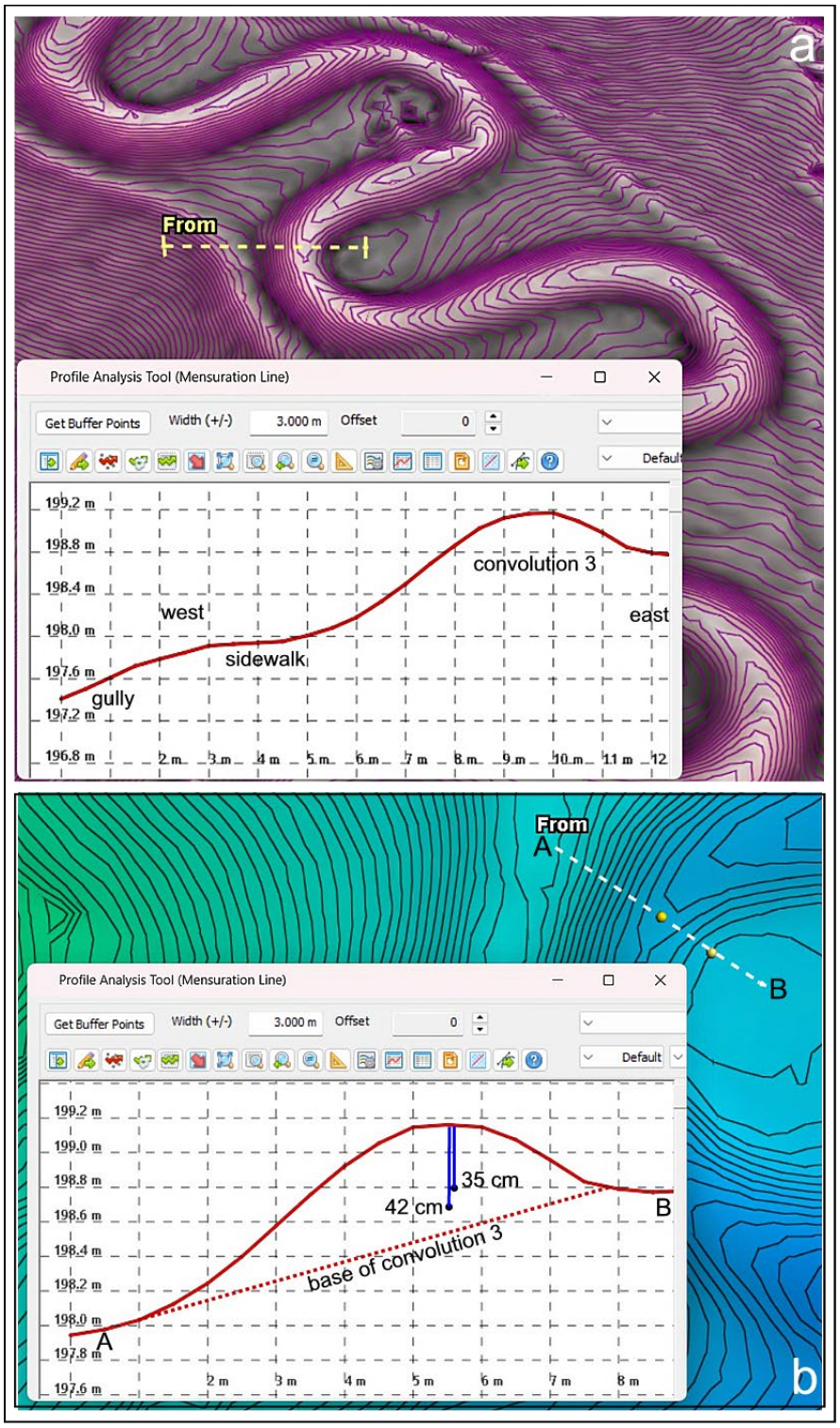


Figure 5a. Lidar image and profile of convolution 3. Contour interval = 0.1 m. No vertical exaggeration.
Figure 5b. Lidar image of convolution 3 showing location for profile A-B. Yellow markers positioned from overlay of georeferenced magnetic gradient image for purposes of identifying location and trajectory of Fletcher trench.

inset profile (red line) extending from point A to point B. Base of convolution 3 shown by dashed line. Depths of radiocarbon samples as per Fletcher et al., (1996, Figure 10). Images by the author.

Depths were determined from Fletcher et al., 1996, Figure 10 which shows a cross-section drawing of their trench and locations for the retrieved samples. Fletcher et al., (1996) do not provide quantitative documentation for the depths of their samples. However, their illustration includes a scale graduated at 10 cm intervals. Assessment of that illustration indicates that the Fort Ancient charcoal came from depths of ca. 35 cm and 42 cm below the surface, respectively.

As Figure 5a shows, the topography at convolution 3 is sloped downward and to the west. The angle of slope is significant, dropping about 115 cm (3.8 ft) in a distance of 7 meters (23 ft) as measured from the inside east edge of convolution 3 to the inside edge of the sidewalk on the west side of the effigy (Figure 5a). This represents a slope angle of 15º. Contrary to that, Fletcher et al., (1996, Figure 12) represent the slope as about 7º. The Fletcher team grossly underestimated the slope. A few simple measurements for vertical height on either side of the convolution might have prevented this blunder. As a result, their assessment for the location for the Fort Ancient charcoal relative to the base of the mound is not accurate. Analysis of the lidar profile with plotted sample depths as well as their own Figure 10 reveals that the Fletcher team did not obtain their radiocarbon-dated samples from the base of the mound. Their samples came from mound fill above the base. (Lepper again failed to excavate to the bottom of a cut through the tail section that he opened-up and recovered charcoal from – see discussion and photograph in Romain & Herrmann 2018.)

In summary and as mentioned earlier, when Putman restored Serpent Mound he scraped-up soil from the area and used it to build-up the height of the mound. As a result, the serpent effigy consists of earth laid-down by the original mound builders and an additional layer added by Putman.

Since Fort Ancient peoples did in fact occupy the Serpent area, it is natural that Fort Ancient charcoal would be included in the soil that Putnam gathered and piled on top of the original mound. If the Fletcher team did not penetrate this additional layer, then what they recovered was from the Putnam-added layer.

Alternatively, it is possible that Fort Ancient charcoal was deposited on the surface of the original Adena-era mound when Fort Ancient people occupied the area. The Fort Ancient charcoal would have remained on the surface and/or been mixed-in with upper layers of the original mound (either naturally or by ploughing) until covered-over by Putnam. In this scenario the Fletcher team penetrated the Putnam layer, but recovered charcoal that had been sitting at or near the surface of the original Adena mound until covered-over by Putnam.

As interesting as it is, radiocarbon dated charcoal from mound fill above the base of a disturbed and restored earthwork does not tell us when it was built. As it stands now, since the Fletcher charcoal did not come from the base of the mound, it cannot be accepted as indicative of when the effigy was built. The Fletcher findings only confirm that there was an occupation of the area by Fort Ancient peoples sometime after its construction.

In 2012, a second set of radiocarbon dates were obtained by The Serpent Mound Project. (I was the permit holder and principal investigator.) Geoprobe coring was conducted at 18 different locations along the spine of the effigy. This phase of the investigation was led by geoarchaeologist Dr. G. William Monaghan (director of the Glenn A. Black Laboratory of Archaeology at Indiana University, and senior scientist for the Indiana Geological Survey).

Monaghan was able to identify the base of the mound in the cores and retrieved four organic sediment samples from the base and three from “fill just above the base” for radiocarbon dating (Herrmann et al., 2014, p. 120). As an example, Figure 6 shows a lidar profile through the neck of the effigy at core # 13. Locations for all cores relative to control point 1 were documented using a total station (Romain et al. 2017, Figure 3). As shown by Romain et al. 2017, Table 1, the depth of the core # 13 radiocarbon-dated sample was 100–105 cm. (Median cal age for this sample was 375 BCE [Romain et al. 2017, Table 1]). By plotting the depth of the sample on the lidar profile we can confirm that it came from the base of the mound. This is in stark contrast to the Fletcher team samples that came from mound fill above the base.

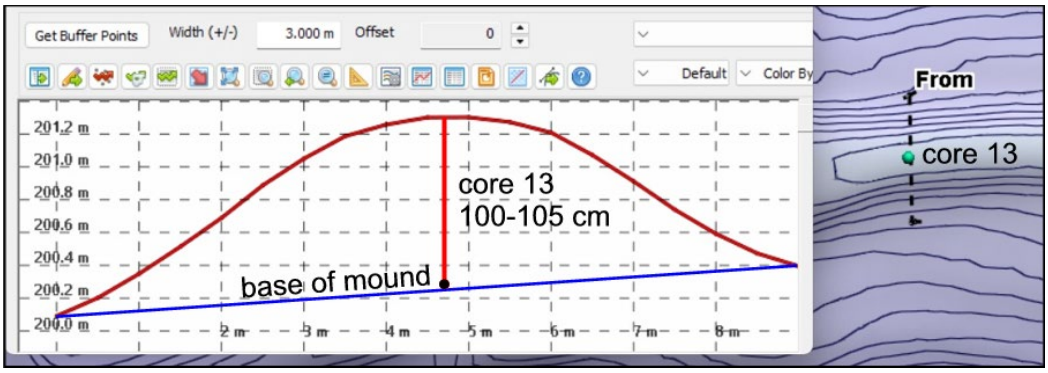


Figure 6. Lidar image and profile through neck of effigy at core 13. Radiocarbon-dated sample Beta # 337170 was recovered at a depth of 100–105 cm below the surface of the mound. Images by author.

Continuing the narrative, Monaghan described the sediments recovered from the base of the mound as “charcoal-rich”. These sediments by the way, although ‘organic’ were not what Lepper (2018, p. 71) misleadingly characterized as “soil humates.” There are significant differences. In any case, as Herrmann et al., (2014, p. 120) explain, “the charcoal pieces sampled were too small to remove from the matrix or to submit as standalone dates.” The samples were dated by Beta Analytic, Inc. who advised the present author that the samples: “provided plenty of carbon for an accurate measurement and the analysis proceeded normally” (letter to Romain dated 12-28-2012).

Statistical analysis (OxCal) indicated a median date of 321 BCE. This positions the effigy as contemporaneous with major Adena sites such as the Cresap Mound (West Virginia), Toepfner Mound (Ohio) and Dover Mound (Kentucky). However, the 2-sigma range for the sample dates is 381 BCE – 44 BCE (Herrmann et al., 2018, p. 121, Figure 2). The upper limit of the 2 sigma range – i.e., the 44 BCE date, situates the effigy within temporal striking range of Hopewell – which according to Seeman and Nolan (2023), flourished from about 90 CE to 430 CE. And of course, Hopewell is well-known for its lunar alignments at the Newark and High Bank earthworks (Hively & Horn, 1982, 1984; Romain 2015a). Notably, none of the Serpent Mound Project radiocarbon samples yielded a Fort Ancient date. If Fort Ancient people built Serpent Mound, they were remarkably good at leaving no evidence of their activities at the base of the mound.

Ultimately, the date when Serpent Mound was built will remain unresolved until new work retrieves radiocarbon-dated charcoal from the undisputed base of the mound. That is not likely to happen soon, given the reluctance to further impact the mound using invasive methods. Important to recognize, however, is that the temporal difference between 381 BCE and 1000 CE would not have made a noticeable difference in the celestial azimuths calculated below. The posited solar, lunar, and stellar alignments would have been basically the same whether viewed by Adena, Hopewell, or Fort Ancient peoples.

The Oval Embankment

Various interpretations have been offered for the oval embankment. One of the oldest and most common is that the oval represents an egg (e.g., MacLean, 1885, p. 46; Greenman, 1935). Others have proposed that the oval represents the Sun (e.g., Pidgeon, 1853, pp. 243–244; Hardman & Hardman, 1987, p. 35; Romain, 2000, p. 252). A more recent interpretation by Lepper et al., (2018) and summarized by journalist Jason Colavito (2026) is that the oval represents the genitalia of the mythical Dhegiha Siouan entity known as First Woman. (The Dhegiha Sioux include the Osage, Omaha, Ponca, Kansa, and Quapaw tribes.) In this interpretation the legendary Great Serpent as represent by the serpent effigy is engaged in sexual intercourse with First Woman. Specifically, according to Lepper et al., (2018, p. 10): “the serpent effigy would be the Lord of the Beneath World, the ‘Frog’ would be First Woman with spread legs in a coital position, and the ‘Egg’ would be the ‘Toothy mouth’ of the Great Serpent or First Woman’s symbolically enlarged vulva.” (Quite the sexual fantasy.) Further, Lepper et al., (2018, p.15) propose that Serpent Mound is a “symbolic representation of a key moment in the Dhegihan creation story…” and as such, it is “an instrument through which the world could be actively renewed.” This interpretation has been aggressively publicized in multiple venues by Lepper and associates.

The idea of world renewal as a reason for building earthworks was popular among scholars decades ago. In fact in year 2000, I opined that: “perhaps the Mound Builders celebrated world renewal ceremonies at the [Serpent Mound] site” (Romain, 2000, p. 253). Since that time new theoretical approaches (e.g., relational, cognitive,

phenomenological, ontological) and new technologies as discussed later, have advanced our understanding beyond such simplistic interpretations.

In any case, according to Colavito (2026, p. 37), however, Ben Barnes, chief of the Shawnee tribe, believes that the “origins of Serpent Mound [are found in] the beliefs of his Shawnee ancestors”. Indeed, the Shawnee have their own version of the Great Serpent (Mooney, 1900, p. 298). As explained by Barnes (quoted by Pember 2021), “The great serpent is present within our Shawnee traditions and religious practices today; this is our umbilical, our connection to the world below.”

However, the Shawnee belong to the Algonquian language group which is different from the Dhegiha Siouan language group used to reference the First Woman story. (Among the many tribes that belong to the Algonquian language group are the Ojibwe, Sauk, Fox, and Miami.) And the Shawnee creation story differs from that of the Dhegiha Siouan (see e.g., Schutz, 2019). So who knows? Was Serpent Mound built by Dhegiha Siouan, or Algonquian peoples? To address this dilemma Lepper (2022, p. 117) has proposed that the effigy “represents a fusion of Mississippian/ Dhegihan ideology and artistic styles, Upper Midwestern Late Woodland modes of telling sacred stories with effigy mounds and Fort Ancient culture traditions.” That is quite a mix. But what about the Cherokee? Why leave them out?

The Cherokee language belongs to the Iroquoian language group and that language group is not related to either Dhegiha Siouan or Algonquian. However, the Cherokee have a well-known story that recounts a fierce battle between the Sun and Great Serpent known as the Uktena (Mooney, 1900, pp. 297-298) (Figure 7a). The Uktena lives in high mountain passes and in “deep pools in the river” (Mooney 1900, p. 297). According to Mooney (1900, p. 297), “Those who know say the Uktena is a great snake, as large around as a tree trunk, with horns on its head and a bright blazing crest like a diamond on its forehead, and scales glittering like sparks of fire.” The Cherokee believe that the Uktena crystal and even pieces of its scales give its possessor extraordinary powers (Mooney, 1900, p. 301).

Coincidentally enough, exposures of calcite crystals are found in the Serpent Mound cliff facing Brush Creek (Figures 7c and 7d). And the Cherokee have a traditional ‘Snake Dance’ that mimics the movements of the rattlesnake (Speck and Broom, 1983).

For this dance the leader wears a carved rattlesnake mask (Sizemore, 1999, p. 248) (Figure 7b). Historically the Cherokee ranged as far north as the Ohio River – a mere 30 miles from Serpent Mound (Royce, 1884).

The Cherokee also have a story known as ‘The Daughter of the Sun’ (Mooney, 1900, pp. 252–253). In this story, the Sun is causing the deaths of the people by its relentless heat. Deciding to kill the Sun, at the request of the Cherokee, the Little People change two people into snakes and send them to “bite the Old Sun” (Mooney, 1900, p. 252). Although it is not advisable to draw a direct historic connection between a single tribal story and an ancient earthwork – except perhaps as a way of introducing a generalized concept, the correspondence between the Cherokee story and Serpent Mound effigy appearing to strike or bite at the Sun symbol is at least, thought-provoking. In the same story we learn that the “Ghost country” where deceased souls exist is situated to the west, in the “Darkening land” (Mooney, 1900, p. 253). It takes little effort to imagine that the Serpent Mound summer solstice sunset alignment shows the direction to the Ghost Country or Darkening Land.

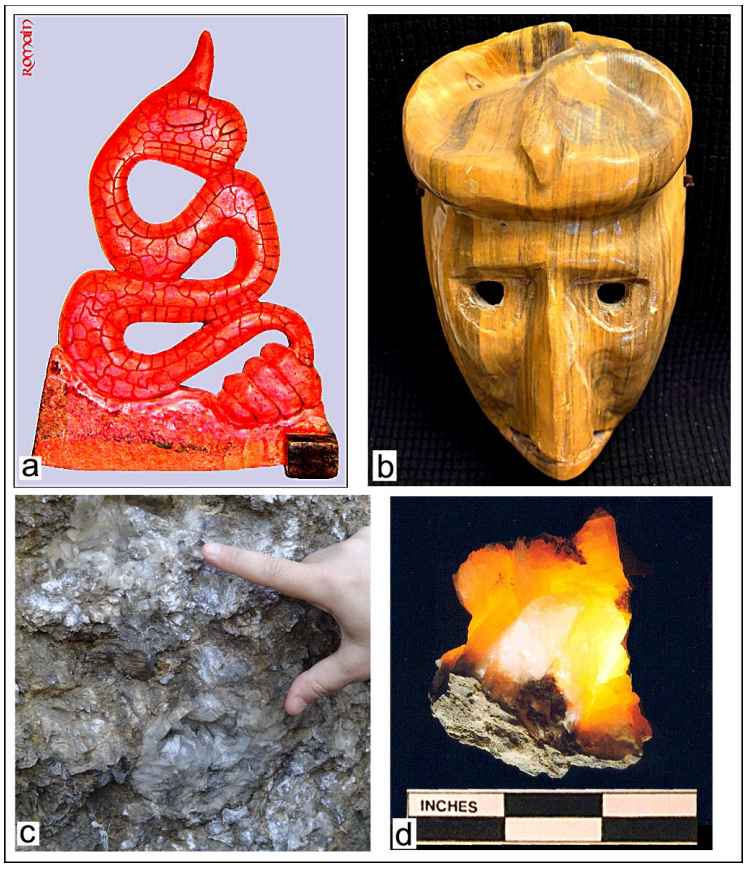


Figure 7a. Great Horned Serpent carved from red steatite. Sculpture by Cherokee artist. Author's collection.
Figure 7b. Cherokee snake dance mask. Author's collection.
Figure 7c. Calcite crystals embedded in Serpent Mound cliff. Photo by author.
Figure 7d. Calcite nodule found along Brush Creek illuminated by backlight. Photo by author.

According to the USDA Forest Service (www.fs.usda.gov) at least 50 American Indian tribes had "known or possible ancestral ties to Ohio." These include the Delaware, Miami, Erie, Wyandot, and Shawnee. As I have noted elsewhere (Romain, 2018) it is a perilous endeavour to attribute Serpent Mound to any one group or tribe based on perceived iconographic resemblances separated by time, distance, and culture and further complicated by diaspora resulting from warfare, disease, and European interactions.

Any connection between Picture Cave in Missouri and Serpent Mound in Ohio rests in the first instance on an interpretation by James Duncan (2015) relative to two or three pictographs selected from among the hundreds of images in the cave and then further interpreted by Lepper and colleagues. However, there are dozens of creation stories among the tribes of the Eastern Woodlands. Selecting a Dhegiha Siouan story that may or may not be depicted in Picture Cave excludes others and advocates for an association where there is no direct evidence. Any proposed connection between three figures lifted from Picture Cave and interpreted by reference to a Dhegiha Siouan story recorded a thousand years after Picture Cave and then applied back in time to Serpent Mound seems an unlikely appropriation.

Moreover, there is no physical evidence that a frog or effigy of First Woman was located in front of the oval embankment. Frederic Putnam who excavated and restored the effigy does not show it on his final, published images (Figure 8). Squier & Davis (1848, pl. XXXV) who first documented the effigy do not show it (Figure 9a). Magnetic gradient survey does not show it (Burks, 2012, 2014) and lidar images do not show it (Figure 9b).

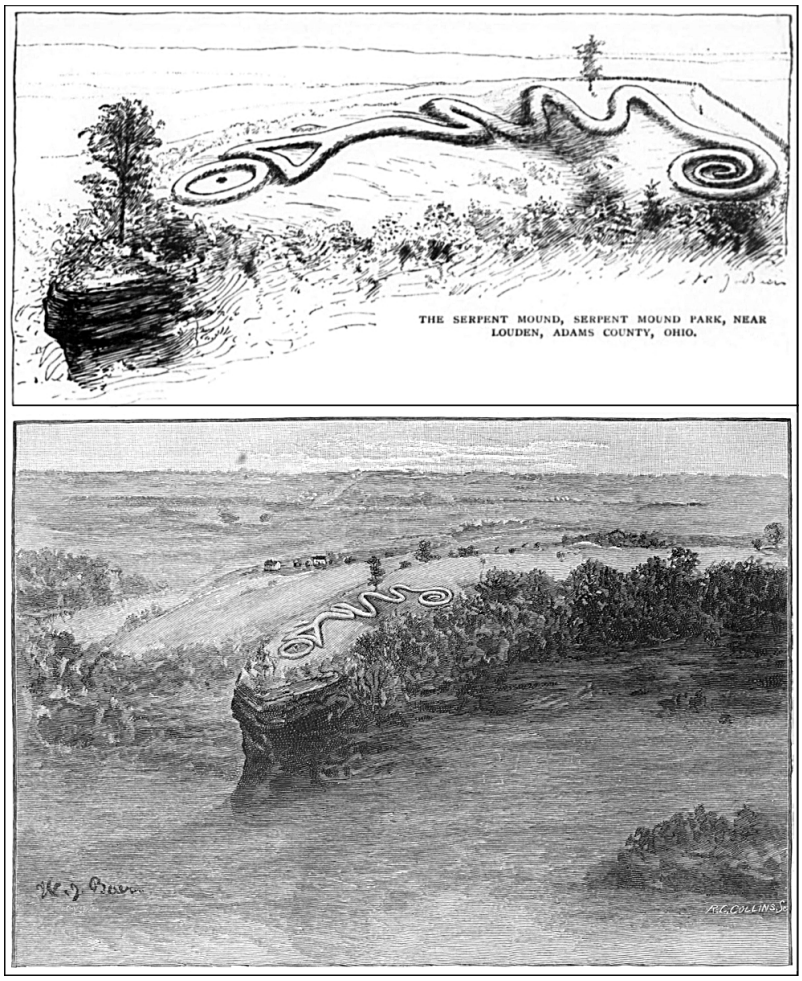


Figure 8. Views of Serpent Mound as published by Putnam (1890). From *Century Illustrated Magazine* 1890, vol. 39, no. 6, pp. 871 & 872.

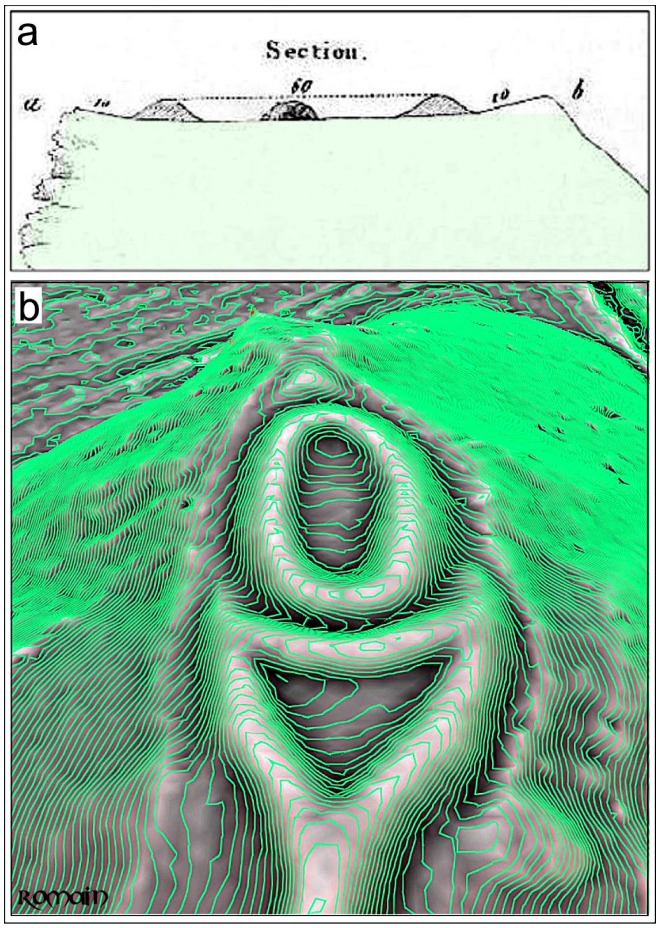


Figure 9a. Squier and Davis (1848, pl. XXXV, inset) cross-section of oval embankment. Color added by present author. No surrounding frog legs are shown on either side of the oval.
Figure 9b. Lidar view of Serpent Mound oval embankment. Ghostly white area around the oval and head is the sidewalk. Contour interval = 0.1 meter. Archival research of Peabody Museum files by Wilson (2017) indicates that the mound at the bottom right held the remains of three persons. Image by the author.

Lepper's 'frog' came alive in 1885 thanks to a map made by Rev. John P. MacLean (Figure 10a). The map was made prior to Putnam's restoration. However, MacLean's map is so inaccurate that one wonders what he was surveying.

By 1885 land surveying in the United States had reached a high level of competency with rigorous standards codified into law (United States General Land Office, 1855, *Instructions to the Surveyors General of Public Lands*). Surveyors were routinely laying out railroads, bridges, buildings and city streets to within arc-minutes of accuracy (Romain, 2024).

As shown by comparison to lidar imagery (Figure 10b), however, MacLean's map fails to show the length of the neck correctly, convolution 1 is almost unrecognizable, other convolutions are not even close to being accurate, the tail is too wide, and so on. This raises the question – if MacLean could not get these obvious features correct, then why would anyone lend credibility to his frog, much less craft an interpretation for Serpent Mound based on his imaginary frog?

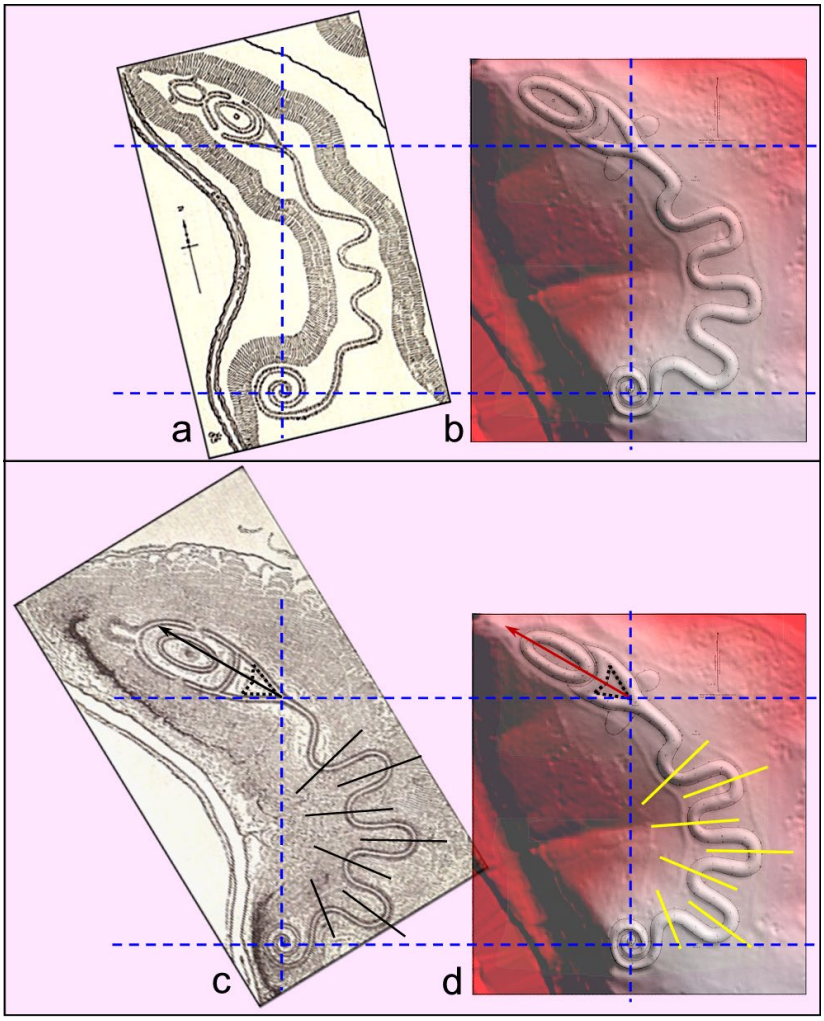


Figure 10a. MacLean 1885 map of Serpent Mound. From MacLean, 1885.
Figure 10b. Lidar image matched to MacLean map using locations for head-neck intersection and tip of tail.
Figure 10c. W. H. Holmes map of Serpent Mound. From Holmes, 1886, fig.1.
Figure 10d. Lidar image matched to Holmes map using locations for head-neck intersection and tip of tail.

In 1886, William H. Holmes also published a pre-restoration map of the Serpent (Figure 10c). Although an improvement over the MacLean map, it was still not accurate.

For example, as shown by Figures 10c and 10d, the area within the head of the serpent as represented by Holmes is roughly twice the size as indicated by lidar. Worse yet, the azimuth for the oval as shown by Holmes is off by several degrees. As was the case for the MacLean map, if we cannot rely on Holmes with respect to these basic details then why should we expect other details to be accurate?

Indeed, one must ask – who's representations are more likely credible – Squier and Davis who first documented the effigy and Putnam who did the actual restoration work – and show no frog? Or the fantastical drawings by MacLean and Holmes who were not able to render even the most basic features correctly?

There are several published post-restoration maps of the effigy. They vary in accuracy. And while interesting as a historical matter, there is no need to rely such drawings when more accurate results can be had using lidar. Willoughby's 1919 post-restoration map is an example. Surprisingly, Willoughby's map is one of the least accurate. Figure 11 shows his map superimposed over a lidar image. Willoughby's depiction of an embankment encircling the oval is questionable given that other major features are not correctly represented. He shows the tail pointing toward the head, which it does not. He shows body convolution 7 (i.e., the one closest to the tail) as far less acute than it actually is. And he shows body convolutions 2, 4, and 6 having a peculiar slant to the south. Why? And again, why would any researcher use these kinds of post-restoration drawings when precise lidar imagery is available?



Figure 11. Willoughby's (1919, Figure 15) map of Serpent Mound superimposed over LiDAR image.

In short, there is no frog at Serpent Mound. There are no embankments around the

anterior half of the oval that might be interpreted as frog legs – even taking into account the added walkway. In fact, Squier and Davis included with their map of Serpent Mound, a profile view through the oval embankment (Figure 9a, above). They show no surrounding embankment.

Ground survey today finds a low triangular shaped feature in front of the oval where surrounding footpaths meet. This was documented by Putnam in his pre-restoration sketches of Serpent Mound (Putnam, n.d.) and apparently is what Lepper believes to be the frog's body. Alternatively, the feature might be a slightly raised viewing location, or maybe its arrow shape was meant to point to the solstice sunset location. It might even be that the feature was symbol for Venus as the Evening Star which closely follows the Sun (Wilson, 2007). Any of these explanations are more plausible than a frog's body.

In fact, with reference to the supposed embankments around the oval, Putnam (1885, pp. 11–12) specifically explains that those features "may have been formed by sheep or cattle approaching the edge of the cliff around the oval figure."

Although his drawing of Serpent Mound leaves much to be desired, Willoughby (1919, pp. 159–160) opined the following: "The portion of the promontory on which the oval rests was carefully graded [as Putnam notes, by prehistoric builders]….This gave the effect of a trench encircling the oval which was very shallow opposite f, f. The gradual sloping of the inner ends of these embankments [i.e., the jaws] to the graded sides of the platform gave the effect of the continuation of f, f, much reduced in height, which accounts for the somewhat misleading delineation near these points in the drawing of McLean [sic, 1885] and Holmes [1886]." Again, no frog legs.

The Serpent Mound oval embankment could have been intended as a Sun symbol or ogee, or both (Romain, 2018, pp. 6–7, 20). Symbols often have multiple meanings. I will return to this idea below. For now, what I wish to enter into the discussion is the possibility that as a Sun symbol, the oval embankment might have been inspired by a real phenomenon witnessed by the Serpent Mound builders. What follows addresses misinformed statements such as: 'the oval cannot have been intended to be a representation of the Sun as it is clearly an oval and the Sun never appears in indigenous iconography as an oval.'

Known as ‘flattening of the Sun’, the effect is caused by atmospheric refraction (Greenler, 1980, pp. 153–154, Figure 7–12). It causes the Sun at sunset and sunrise to look like an oval. The extent to which the Sun appears squashed (i.e., its ellipticity) depends on the Sun’s altitude above the horizon and atmospheric conditions at the time. Figure 12a shows the phenomenon. The flattening effect is something most people witness at one time or another, but simply give no particular thought to.

By the way, when I refer to the oval embankment as an oval, I am using the term loosely and in deference to common descriptions of the feature. In actuality the oval embankment is more of a symmetrical ellipse. Ovals – like eggs, are not necessarily symmetrical.

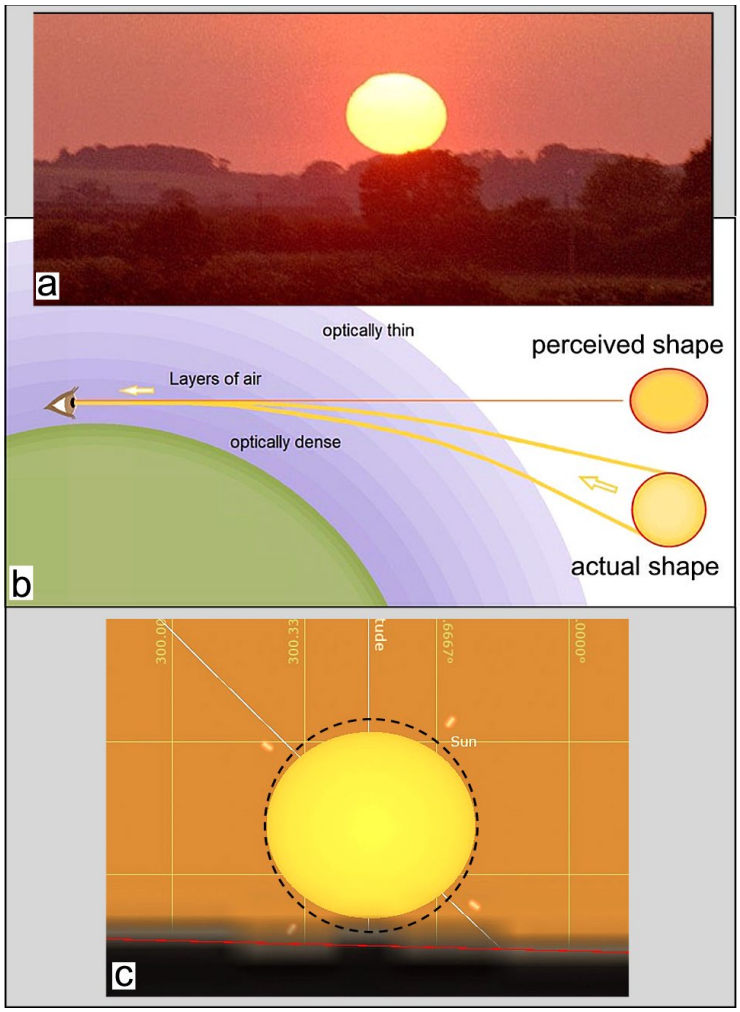


Figure 12a. Photograph showing flattening of the Sun at sunset. Photo by Les Cowley at: https://www.atoptics.co.uk/blog/flattened-suns/

Figure 12b. Graphic showing how the sun appears to change shape due to atmospheric refraction. Image annotated by present author. From File:Atmospheric refraction - sunset and sunrise.png - Wikimedia Commons

Figure 12c. Close-up of summer solstice sunset in year -292 showing how Stellarium represents the flattened Sun. Dashed line circle added by author for comparison.

The flattening effect is explained by Gutierrez et al., 2004, p. 101:

> Other interesting refraction phenomena occur during sunsets. The flattened sun is probably the most common one, and happens when the atmosphere has an index of refraction that decreases with height. It is so common because usually the density of the air decreases as one moves away from the Earth, and so the index of refraction decreases as well. As a result of this, the sun is not seen as a perfect circle, but appears rather flattened along the vertical axis. The rays become curved downwards, towards the areas with a greater index of refraction, causing the distortion of the sun.

Figure 12b shows the physics of the phenomenon. I suggest that the ancient Serpent Mound builders were astute sky-watchers and would not have missed such an obvious shape-shifting phenomenon. Interestingly, the optical flattening at sunrise and sunset is simulated in Stellarium when the 'atmospheric visualization' box is checked in the Viewing Options tab (see Figure 12c).

The other thing about the oval as a Sun symbol is that when a circle is squashed to an oval shape, a major axis is created through the longitudinal length of the oval. In the case of the Serpent Mound oval embankment, the major axis allows the oval to point to a specific direction – which in this case is to the summer solstice sunset. Circles do not afford that option as their diameters point in all directions.

Solstice Alignments

In 1979 avocational archaeologists Clark and Marjorie Hardman visited Serpent Mound. They established 17 ground "triangulation points" on the effigy, overlaid their triangulation grid onto a 1960 USGS aerial photo and from that, drew a map of Serpent Mound. They noted that the image of the effigy was "about three-eighths of an inch long

on this 9 x 9 negative" (Hardman & Hardman, 1987, p. 35). Based on their map they proposed that the oval was aligned to the summer solstice sunset. The Hardmans (1987) published their findings in the *Ohio Archaeologist*. Specifically they said: "Note the long diameter of the oval is an approximate alignment with the summer solstice position on the horizon" (Hardman & Hardman, 1987, p. 35).

Sadly, however, in the official 1994 Serpent Mound guidebook, published by the Ohio Historical Society and authored by Robert C. Glotzhober and Bradley Lepper (at the time senior archaeologist for OHC) the Hardmans' discovery was not mentioned. Instead, the OHC guidebook (Glotzhober & Lepper, 1994, pp. 10–11) featured a two-page centerfold map made by Fletcher and Cameron showing the same alignments for the Serpent's body as proposed by the Hardmans. The accompanying figure caption by Glotzhober and Lepper stated: "astronomical alignments at Serpent Mound were mapped by Robert V. Fletcher and Terry L. Cameron in 1993." Lepper had worked with Fletcher and Cameron at Serpent Mound in 1991 when they obtained the controversial Fort Ancient radiocarbon dates.

A few years later Lepper penned an article for *Timeline* – a journal published by the Ohio Historical Society. This time Lepper (1998, p. 40) said: "Avocational archaeologists Robert Fletcher and Terry Cameron discovered that the head of Serpent Mound…is aligned to the setting Sun on the summer solstice. Furthermore, they found that the coils of the Serpent Mound are variously aligned to the summer solstice sunrise, the sunrise on the equinox, and the winter solstice sunrise." Again, no mention of the Hardmans.

In an article wherein Lepper was third author (Fletcher et al., 1996, p. 138), the primacy of the Hardmans' discovery was acknowledged. But by then, nearly 10 years had passed.

Initially I was sceptical of the Hardmans' solstice alignment through the oval because of inaccuracies I found elsewhere in their mapping. That changed, however, when I was able to photograph the solstice event (Figure 13a). And, calculations (Romain, 1991) confirmed the alignment – although it is not perfect. The issue is not so much the change in the Sun's azimuth over time. In fact the change in the Sun's azimuth due change in the obliquity of the orbit is only about 0.28˚ from 500 BCE to 1000 CE.

Rather, accuracy of the alignment depends on where the observer makes the sightings from. The azimuth for the oval's longitudinal axis is not the same as the azimuth for a sightline originating at the juncture of the head and neck. The difference is about 0.5º. The discrepancy, however, is within the margin of error for all the proposed alignments of plus or minus one degree resulting from unknown tree heights both near and far, refraction for other than assumed standard conditions, differences in whether rise and set points were considered to occur at upper limb, lower limb, or center of the Sun, and other variables.

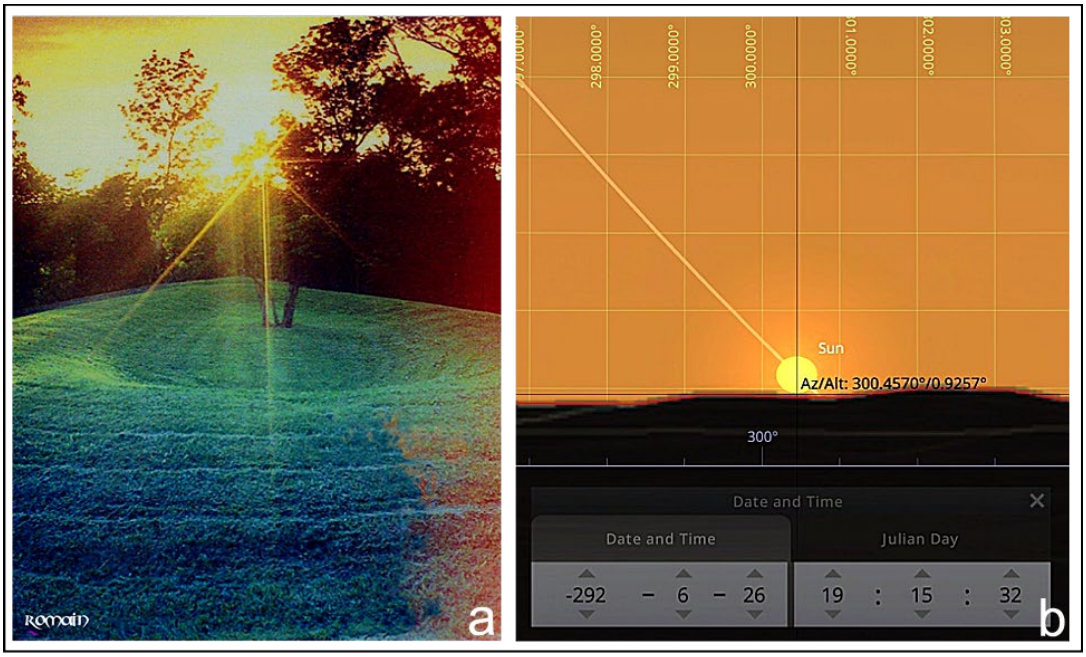


Figure 13a. Photo of summer solstice sunset at Serpent Mound, June 21, 1990. Photo by author.
Figure 13b. Stellarium (ArchaeoLines enabled) and PeakFInder view of summer solstice sunset from intersection of serpent's neck and head, year -292. (δ = +23.72º apparent). Distant horizon shown by red line. Image by the author, courtesy of Stellarium and PeakFinder.

Figure 13b is a screenshot of the solstice alignment generated by Stellarium with ArchaeoLines plug-in and distant horizon imported from PeakFinder. For Figure 13b the date selected was summer solstice in year -292. I chose this year because it was a lunar standstill year close to the ca. 300 BCE radiocarbon dates obtained for the effigy (Herrmann et al., 2014; Monaghan & Herrmann, 2019; Romain, 2018). As mentioned, however, the change in the Sun's rising and setting azimuths between 500 BCE and

1000 CE was only about 0.28˚. Thus even if the reader wishes to attribute the effigy to a later date, the alignment is still acceptable.

Note too that the date at the bottom of the Figure 13b differs from the calendar date for the solstice today. The difference is due to our use of the Gregorian calendar whereas Stellarium uses the Julian calendar for dates before 1592 CE. The year -292 (293 BCE) (and -301) are years when the moon reached a standstill extreme. (For those interested, declination values as per Stellarium for date and time for the images are given in relevant figure captions.)

The manner in which the Stellarium-calculated 300.5˚ azimuth for the summer solstice sunset as shown in Figure 13b aligns with the earthwork is shown in Figures 17a and 17b. Also interesting to note is that beginning at the head and extending to the northwest, the promontory itself points in the direction of the summer solstice sunset (Hancock 2026). (To be clear, I disagree with Hancock's apocalypse theory, but in this observation he is correct.)

Regarding the promontory, Squier and Davis (1848, p. 97) had this to say: "The point of the hill, within which this egg-shaped figure rests, seems to have been artificially cut to conform to its outline [referring to the oval]…"

Squier and Davis's suggestion cannot be confirmed. What we do know, however, is that simultaneous alignments to earth and/or water features and celestial bodies are common to many sites in the Eastern Woodlands. As Hancock proposes, the Serpent Mound promontory likely helped establish the special quality of this location. The alignment of the oval to the summer solstice brought that relationship into conscious awareness.

The alignment of the oval embankment to the Sun establishes that the two are connected. Indeed, I agree with others who suggest that the oval was a Sun symbol. And, as discussed, I would add that perhaps the oval shape of the earthwork was inspired by the elliptical shape of the Sun at sunset.

The notion that the oval embankment is a Sun symbol is supported by Squier and Davis's discovery of a so-called 'altar' at the center of the oval. If the fire-cracked rocks that comprised the altar were the result of fires contemporaneous with ancient ritual activity, then that is consistent with ethnohistoric data that many Native American tribes

believed fire to be a manifestation or representative of the Sun (e.g., Lankford, 1987, p. 55; Hudson, 1976, p. 126).

As to the oval embankment as a portal, I would note this. The ogee is a well-known portal symbol in Mississippian iconography (Lankford, 2007b; Reilly, 2004, 2011; Romain, 2021). However, oval-shaped earthworks are not exclusive to Mississippian peoples – see e.g., Hopewell-era Newark Ellipse, Hopewell-era Turner site ellipse, and Archaic period Watson Brake and Poverty Point sites. In the present context, if intended as an ogee, then I would suggest that the feature is not a portal in the sense that if one stands inside of it that the person will be physically transported to another dimension. Rather, the major axis of the oval-ogee points a location on the horizon where the solstice Sun sets and thereby shows the location for one of several portals associated with the Serpent Mound.

The horizon is a liminal place that separates the Above World from the Below World. It is a place of twilight and a place where things change in appearance. The horizon is a place of mystery. Indeed, how does one explain how the Sun seems to disappear into the thin line of the horizon? In this I am reminded of a Shawnee story that tells of a young man who embarked on a journey to find his sister who had died and went to the 'world of spirits.' With all due caution concerning the use of specific stories for interpreting earthworks, the story provides a conceptual exemplar.

According to the story (collected by Josiah Gregg in the 1820s and related by Schutz, 2019, p. 178), the young man "commenced his pilgrimage toward the setting Sun. Steadily pursuing the same course for days and moons together, he at last came to where the sky and earth meet, and finding an opening, he ascended to the upper regions."

The relevant concept in this story is that the portal it is located 'where the sky and earth meet' – in other words, at the horizon. Moreover, the direction for this particular portal is given by the direction of sunset. As Kent Reilly III (2015, p. 138) has pointed-out, however, there are multiple kinds of portals. Later we will encounter several to include caves, streams, springs, and sinkholes.

Sightline Lengths

With reference to alignments through the Serpent's body convolutions, there is bit of misinformation that needs to be addressed. In a blog posting, Ben Barnes (Shawnee chief) and Brad Lepper (2021) opine the following:

> Some think the three main curves of the Great Serpent's body are aligned to the Summer Solstice sunrise, the Equinoxes, and the Winter Solstice sunrise. The problem with this idea is that the sight lines are very short, which means there is a lot of wiggle room in the proposed alignment. The extent of this wiggle room is indicated by the fact that other investigators think the same three curves are aligned to some of the key risings of the Moon in its 18.6-year-long cycle. They can't both be right.

As a factual matter, it is not difficult to bisect a U-shaped curve along its longitudinal axis thereby establishing a sightline. Clark and Marjorie Hardman (1987, p. 35) explained how they did it: "The instrument stations on the center of the convolutions were established by measuring across the convolution spaces at two points and marking the midpoints."

Moreover, a long sightline is not needed to establish an accurate sightline. Consider, for example, a 4-inch long gun barrel with standard sights. If the shooter lines-up the sights, a very accurate shot can be taken, even with the short distance measured in inches between the gun barrel sights.

So too, one can take two or three sticks, plant them in the ground and align them to a distant object – such as the Moon. This easily establishes a sightline accurate to within one-half of one degree, which is the approximate horizontal width of the Sun and Moon. Once the sightline is set, the convolution can be laid out. It's not that difficult.

What seems peculiar is that Barnes would make such a statement given that there is considerable ethnohistoric data documenting how across the Eastern Woodlands the creator deity known as Our Grandmother, Old Woman, or Earth-Mother is associated with the Moon and serpents (e.g., Trowbridge, 1939; Voegelin, 1936; Hultkrantz, 1957; Prentice, 1986; Emerson, 2022). In fact, with specific reference to the Shawnee, United States Department of Interior, archaeologist Guy Prentice (1986, Table 1) finds that the

Old Woman, or Our Grandmother, is believed to be a fertility and agricultural goddess, is also associated with death, “lives in the land of spirits”, is “creator of the monster serpent”, is “represented as a serpent or woman” and is a “*lunar goddess…reflected in the moon*” (emphasis added by present author). As Emerson (2022, p. 9) explains “in many cases, these aspects are conflated and interchangeable.”

As to Barnes and Lepper’s opinions concerning solar vs lunar alignments – as I demonstrate below, proposed solar alignments through the convolutions are not the best fit. Lunar alignments are a better fit; and the intentionality of the lunar alignments is supported by multiple lines of evidence.

In any case, establishing a sightline on the ground along which to view the Sun or Moon may be a moot issue. What may have been equally or even more important was how the lunar azimuths intersected or engaged with the serpent’s convolutions. More on that later.

Proposed Solar Alignments

In addition to the oval embankment solstice alignment, the Hardmans proposed solar alignments through six of the Serpent’s body convolutions. Figure 14a shows their alignment and solar azimuths through the convolutions based on values I derived using Stellarium with PeakFinder. The problem is that neither the Hardmans’ nor the Stellarium/PeakFinder solar azimuths are a good match to the orientations of the convolutions as established by bisecting the convolutions per the dashed lines also plotted in Figure 14a. For example, the Hardmans’ winter solstice set azimuth through C1 is off by about 4º; their summer solstice rise azimuth through C2 is off by about 10º. Their equinox set alignment is off by about 3º. The equinox rise azimuths are good. Their summer solstice set azimuth through C5 is off by about 7º. (Note the Hardmans positioned their control point for C5 [black dot] south of center thereby forcing a better fit.) Their winter solstice azimuth through convolution 6 is off by about 3º.

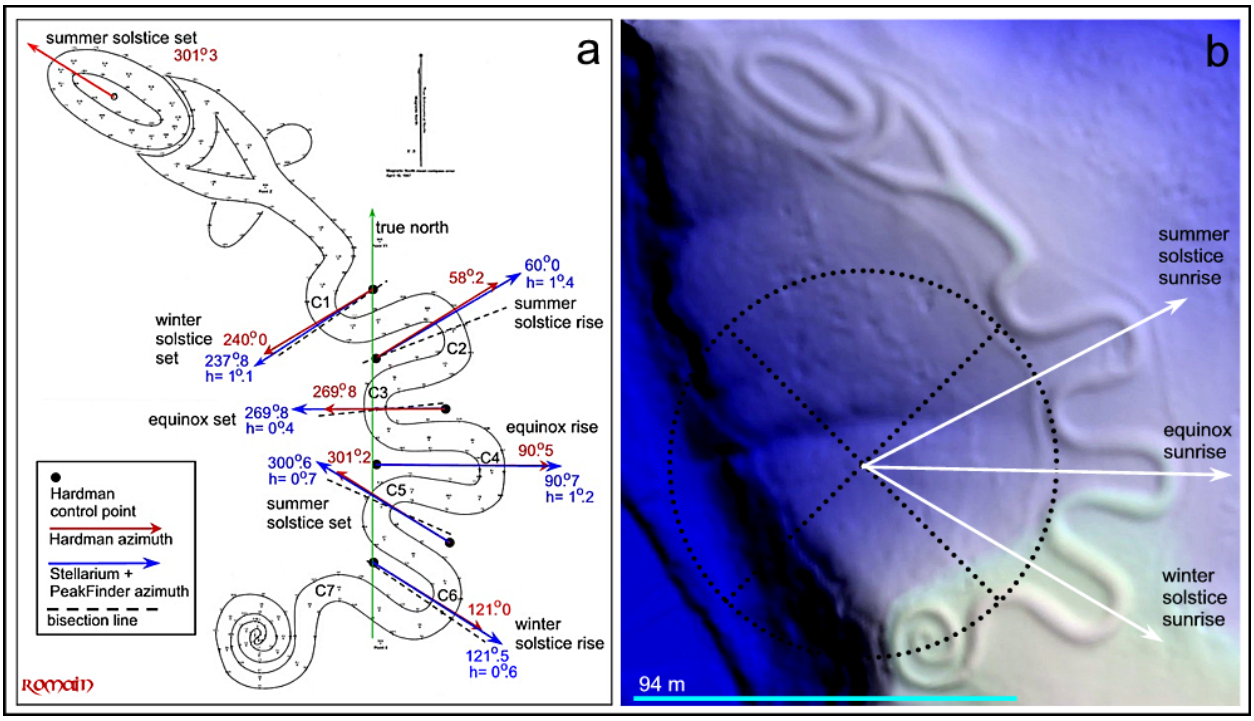


Figure 14a. Hardmans' (1987) proposed alignments (red lines) and Stellarium-determined azimuths (blue lines) plotted on Romain (1987) map. Black dots are control point locations established by Hardmans. Hardman calculations for AD 100, h = 0º. Note Hardmans' azimuth for summer solstice sunset is plotted from feature in center of oval – not the intersection of head/neck – hence a difference between Hardmans and Romain azimuths. Stellarium/PeakFinder azimuths for -292 with horizon altitudes as shown.
Figure 14b. Jeffrey Wilson's point of origin for solar alignments superimposed on lidar image. Black dotted circle shows Wilson's hypothetical design circle used to establish the point of origin and curve of the effigy. Images by present author.

It is interesting to note that the Hardmans did not plot a north-south sightline extending from the tip of the Serpent's tail through the intersection of the head and neck. To their credit they plotted a line from the tail to a point near the head-neck intersection – but that point was roughly 3 meters (10 ft) to the southwest (Hardman & Hardman, 1987, Figure 6). If their map had been more accurate they likely would have spotted the neck-head to tail alignment. In any case, the present author established that a sightline extending from the intersection of the head and neck through the tip of the tail is accurately aligned north-south. The north-south sightline was established by Polaris observations (Romain, 1987). I shared the true north survey data with Fletcher and Cameron (1988) who used it to orient their map.

The significance of the north-south sightline is two-fold. First it suggests the importance of that meridian. Notably, although I used it, the current North Star – i.e., Polaris, was probably not used by the Serpent Mound builders to establish the north-south line – as that star's apparent position has changed considerably over the millennia due to precession. Rather, Antares may have been used, and the important direction may have been south – which as discussed below, is where the Milky Way came into view on the night of the summer solstice when Serpent Mound was built and for a thousand years after that date.

An astronomic interpretation conceptually similar to what the Hardmans proposed was later offered by Jeffery Wilson, president of the Friends of Serpent Mound. Wilson (2007, 2017) posited the same solstice and equinox alignments through the same convolutions as the Hardmans. Wilson (personal communication 7-20-2026) confirms that for his sightlines he used the azimuth values I had calculated for an earlier assessment of the Hardmans' work (i.e., Romain, 2016a, 2016b). Interestingly, Wilson's assessment differed, however, from Hardmans in that he plotted his sightlines from a hypothetical center point west of the effigy (Figure 14b).

There are problems with the Wilson hypothesis. First, as Figure 14b shows, the proposed solar sightlines do not bisect the summer and winter solstice convolutions. Also, as Figure 14b indicates, Wilson's sightlines originate at a point that hovers 98 – 131 meters (30 – 40 ft) above a gully that cuts along the west side of the Serpent Mound promontory. If Wilson's point of origin was anchored to the ground, lidar line-of-sight analysis shows that the apexes of the Serpent's convolutions would not be visible from that location.

Recognizing the problem, Wilson (2016) proposed that the effigy builders laid-out a woodhenge-like structure south of the effigy and then used that as a design template to establish the curve of the Serpent's body and point of origin for the purported solar alignments.

To his credit, Wilson's research provided a heretofore unpublished sketch map made by Putnam. The sketch shows what looks like a double row of post holes (referred to by Putnam as "fort holes") extending in an incomplete, lop-sided circle. Wilson's

assessment finds that the structure was centered on a small mound containing Adena and Hopewell projectile points, located near the present-day picnic shelter house.

The Putnam sketch adds to our understanding of the area (likely used as a ceremonial and mortuary preparation area and not a village site). However, the feature is not symmetrical and its dimensions vary depending on what is considered to be its diameter.

From an astronomic perspective, the bigger problem with both the Hardman and Wilson hypotheses is that regardless of the vantage point, their proposed sightlines do not bisect the Serpent's body convolutions and they fail to intersect the place on the horizon where the Sun rises (or sets). To deal with this, Wilson (2024) expanded his explanation to say that the sides of the U-shaped convolutions create lines that when extended, define a range within which the solar alignments appear. Certainly it is true that if one draws a set of east-west pointing parallel lines then at some point the Sun will cross within.

No matter the extended arguments and with one exception to be discussed, the sightlines through the Serpent's body as proposed by the Hardmans and Wilson are simply not a good fit. It is neither necessary nor convincing to explain the mismatch by recourse to floating points of origin, degree windows, or designs transposed from a lopsided presumed woodhenge of unknown date. A far simpler explanation for the orientation of the body convolutions is that, as explained below, they are associated with lunar rise and set azimuths – similar to lunar rise and set azimuths that were repeatedly incorporated in subsequent Hopewell earthworks.

Winter Solstice Alignment

That said, there is, however, a solstice alignment that has not yet been discussed. That alignment is to the winter solstice sunset originating at convolution 7 and passing through the tip of the Serpent effigy's tail (Figure 15). Jeffrey Wilson first noted the alignment by on-the-ground observation. Stellarium assessment by the present author confirms the alignment (Figure 16).

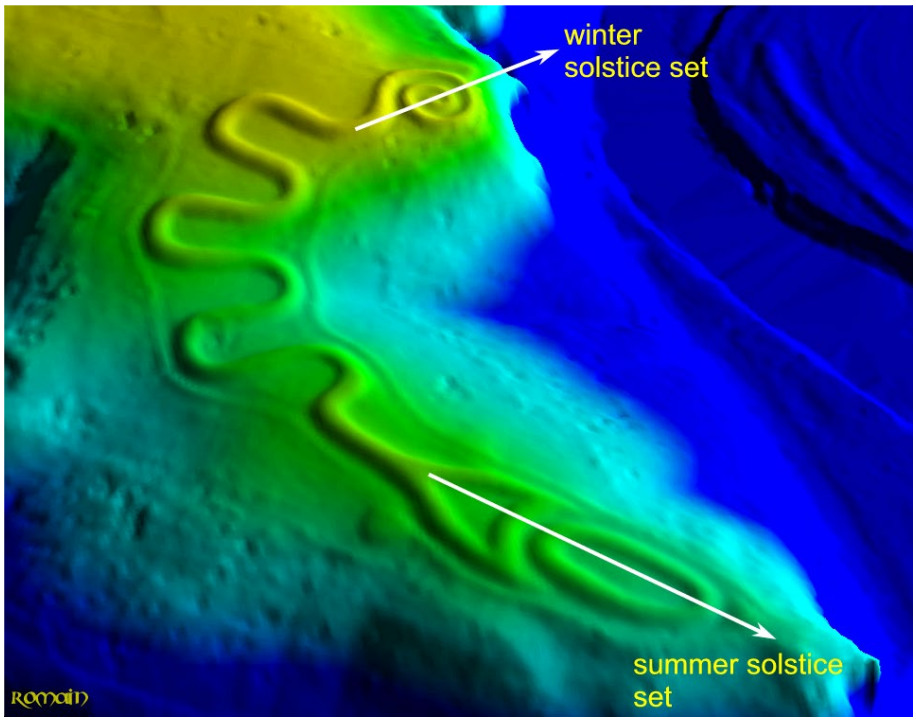


Figure 15. Lidar view of Serpent Mound with summer solstice sunset and winter solstice sunset alignments plotted. Image by the author.

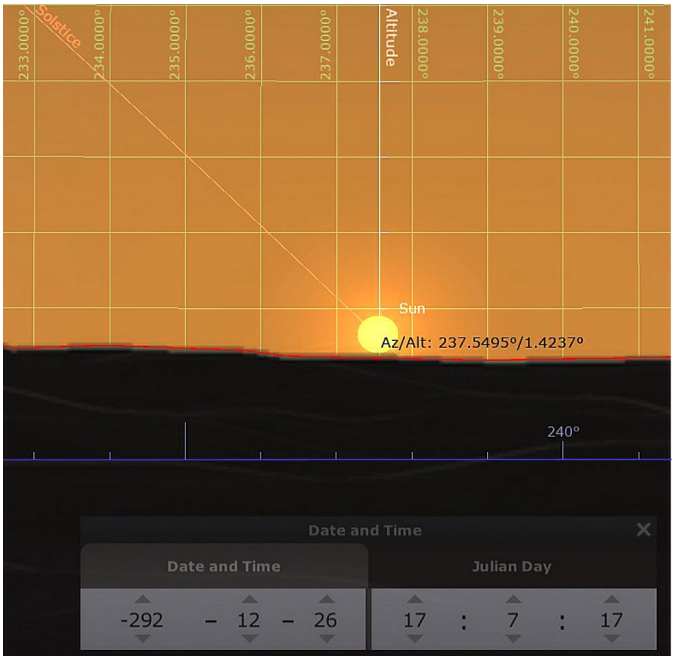


Figure 16. Stellarium/PeakFinder view of winter solstice sunset from apex of convolution 7 through tail of Serpent Mound year -292 (δ = -23.48º apparent). Distant horizon shown by red line. Image by the author. Courtesy of Stellarium and PeakFinder.

Normally one might be sceptical of the intentionality of this alignment given that its point of origin differs from those for other body convolutions. On the other hand, the north-south alignment through the tail from the intersection of the Serpent's head and neck also differs from other points of origin. And the accuracy of the winter solstice alignment is compelling. Lastly, it is interesting to note that when considered together the summer solstice axis of the Serpent's head and the winter solstice sightline through the tail describe a field of view that the Serpent's body fits within. In other words, the Serpent effigy extends in an arc between the solstices. In effect, the Serpent creates a link between two opposite spatial and temporal locales (Figure 15).

It may be that the winter solstice alignment points to a second horizon portal – with different portals for different people, manner of death, or even time of death.

As to the sightline that extends between convolution C7 and the center of the oval (yellow dashed line in Figure 17a) it is noteworthy that it bisects convolution 7 – supportive perhaps, of its intentionality. And it is noteworthy how the line intersects both the summer and winter solstice sightlines. (The yellow dashed sightline does not point to any celestial body I am aware of.) The sightline is a connector of sorts.

With reference to the tail of the effigy, it is appropriate that the tail would end in a coil – as that is a common characteristic for many snakes. Additionally, however, the Serpent Mound tail spirals around in a counter-clockwise manner. This is contrary to the Sun's daily east-to-west clockwise movement – but quite appropriate for a Below World entity in opposition to the Sun and Above World (*sensu* Emerson, 1989, p. 72). (Depending on the author, the Beneath World is sometimes called the Underworld, Below World, or Lower World.) Emerson (1989, p. 58) provides a succinct description of the Great Serpent and Below World realm: "The serpent monster is usually a composite beast with attributes of several animals. Regardless of form, these monsters are all associated with the Underworld. This Underworld has two aspects: It is the dwelling place of monsters, danger, and evil; but conversely it is also the source of water, fertility, and power against evil." Kent Reilly III (2015, p. 139) elaborates on the Great Serpent: "Its dwelling place is usually described as a watery domain….It travels between bodies of water through underground conduits such as caves, springs, streams, and rivers….It

has strong associations with the celestial Path of Souls, or Milky Way, as well as with the Realm of the Dead."

Lunar Alignments

Earlier, Figure 2 showed a lidar image of the effigy superimposed on the 1987 ground survey map. For archaeoastronomic analyses it is necessary to reference true north – as that is the direction that azimuths are measured from. As mentioned, for the 1987 map, true north was established by time-corrected Polaris observations. My findings were double-checked on site with additional sightings made by professional surveyors Thomas E. Purtell, P.S. and Eric N. Lutz, S.I.T. of McCarty Engineering, Hillsboro, Ohio (Romain 1987). The two sets of measurements differed by two minutes of arc. A true north oriented baseline for survey purposes was then established by a benchmark embedded in the ground at the south end (CP1) and a rebar stake at the other end (CP2).

Using the 1987 map in conjunction with lidar imagery eliminates the possibility of making a mistake when correcting the lidar imagery to true north – given that lidar data are typically referenced to either UTM or State Plane north.

The procedure employed here was to determine the azimuths for the Sun, Moon and Antares using Stellarium and PeakFinder for the relevant dates and times. Those directions were then plotted onto the 1987 survey map and lidar image. Figures 17a and 17b show the results. The advantage of this approach is that rather than trying to bisect the convolutions through their interiors and then seeing how well those sightlines match something in the sky, the present method eliminates any subjectivity in determining bisecting sightlines while at the same time, allowing the reader to come to his or her own conclusions relative to how well the calculated azimuths intersect the convolutions. Thus for Figures 17a and 17b, all directional arrows show Stellarium-determined azimuths. Figures 18a–18d show the relevant Stellarium screenshots.

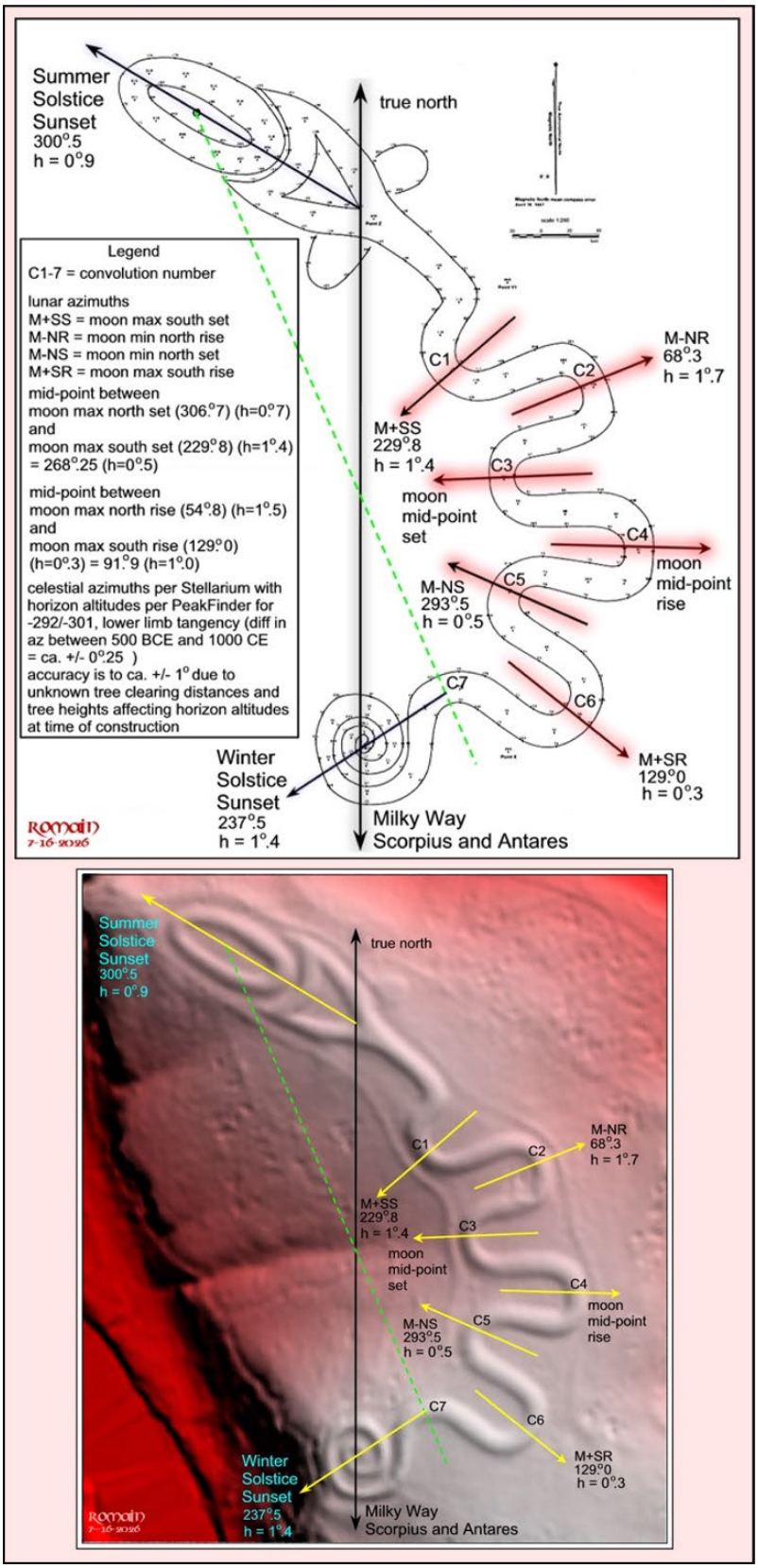

Summer
Solstice
Sunset
300°.5
h = 0°.9
true north
Legend
C1-7 = convolution number
lunar azimuths
M+SS = moon max south set
M-NR = moon min north rise
M-NS = moon min north set
M+SR = moon max south rise
mid-point between
moon max north set (306°.7) (h=0°.7)
and
moon max south set (229°.8) (h=1°.4)
= 268°.25 (h=0°.5)
mid-point between
moon max north rise (54°.8) (h=1°.5)
and
moon max south rise (129°.0)
(h=0°.3) = 91°.9 (h=1°.0)
celestial azimuths per Stellarium with horizon altitudes per PeakFinder for -292/-301, lower limb tangency (diff in az between 500 BCE and 1000 CE = ca. +/- 0°.25)
accuracy is to ca. +/- 1° due to unknown tree clearing distances and tree heights affecting horizon altitudes at time of construction
C1
C2
M-NR
68°.3
h = 1°.7
M+SS
229°.8
h = 1°.4
C3
moon
mid-point
set
C4
moon
mid-point
rise
M-NS
293°.5
h = 0°.5
C5
C7
C6
M+SR
129°.0
h = 0°.3
Winter
Solstice
Sunset
237°.5
h = 1°.4
Milky Way
Scorpius and Antares
Romain
7-16-2026

Figure 17a. Ground survey map of Serpent Mound with Stellarium determined azimuths plotted. Image by the author.
Figure 17b. Stellarium determined solar and lunar alignments plotted on lidar image. Image by the author.

Stellarium is a planetarium simulation program. PeakFinder generates a horizon profile for whatever location is inputted by reference to latitude and longitude coordinates. Coordinate data the convolutions were determined using Google Earth Pro (2025).

For example, Figure 18a shows the Stellarium view of the major maximum moonset from the inside center of convolution # 1. The figure shows two arcing lines for the Moon generated by the ArchaeoLines plug-in for Stellarium. The bottom line shows the Moon's trajectory corrected for parallax and refraction. The upper line is the trajectory without those corrections. Notably, the Moon is not centered on the bottom line. This is because maximum declination almost never occurs exactly at moonrise or moonset. Maximum declination is an instant in time that happens during the course of the 24-hour maximum declination date. The moon, however, does not stop at its maximum declination. It moves and that changes its azimuth relative to the horizon. As shown in Figure 18a, since the instant of maximum south declination occurred sometime earlier in the day, the moon moved about two-tenths of a degree north to an azimuth of 229.8º (lower limb tangency).

With reference to the horizon line, computer applications such as PeakFinder (https://peakfinder.com) obtain their elevation data from a variety of sources including lidar, Synthetic Aperture Radar (SAR) and stereoscopic imaging (e.g., SRTM, NASADEM, TanDEM-X). For areas within the United States the program uses USGS DEM and USGS 3DEP lidar data – meaning PeakFinder measurements are to the bare earth and not tree top level. Toward an assessment of PeakFinder's accuracy, the horizon altitudes shown in the figures below were compared to altitudes taken by the present author in 1987 using a theodolite. The two sets of measurements differed by less than 0.25˚.

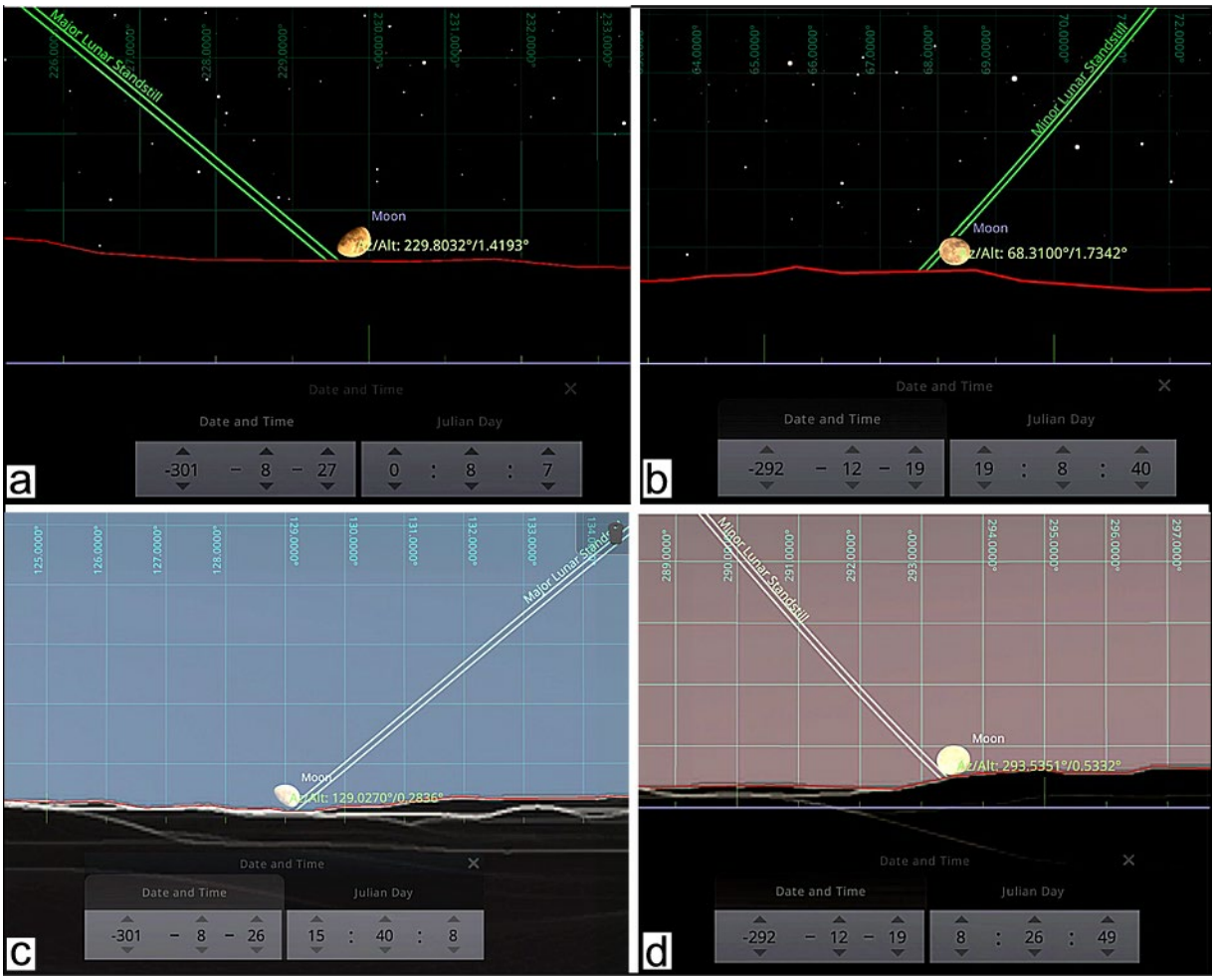


Figure 18a. Stellarium and PeakFInder view of Moon's maximum south set from inside center of Serpent Mound convolution C1, standstill year -301 (δ = -28.93º apparent). Distant horizon shown by red line.
Figure 18b. Stellarium and PeakFInder view of Moon's minimum north rise from inside center of Serpent Mound convolution C2, standstill year -292 (δ = +17.97º apparent). Distant horizon shown by red line
Figure 18c. Stellarium and PeakFInder view of Moon's maximum south rise from inside center of Serpent Mound convolution C6, standstill year -301 (δ = -28.95º apparent). According to Stellarium data the Moon's magnitude was -11.6. Thus it would have easily been visible even though it was not yet night. Distant horizon shown by red line.
Figure 18d. Stellarium and PeakFInder view of Moon's minimum north set from inside center of Serpent Mound convolution C5, standstill year -292 (δ = +18.57º apparent). Distant horizon shown by red line. Images by the author courtesy of Stellarium and PeakFinder.

There are a couple of interesting things about the lunar alignments referenced in Figures 18a–18d. First, note that convolutions C1 and C6 are oriented to the Moon's maximum standstill. In the years of maximum standstill, around the time of summer solstice (as indicated by oval embankment alignment), at sunrise and sunset the full

Moon can appear reddish in color. At this time in the moon's 18.6 year cycle, the Moon is at its lowest arc in the sky. As a result, light reflected from the moon travels through the densest layers of the earth's atmosphere. This causes increased light scattering – hence the reddish (or orange) glow.

Astute skywatchers may have witnessed the red moon phenomenon. Although we do not know what the Serpent Mound builders thought about the color, red, given its frequent inclusion as red ochre in Native American burials, it is very likely that red was a sacred color. If that was the case then association of a red Moon with the Serpent seems appropriate.

Another interesting thing is that the lunar alignments extend in complimentary opposite pairs. The Moon's maximum south set azimuth through C1 has its counterpart in the maximum south rise azimuth through C6. The Moon's minimum north rise through C2 has its counterpart in the minimum north set through C5. And the Moon's midpoint rise through C4 has its counterpart in C3. Among other things, this complimentary duality reinforces recognition of the cyclic nature of things – including the Moon.

To clarify, the lunar azimuths plotted in Figures 17a and 17b are not simply bisected convolution sightlines pointing to the moon for observational or calendric purposes. They point to the Moon, but in a reciprocal manner, light from the Moon intersects the convolutions in such a way as to establish a geometric relationship with the effigy. Figure 19 shows what I mean. In this figure, the white cross represents the apex of convolution 2. The yellow and orange circles represent the summer solstice sunrise and minimum north moonrise on the horizon relative to convolution 2. If the azimuth of the summer solstice sunrise is 60.3˚ then its reciprocal is 240.3˚. The turquoise line shows how that reciprocal azimuth intersects the convolution apex and interior of the convolution. The Sun's azimuth fails to establish a geometrical relationship with the convolution. Conversely, if the reciprocal azimuth for the Moon's minimum north rise is plotted, we see that in addition to intersecting the apex of the convolution it also creates a symmetrical alignment through the convolution's interior. If one were to place a gnomon stick at the apex of convolution 2, the shadow from the moonlight would bisect the interior of the convolution.

Returning to the Barnes and Lepper statement referenced earlier, the lunar alignments are not dependent on a long, or short sightline established from inside the convolutions. Rather, the way that moonlight intersects the body convolutions defines the orientation of the convolutions. “Wiggle room” is not an issue. It’s more about seeing the effigy from the perspective of the Moon – which as discussed next, might be considered an animate entity.

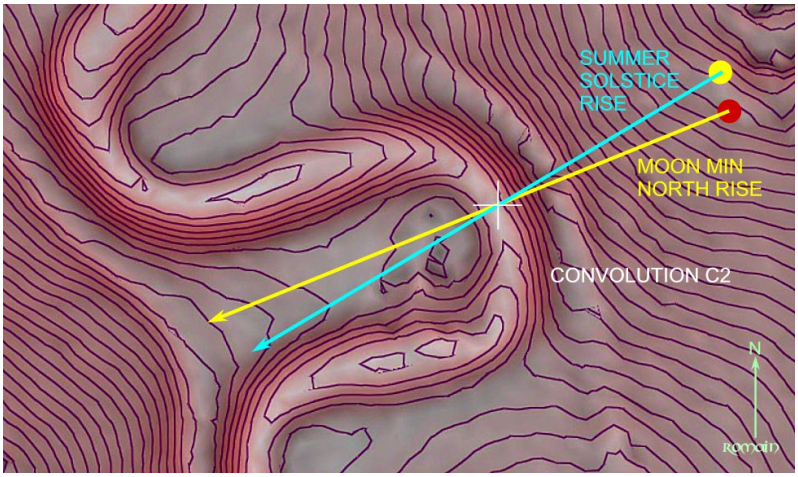


Figure 19. Lidar view showing how the summer solstice sunrise and moon minimum north standstill azimuths intersect convolution C2.

Why the Moon

A question that sometimes arises is – how are the proposed lunar alignments related to the serpent effigy? What’s the connection?

There are variations on the theme, but in many Native American stories across the Eastern Woodlands, the creator deity is known as Grandmother, or Old Woman. Generally considered a Below World entity, she is associated with death, fertility, agriculture, water, and the moon (Emerson, 2022). Moreover, she has the ability to change appearance, or manifest in different forms. Among the Shawnee, for example, Our Grandmother or the Old Woman is a creator deity; and as mentioned earlier, she is a “fertility goddess”, “death goddess” and “lunar goddess” (Prentice, 1986, p.249). Important to the discussion here, she can manifest as a woman, or a serpent and is said to be reflected in the moon (Prentice, 1986, p.249, Table 1).

If the Serpent Mound effigy is the Old Woman in earthen serpent form, then the Moon is her celestial form. The lunar alignments reinforce that identity. Further, the Moon’s

nightly rise from the Below World followed by her descent back into the Below World reinforces her chthonic nature.

From a phenomenological perspective, the Moon's standstill positions give rise to the shape and orientation of the Serpent's convolutions; while in its earthen form the Serpent brings into visible awareness the Moon's pivotal role in the cosmic cycle. From an ontological perspective the Serpent and Moon are necessary to each other.

Antares and the Milky Way

One of the most impressive aspects of the Serpent Mound its true north-south sightline. Today we reference true north using Polaris, i.e., the North Star. Due to precession, however, Polaris was not a very good north indicator in ancient times. In 300 BCE, for example, at eastern and western elongation the star was about 17˚ on either side of true north. At 1000 CE it was 8˚. There is, however, another star that would have served admirably at both dates as an indicator for true south. That star is Antares.

Antares is a bright red star in the constellation Scorpius. Its apparent visual magnitude ranges between + 0.6 to + 1.6 which means it is always visible in the night sky when above the horizon. If the constellation Scorpius is seen as a celestial serpent (see discussion below), then as shown by Figure 20, Antares is at the intersection of the head and neck, recalling the Cherokee story that describes the Uktena's diamond-like crystal on its forehead (Lankford, 2007b, p.129). The curvature of the tail end of the Serpent effigy is reminiscent of the tail end of Scorpius.

Of course we do not know if the builders of Serpent Mound considered Scorpius to have the same configuration as shown below – which is a Western representation. However, several tribes have stories that tell of celestial serpents. And, the Pawnee, for example, specifically identified Scorpius as the Great Serpent (Chamberlain, 1992).

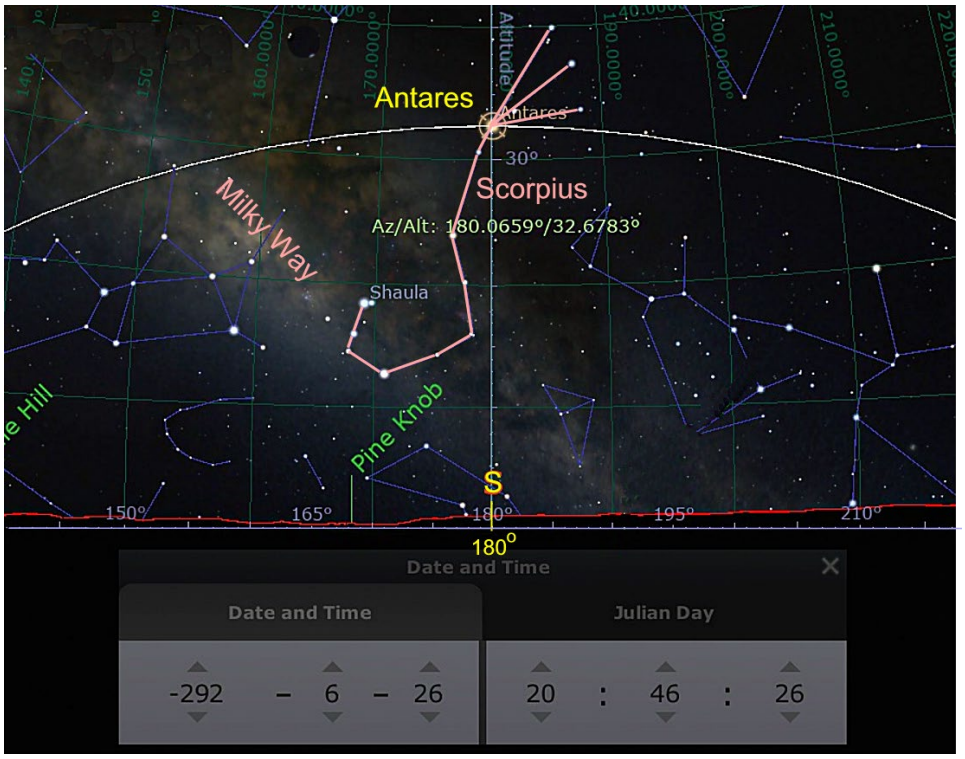


Figure 20. View of Antares and Scorpius looking south from intersection of serpent effigy neck and head through tail. Antares is due south at upper culmination – i.e., its highest altitude. Distant horizon shown by red line. Image annotated by author, courtesy Stellarium/PeakFinder.

For purposes here the important point is that as viewed from Serpent Mound, Antares is due south at upper culmination, or meridian transit. Upper culmination occurs when a star reaches its highest point in the sky. For convenience in Figure 20 I chose the summer solstice date for plotting purposes. During the course of the night the star moves from the lower left end of the trajectory line higher and across the sky in an arc as shown. When Antares reaches its highest altitude relative to the horizon, its azimuth is 180˚. That is the case regardless of the year. The same alignment to due south occurred more than a thousand years later in year 1001 CE, as well as years in-between. The due south alignment was the same from Early Woodland through Mississippian times. The only thing that changed was the time of night when upper culmination occurred.

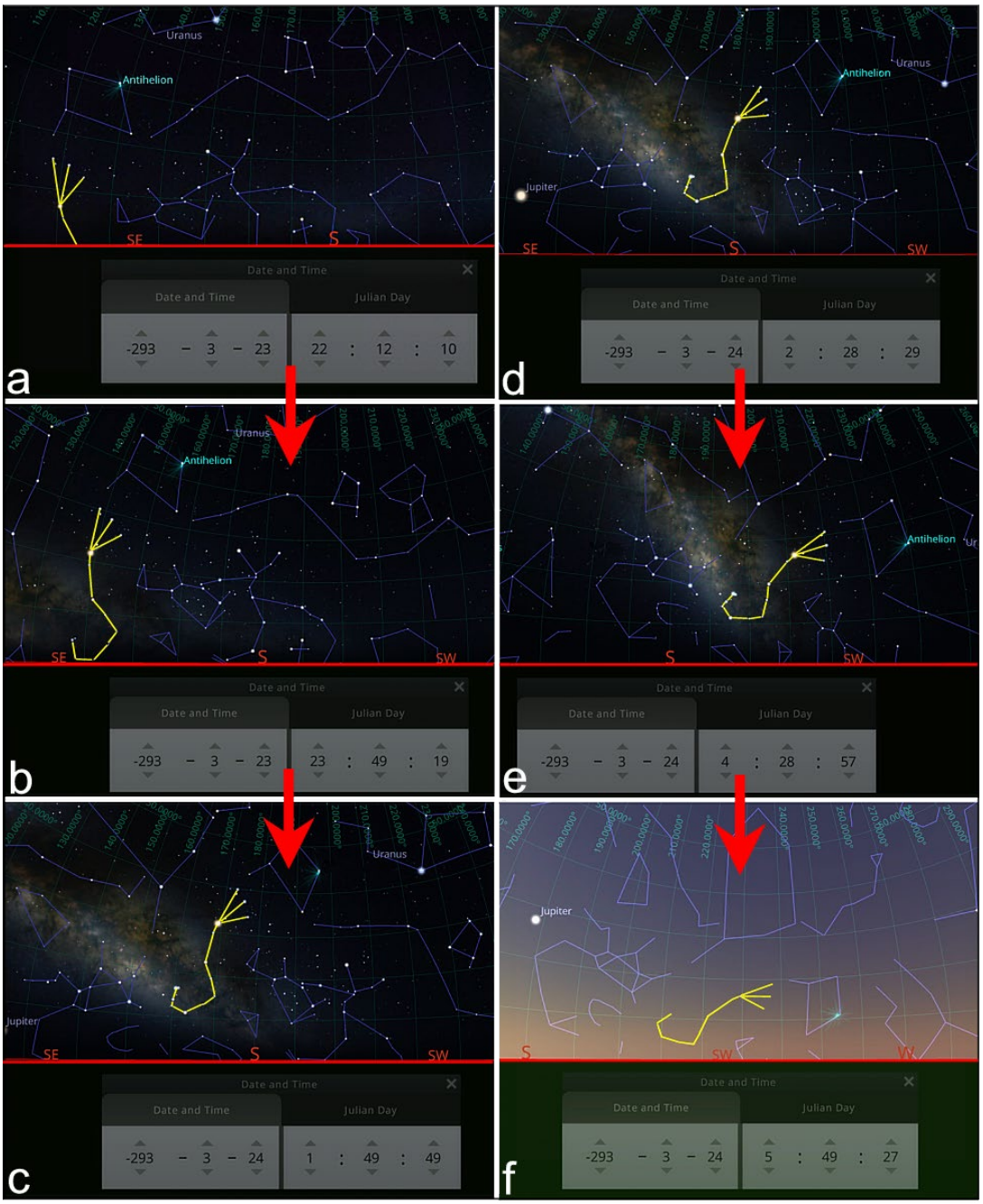
To determine when Antares reached its maximum altitude all that would have been needed was a bit of patience as the night hours passed and a notched stick to track the

star's height above the horizon. What helps in this regard is that the arcing trajectory of Antares is rather gentle which makes measurements easier.

For an ancient observer standing at the intersection of the effigy's neck and head, when Antares reached its highest altitude in the sky, it was directly in line with the tip of the effigy's tail, due south. If Serpent Mound was intended as a representation of the Great Serpent, then that Serpent was directly oriented to the red star Antares, in Scorpius, at the end of the Milky Way and as discussed below, at the end of the Milky Way Path of Souls.

A question that arises is: If the Serpent is a Below World creature then how is it seen in the night sky? The answer according to many Native American tribes – including the Osage, Omaha, and Ojibway, is that the sky realm was thought-of as a bowl. As nighttime approached, the Below World rotated up into the night sky. What was below during the day, was visible above in the night sky (Reilly, 2011, p 119). At night therefore, the Milky Way Path of Souls and Below World Serpent became visible.

There is another aspect to Scorpius that connects it to the Below World Serpent. Scorpius is an easily recognized constellation – best viewed at Serpent Mound from March through June. On any given night the constellation will slowly rise up out of the southeast horizon and gain in height and visibility as the hours pass. After it reaches upper culmination the constellation will move down toward the southwest and sink below the horizon before sunrise. Thus every night during the summer half of the year, after the Sun sets, the Great Serpent will emerge headfirst from the Below World, arc across the sky from east to west, and descend back into the Below World (Figures 21a–21f). The same thing happens on a monthly basis if a skywatcher observes the constellation at the same time every night from late spring to early fall. Again, the celestial movements just described would have been visible to the Adena, Hopewell, and Fort Ancient peoples.



Figures 21a-f. Stellarium views from Serpent Mound showing how during the course of a late spring night, Scorpius rises in the southeast, arc across the sky, and descends below the horizon before sunrise. Annotations by author.

To summarize, what suggests Scorpius as the celestial form of the Great Serpent and the Serpent Mound as a cognate for that star constellation is: 1) the intersection point of the head and neck of the effigy corresponds to the due south location for Antares – the brightest star in the head of Scorpius; 2) the 'jaws' of the serpent effigy correspond to

the configuration of stars in Scorpius; 3) as Scorpius moves through the night sky it appears to chase after the setting Sun analogous to the serpent effigy appearing to strike at the oval embankment; 4) the tail of the serpent effigy mimics the curve of the constellation Scorpius tail; 5) during the course of the night, Scorpius rises from the Below World and later that same night, descends back into the Below World; and 6) In an analogous way, as measured from the tail of the Serpent Mound effigy to the oval embankment the elevation drops by about 6 meters (20 ft). Viewed from the effigy's tail the serpent appears to be slithering downslope toward Brush Creek and the Below World mimicking movement of Scorpius back into the Below World.

Land of the Dead

George Lankford (1938-2023) was a highly regarded folklorist and archaeologist who more than any other researcher, documented the Path of Souls story in North America and the Eastern Woodlands (Lankford, 1987, 2007a, 2007b, 2007c).

As explained by Lankford, the Milky Way is a path that souls of the deceased must travel in order to reach the Land of the Dead which is located at the end of the Milky Way Path. The path is variously known as the Ghost Road, Spirits' Path or Path of Souls. Vine Deloria Jr. (2003 [1973], p. 153) provides the following succinct explanation: "Indians see themselves returning to nature, their bodies becoming the dust of Mother Earth, and their soul journeying to another place across the Milky Way or sometimes being reborn in a new generation of the tribe."

Native American author (Cherokee and Omaha) Taylor Keen (2024, p. 1) points out that, "Stories, parables, and myths are forever enduring and are perhaps a lineage that can be traced and compared to tie different cultures together cosmologically and illustrate how cultures are related through story." Indeed, that is the significance and beauty of the Path of Souls story. As Lankford (2007a, 179–180) explains, the Path of Souls story "is recorded from the Ojibwa, Fox, Sauk, Menomini, Miami, Delaware, Shawnee, Powhatan, Cheyenne, Huron, Iroquois, Oglala, Osage, Omaha, Quapaw, Saponi, Caddo, Pawnee, Chickasaw, and Creek, and the designation extends at least as far south as the Andes (Sullivan, 1996, 58–75), as far north as Siberia (Eliade, 1964, 188, 248–251, 295, 466), and as far west as California (see Krupp, 1995)."

Lankford (2007a, p. 178) further explains that, according to some Eastern Woodlands beliefs, the Below World Serpent is the Guardian to the Land of the Dead. Central to the narrative here, Lankford (2004, 2007a, 2007b) places the Serpent Mound effigy in the Milky Way, identifying it as a cognate for Scorpius. According to Lankford (2007b, p. 132), “the identification of Scorpio and Antares as the Serpent and his red eye points to a significant ethnoastronomical belief complex which cuts across tribal and linguistic lines.”

Based on ethnographic data from numerous Eastern Woodlands and Plains tribes, Langford (2007c, pp. 213–214) proposed a generalized model of the soul’s death journey. Lankford explains that details vary from tribe to tribe, but from the grave the soul travels west to where a portal to the Otherworld is located. Specifically Lankford (2007a, p.176) says that the path the soul takes “leads toward the west, the place of the setting Sun, the end of the east-west cosmic passage, the point of the transition from day to night.” From there the soul must make a leap through the “Hand Constellation” and thence to the Milky Way Path (Lankford, 2007a, p. 177).

It is interesting that in this explanation, the soul travels to the ‘place of the setting Sun’ as a prelude to continuing-on to the Milky Way Path. Recall that the major axis of the Serpent Mound oval embankment points to this horizon location.

To be clear, I am not proposing that the oval feature was a portal. Standing inside the oval embankment will not transport a person to the Otherworld. Rather, I suggest that the oval was an ogee-portal and Sun symbol pointing to a liminal point on the horizon where the Sun disappears into the Below World.

Continuing the story, from the entry portal the soul jumps to the Milky Way. After following the Milky Way Path for some distance the soul encounters a celestial gatekeeper – variously described as an old woman, brain smasher, dog, or giant bird. In some stories the soul has to cross a river or log bridge that sometimes turns into a snake. In any case, “The goal of the journey is the Realm of the Dead, which lies at the southern end of the Path. It is protected by the Great Serpent with the red jewel in its forehead [Scorpius]” (Lankford, 2007a, p. 178). Elsewhere Lankford (2007c, p. 214) refers to the Great Serpent as the “guardian” of the Land of the Dead (Figure 22).

A interesting version of the soul's journey is told by Oglala Sioux wisdom holder, Black Elk (Brown 1989 [1953], p. 29):

> It is held by the Sioux that the released soul travels southward along the 'Spirit Path' (the Milky Way) until it comes to a place where this way divides. Here an old woman, called *Maya owichapaha* sits; 'She who pushes them over the bank,' who judges the souls; the worthy ones she allows to travel on the path that goes to the right, but the unworthy she 'pushes over the bank,' to the left.

Again, no direct historical connection between the Oglala Sioux and Serpent Mound is suggested; but it is interesting that in this version of the story an old woman waits for the soul at the end of the celestial path. Recall that the Great Serpent has several guises – including that of an old woman. Also interesting is that in the Sioux story, the Milky Way Path extends to the south – reminiscent of the direction indicated by the main Serpent Mound axis.

Based on the data presented, my speculation is that the design of Serpent Mound was intended to reference a special time. That special time was the night of the summer solstice sunset (and perhaps the winter solstice sunset). The alignment through the oval embankment referenced and connected the effigy to the solstice and that special time; and on that special night, the major site axis, or sightline extending from the neck-head intersection through the tail pointed to the Milky Way Path of Souls guarded by the Great Serpent in its guise as Scorpius. Perhaps this was the time when souls of the people buried at Serpent Mound began their journey to the Land of Ancestors.

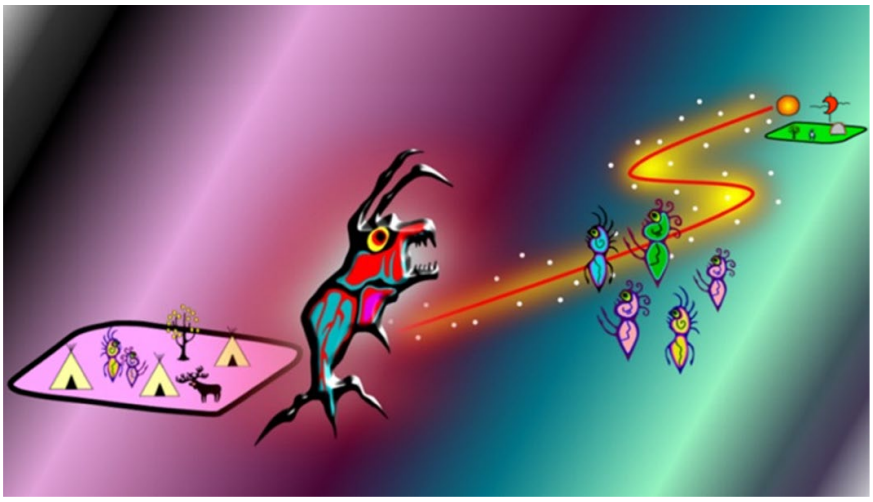


Figure 22. Souls making their way along the Milky Way Path of Souls toward the Land of the Dead. Illustration by the author with figures based on and adapted from the art of Native American artists Norval Morrisseau, Ray Carl, and Ayla Bouvette.

Landscape Associations

In the preceding pages association of the Serpent Mound with the Below World has been suggested by alignment of the oval embankment to the summer solstice sunset – in the direction of the Land of the Dead and correspondences of the effigy to the star constellation Scorpius, Guardian of the Realm of the Dead. There is more, however.

Ancient sites need to be considered not only relative to potential celestial relationships but also relative to their environmental context. Sacred places like Serpent Mound are – dare I say, always, entangled with significant environmental and/or landscape features. This includes geologic and biologic features. As Vine Deloria Jr. (2003 [1973], p. 69) has said: “Tribal religions are actually complexes of attitudes, beliefs, and practices fine-tuned to harmonize with the lands on which people live.” Celestial associations have already been discussed. At Serpent Mound, however, there are a number of features and entities that directly reinforce association of the earthwork with the Below World.

Some years ago, archaeologist R. Clark Mallam (1984, pp. 18–19) commented: “As documented in the ethnographic literature, springs, seeps, crevices, and caves are almost universally regarded by native peoples as avenues to the underworld.” And, where multiple “chthonic” features are present, the result is a “synergistic effect” on beliefs (Mallam, 1984, p. 19).

The immediate Serpent Mound area includes all of the features noted by Mallam. To Mallam's list we can add rivers, streams, and sinkholes. The notion that these features are conduits, or entrances into the Below World finds expression in many Native American contexts (e.g., Blakeslee, 2012; Hall, 1997; Moyes & Brady, 2012; Reilly, 2004, 2015).

Serpent Mound Meteorite Impact Crater

A significant aspect of Serpent Mound is its location near the edge of an 11 kilometer (7 mi) wide meteorite impact crater (Baranoski et al., 2003; Milam, 2010). The impact occurred 250 – 330 million years ago (Figures 23a and 23b). The builders of Serpent Mound would not have known that the area was impacted by a meteor. What they would have noticed, however, was the extraordinary aftermath. Rock formations within the crater area are visibly uplifted, vertically tilted, and down-dropped. Traveling through the area in the early 1800s, geologist John Locke (1838, p. 266) said: "it became evident that a region of no small extent had sunken down several hundred feet, producing faults, dislocations and upturning of the layers of rocks…" Seeing this, who would doubt that the disturbance was caused by a Great Serpent emerging from the Below World?

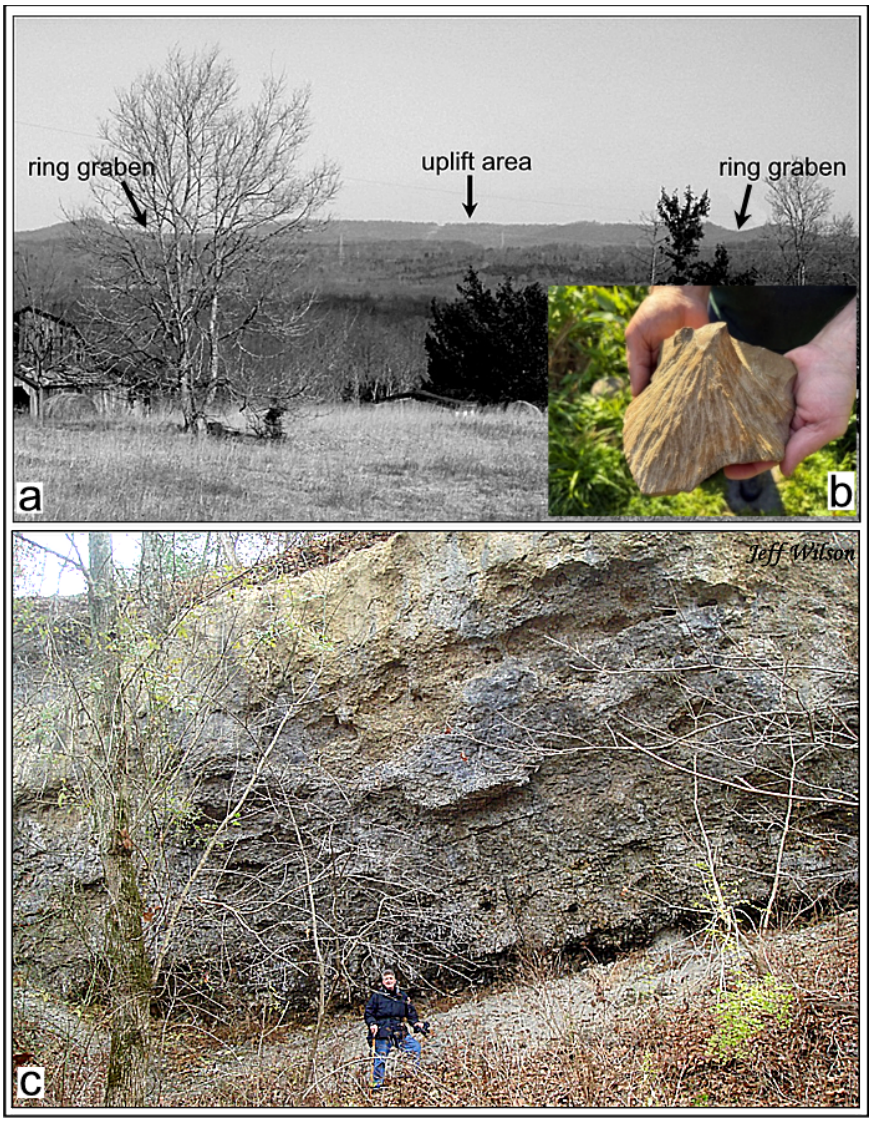


Figure 23a. View of the Serpent Mound Impact Crater from the south. Photo by the author. Figure 23b. Shatter cone found by Tom Johnson in the central uplift area of Serpent Mound Impact Crater. Shatter cones are physical evidence for meteorite impact. Photo by the author. Figure 23c. Photo showing the author standing in front of Serpent Mound cliff. Note the syncline slope of the bedrock. Photo by Jeffrey Wilson.

There are two major geological faults at Serpent Mound – one on the north and one on the east side of the park. A steep syncline extends somewhat perpendicular to Brush Creek just south of the effigy (Figures 23c and 24a).

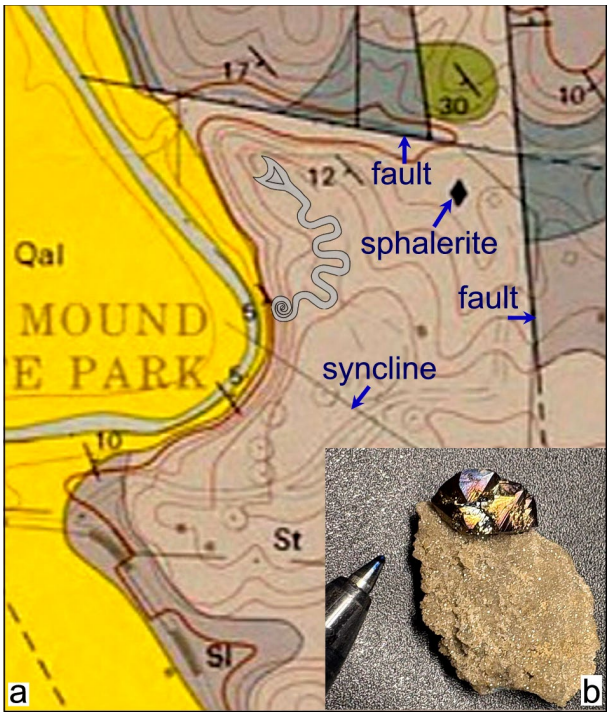


Figure 24a. Detail from Reidel (1975) map of Serpent Mound Impact Crater Bedrock. Serpent figure and text added by present author. Map detail reproduced by permission of Stephen Reidel.
Figure 24b. Iridescent sphalerite crystal (2 cm x 1.8 cm x 1 cm) from the Standard Slag Quarry, Peebles, Ohio. Located about 13 km southwest of Serpent Mound, this quarry was used to mine dolomite and zinc ore. Author's collection.

Of interest on the Reidel map (Figure 24a) is a sphalerite deposit about 180 m (590 ft) east of the effigy near the bottom of a ravine. Sphalerite is a zinc ore mineral. Figure 24b shows a specimen. Depending on its iron content, sphalerite crystals can be clear, yellow, black, or red. The specimen shown here is iridescent sphalerite referring to how it reflects and refracts flashes of light of different colors. I know of no sphalerite crystals found in Adena or Hopewell contexts. However, projectile points made of quartz crystal were occasionally made by Adena and Hopewell peoples and at least a couple were found in mounds at Serpent Mound. It is interesting to think about how the sphalerite deposit might relate to the Serpent effigy and earlier Uktena story. In any event, the feature certainly adds to the special nature of the site.

Brush Creek

I mentioned earlier that traditional stories throughout the Eastern Woodlands tell how the Great Serpent is associated with the watery Below World. Indeed, the belief in monstrous serpents dwelling and emerging from the watery depths of rivers and lakes is pervasive. At Serpent Mound, the relationship between the effigy and water is made explicit in several ways. The promontory is surrounded by watercourses on three sides. Brush Creek (Figure 25a) is to the immediate west, while an intermittent stream that Putnam refers to as 'East Creek' cuts through the gullies to the east. The Serpent Mound promontory is about 500 meters (0.3 mi) south of the confluence of Brush Creek and Baker Fork.

Also notable is how the effigy mimics the curve of Brush Creek (Figure 25b). I do not know the extent to which the course of Brush Creek may have changed over time; but the correspondence is sufficiently remarkable to make it worthy of note.

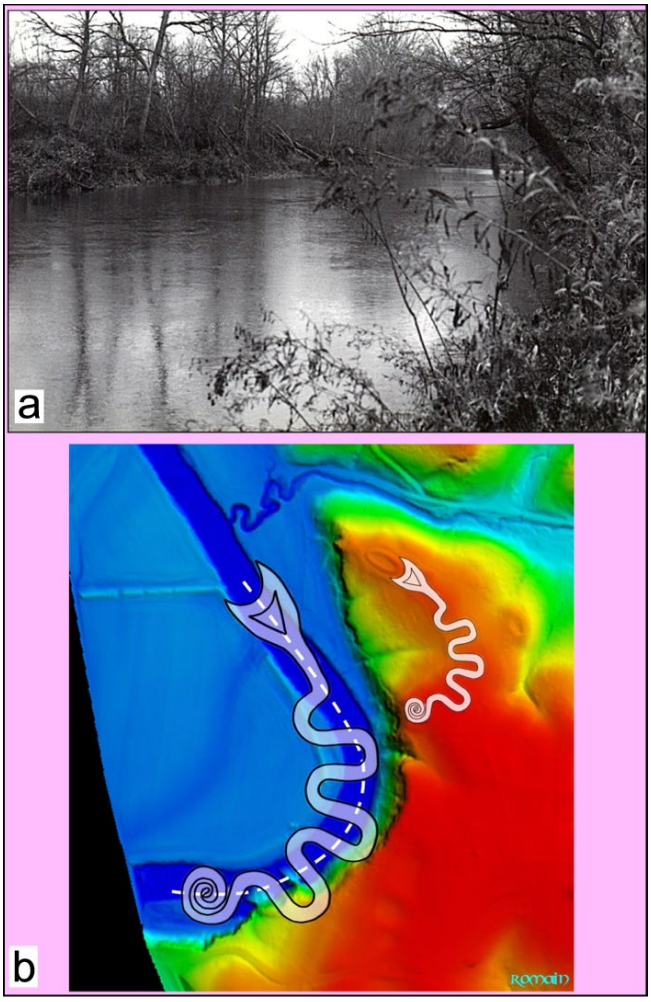


Figure 25a. View of Brush Creek at Serpent Mound. Photo by the author.

Figure 25b. Outline of Serpent Mound superimposed over lidar image of Brush Creek. Image by the author.

Moreover, the idea of Serpent Mound emerging from Brush Creek and the Below World is reinforced by its appearance relative to the creek (Figure 26). As explained by Holmes (1886, p. 627), the contour of the bluff "readily assumes the appearance of a colossal reptile lifting its front from the bed of the stream…The varying effects of light must greatly increase the vividness of the impressions…"

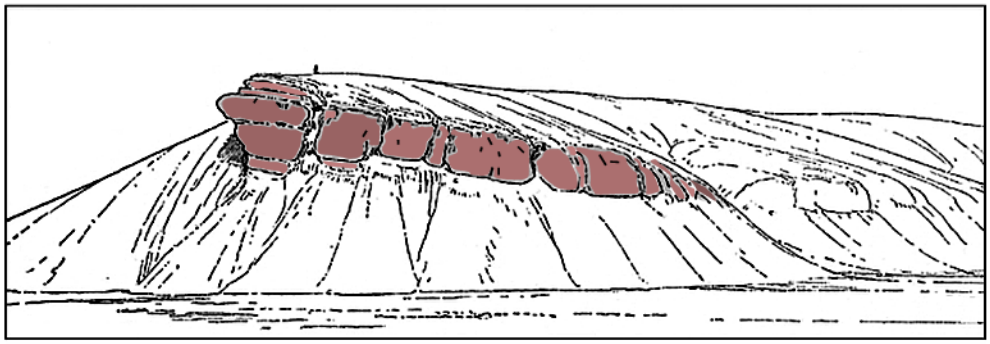


Figure 26. Sketch of Serpent Mound as seen from west side of Brush Creek. From Holmes 1886, color added by present author.

Further highlighting association of the effigy with water is that during heavy rains, the effigy's body convolutions hold rain water (Figure 27). This is the case even after the installation of drainage by Putnam. Jeffrey Wilson (2016) suggests that water pooling was intended as part of the effigy's design. I agree. If the Serpent Mound builders wanted to keep the inner convolutions dry, they likely could have engineered that. As a creature of the Below World, the visible manifestation of water within the coils of the Serpent reinforces association of the Serpent with the watery Below World. Indeed, seeing the Serpent weave in and around pools of water invokes the vision of an animate life-form.



Figure 27. Pooled water within Serpent Mound convolution after a rainstorm. Photo by author.

Karst Features

The meteorite hit in an interesting place. The north-central region of Adams County rests on the Silurian geologic system which is characterized by limestone, dolomite, and shale bedrock. The Serpent Mound ridge itself consists primarily of Silurian-age dolomite. Rainwater seeping into the dolomite over thousands of years has resulted in a karst landscape. In fact, karst encompasses much of central and southwestern Ohio with Adams County having an especially high density of karst features. These include solution caves, springs, sinkholes and disappearing streams (Parrick & Aden, 2021). The tiny village of Sinking Spring located about 6.5 km (4 mi) northeast of Serpent Mound was named for a disappearing or ‘losing’ stream that emerged from a spring and then, after a short run, disappeared into a sinkhole or crack in the bedrock. Figure 28 shows where several karst features are located in the park.

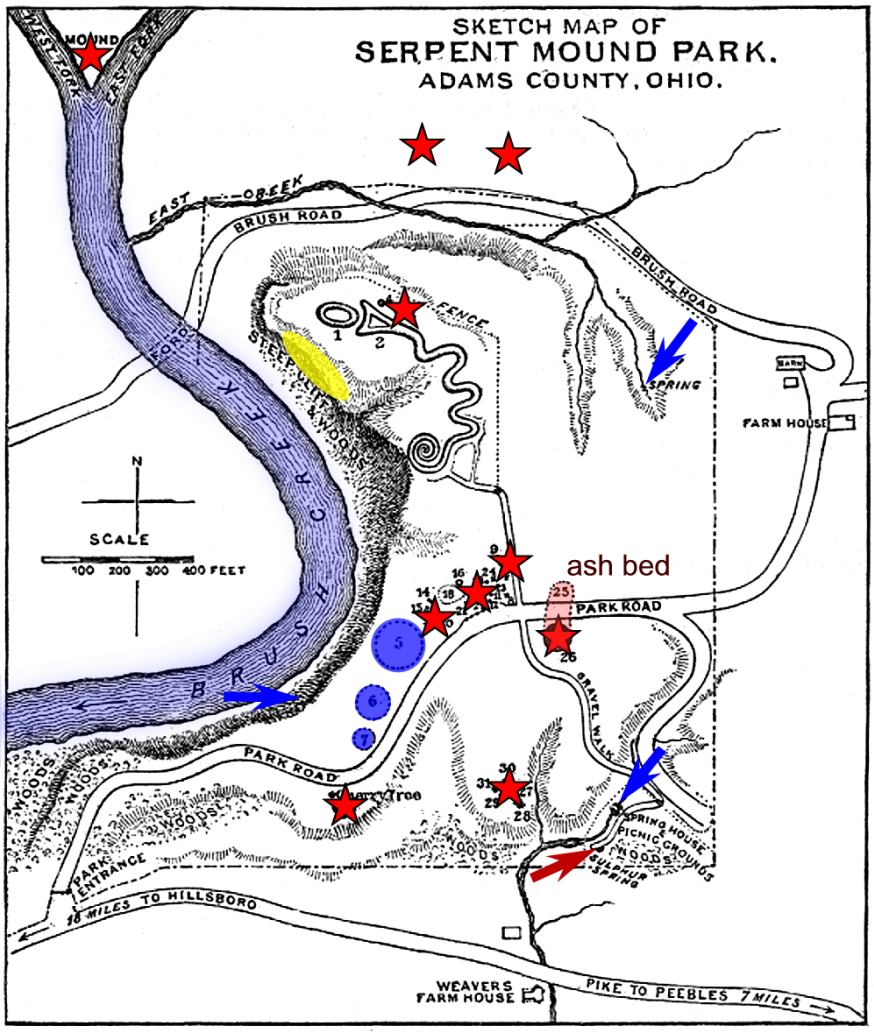


Figure 28. Frederic Putnam's (1890) map of Serpent Mound Park. Annotations by the author: blue circles = sinkholes, blue arrows = springs, red arrow = sulphur spring, yellow oval = area of solution voids, red stars = burial mound/multiple burial mounds.

Caves

Caves are an obvious conduit to the Below World. Numerous small solution crevices occur in the Serpent Mound cliff facing Brush Creek (Figures 29a and 29b). To my knowledge no one has ever systematically assessed what, if anything, might be in these voids and crevices. The largest will accommodate a standing person (Figures 29c). If the ability to stand inside is used as a defining feature for a cave, then the void just mentioned can be considered a cave. The feature extends about 4 meters (13 ft) horizontally into the cliff. Interestingly, there is a significant crack in the ceiling that runs along its length (Figure 29d). Jeffrey Wilson (2022) suggests this fracture might be

interpreted as an entrance to the Below World. The age of the cave is not known. But if the cave and ceiling fracture were present during ancient times then Wilson's interpretation adds to the notion of Serpent Mound as a portal.

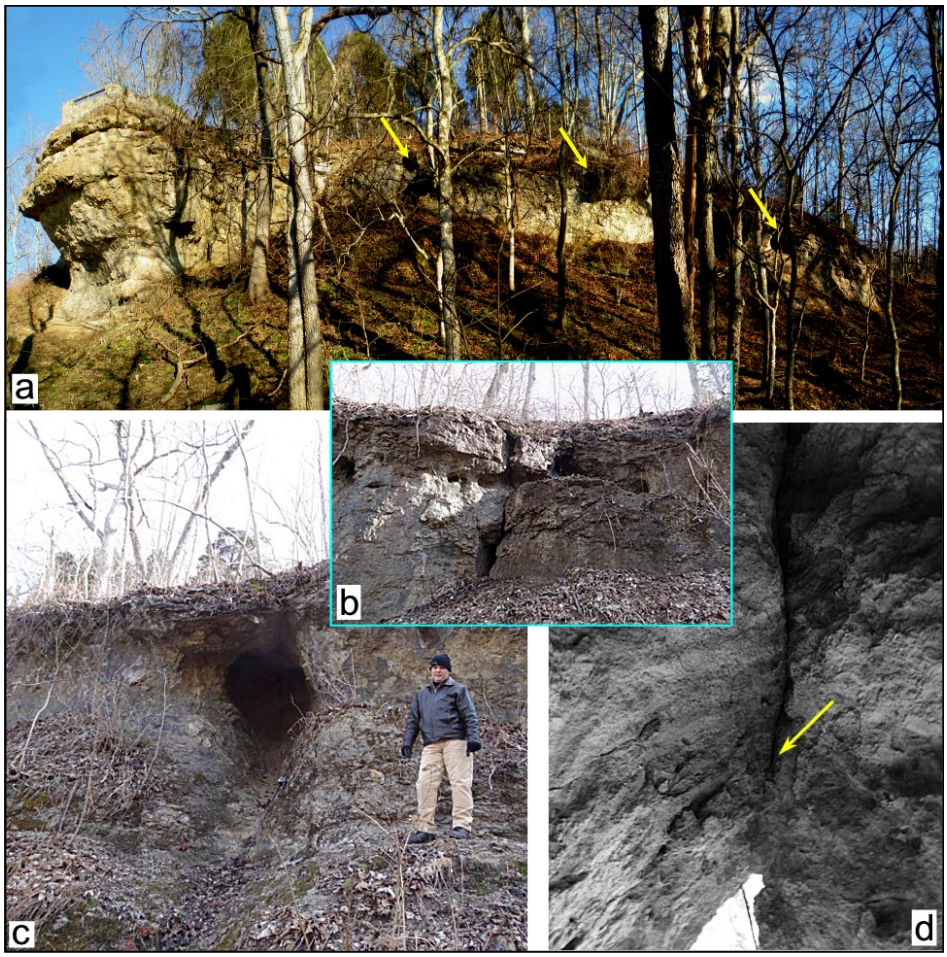


Figure 29a. View of Serpent Mound cliff. Multiple solution voids shown by arrows. Photo courtesy of Jeffrey Wilson.
Figure 29b. Close-up view of Serpent Mound cliff showing several small solution voids. Photo by the author.
Figure 29c. Jeff Wilson at entrance to Serpent Mound solution cave. Photo by author.
Figure 29d. Fault crevice in ceiling of Serpent Mound solution cave. View is from inside the cave looking out. Photos by the author.

Springs

As Mallam (1984, pp. 18–19) noted, springs are often considered a conduit to the Below World. There are several springs at Serpent Mound – including one that Putnam shows as a 'sulphur spring' (red arrow in Figure 28). Putnam's finding is consistent with the fact that at one time, Adams County was famous for its medicinal springs – hence, for

example, the town named ‘Mineral Springs’ located about 18 km (11 mi) southeast of Serpent Mound.

Sinkholes

As part of the Serpent Mound Project, geologist Mike Zaleha and I conducted an ERGI (electric resistivity ground imaging) study of several depressions just south of the effigy (Zaleha & Romain, 2014). For years these features were often referred to as borrow pits (although Putnam correctly identified them as ‘sinks’ on an unpublished map [Wilson, 2017, slide 105]). Our work confirmed they are sinkholes. Figure 30 shows sinkhole # 2. Figure 31a shows its location relative to the serpent effigy. Figure 31c is an ERGI profile through sinkhole # 2 revealing a silt-filled void or cavern underneath. In the early 1970s sinkhole # 2 opened into a hole described by the Serpent Mound area manager as 1.2 meters (4 ft) in diameter and at least 2.4 meters (8 ft) deep. It took more than six tons of gravel to fill it (personal communication with William Gustin, 7-16-1987).

Following the line of three sinkholes northward leads to a large depression that could be a collapsed and eroded sinkhole, or simply an erosional gully (Figure 32). A detailed bedrock geology map made by geologist Stephen Reidel (1975) shows a syncline at the location (Figure 24a). Rainwater percolating down along the syncline could have resulted in either sinkhole or gully feature. In any case, given the effigy’s location immediately next to this declivity, it would not take much to imagine it as a portal from which the Serpent emerged and ascended into the night sky as Scorpius. Figure 33 shows my rendering of that scenario using Stellarium and lidar imagery.



Figure 30. Serpent Mound sinkhole # 2. Photo courtesy of Horton Hobbs.

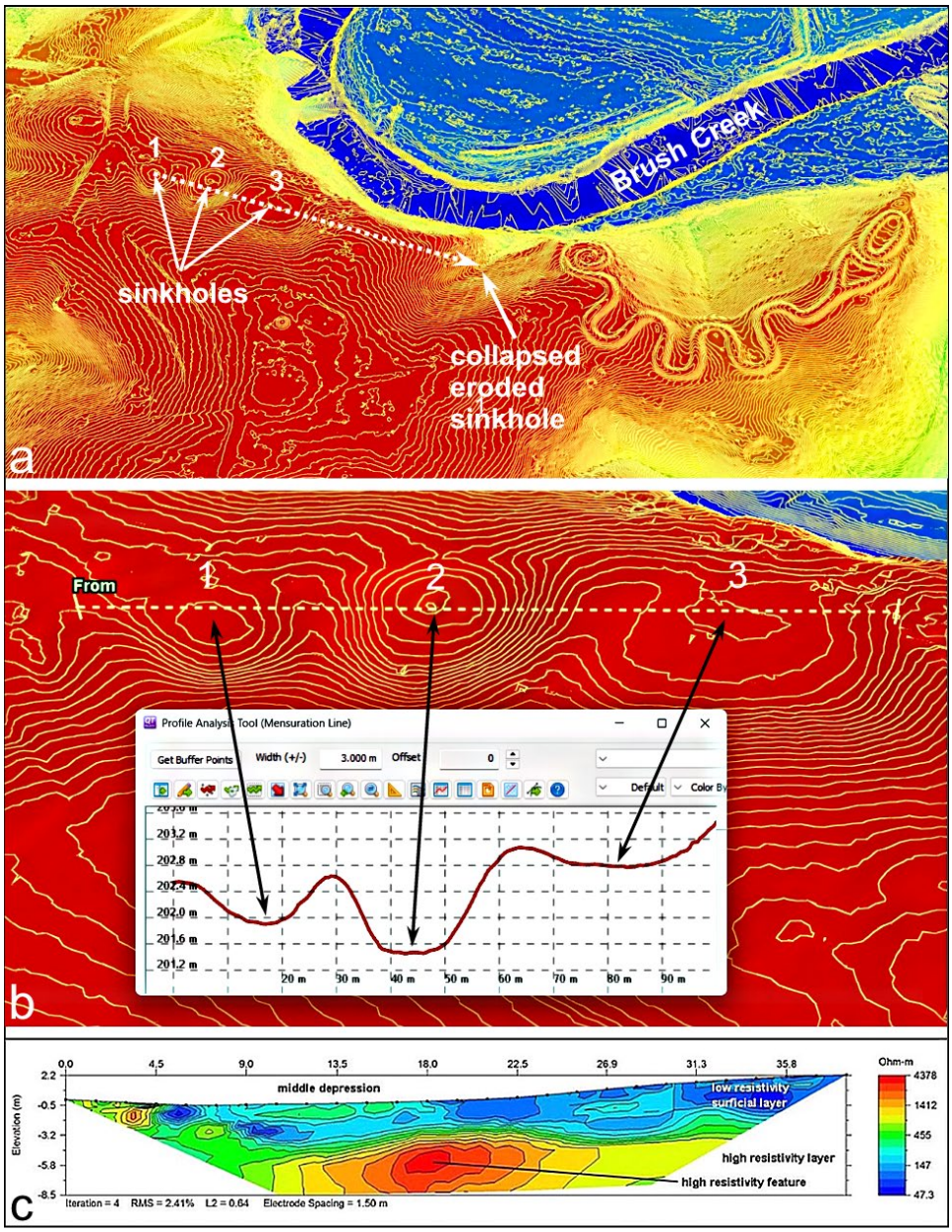


Figure 31a. Lidar view of sinkholes south of Serpent Mound effigy.
Figure 31b. Lidar profile through sinkholes 1-3. Images by author.
Figure 31c. ERGI cross section view through sinkhole # 2 at Serpent Mound. Image courtesy of Mike Zaleha.

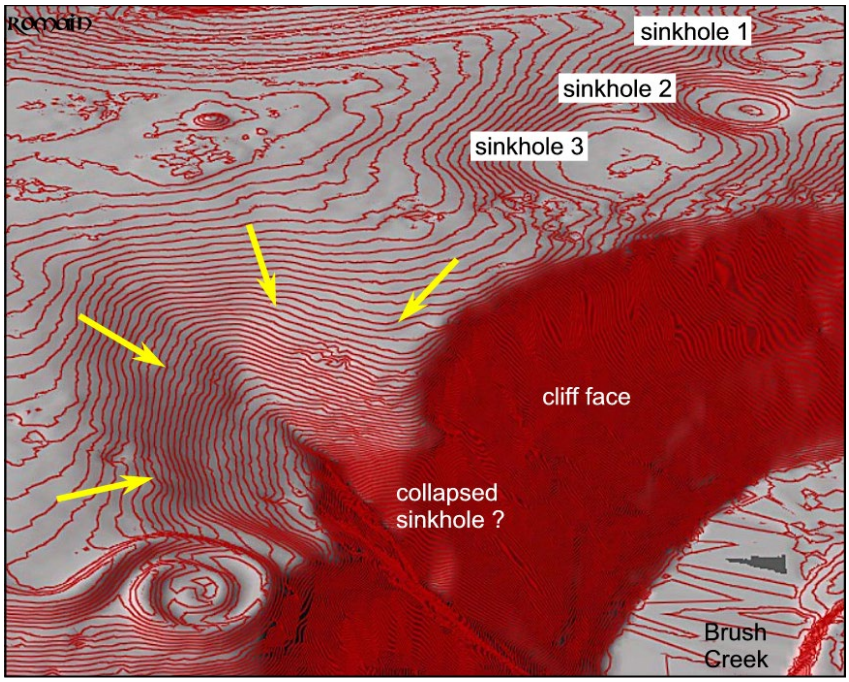


Figure 32. Lidar view showing erosional gully or collapsed sinkhole immediately south of Serpent effigy's tail. Contour interval = 0.2 meter, no vertical exaggeration. Image by the author.

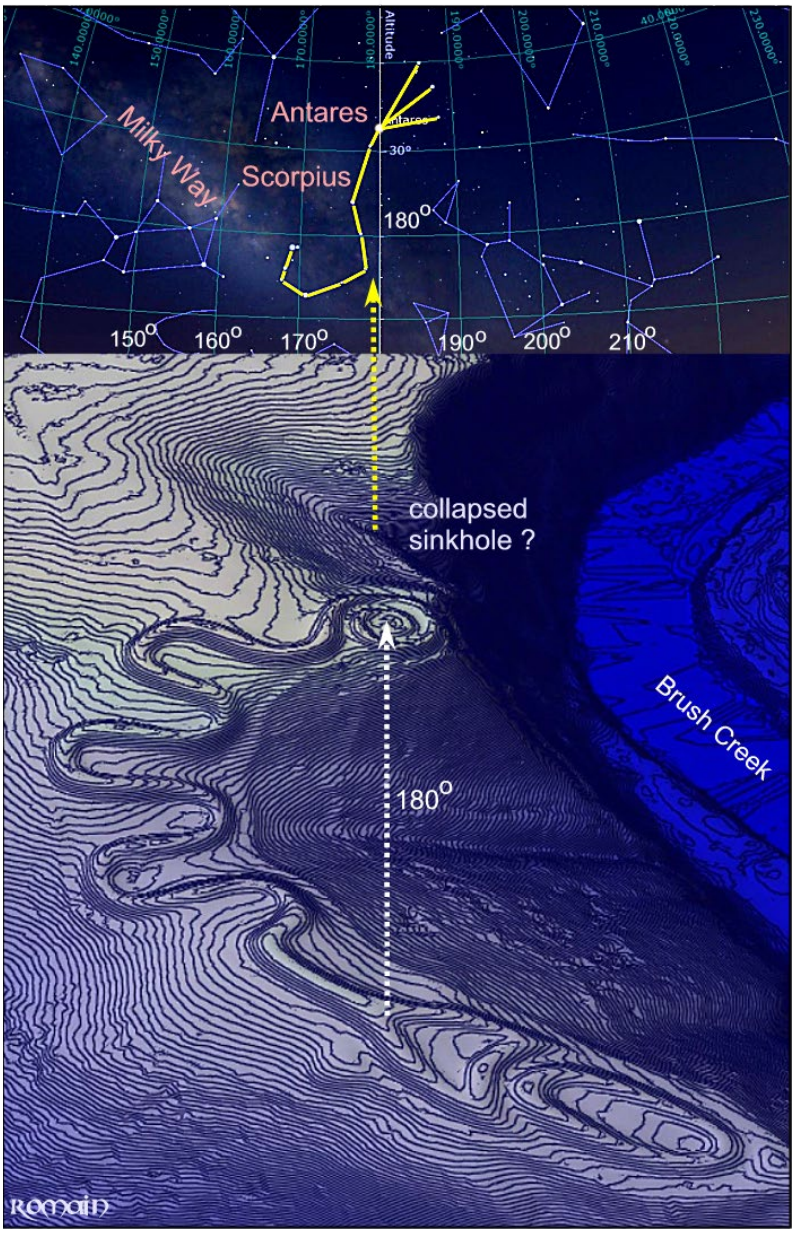


Figure 33. Stellarium and lidar views showing Below World Great Serpent/Scorpius and Milky Way emerging from collapsed sinkhole. Summer solstice year -292, Antares at upper culmination. Images by author.

Below World Creatures

As one might expect, there are creatures in and around Serpent Mound that are of the Below World. Among the Below World creatures are fish and mussel species in Brush Creek. There are also frogs and peepers. I'll long remember their non-stop chorus during a nighttime overwatch of our project equipment as I slept at the head of the effigy. And there are snakes. Several species of snakes are found in Adams County.

Venomous serpents include the copperhead (*Agkistrodon contortrix mokasen*) and endangered eastern timber rattlesnake (*Crotalus horridus*). Seen more commonly at Serpent Mound, however, are bats. Due to the large number of sinkholes and crevices in the area, Adams County is known as the bat capital of Ohio (Elfner, 1979). Bats are a common summer nighttime sight at Serpent Mound (Figure 34a).

Also present are fireflies. Depending on the night and weather conditions, massive numbers of fireflies can appear everywhere, flashing in an amazing display. An old-timer once told me that the tiny flashes of light are the spirits of people buried here.

One of the strangest looking Below World creatures has to be the trilobite. Southern Ohio is world-renowned for its Ordovician and Devonian trilobite fossils. Figure 31b shows an exceptional large specimen (*Isotelus maximus***)** found in Adams County. Given the creature's unusual appearance, if seen emerging from exposed bedrock along a creek, who would doubt that it is a denizen of the Below World.

There is more, however, to Serpent Mound than a simple a catalog of animate and inanimate entities. The celestial alignments, sinkholes, caves, water, crystals and biologic beings each bring unique qualities that along with the Serpent effigy and people buried here, create a unique inter-connected matrix. It is this relational web that for the living, makes Serpent Mound a special, or sacred space. It's all connected.

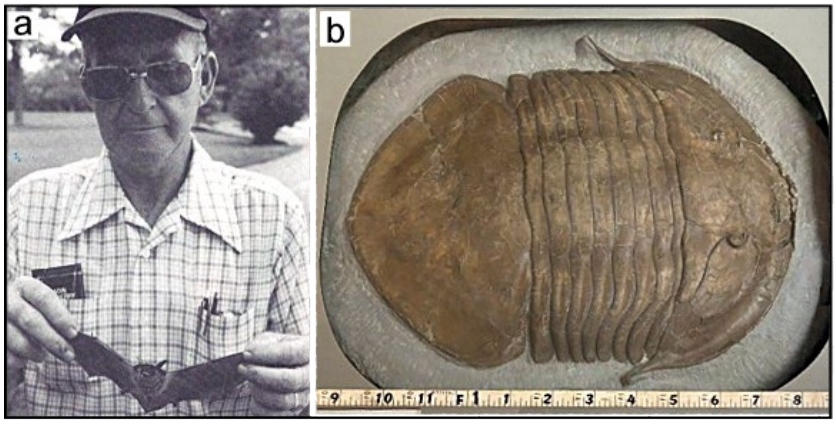


Figure 34a. Serpent Mound resident with site manager Bill Gustin.
Figure 34b. Trilobite fossil found by Tom Johnson in upper Ordovician, Waynesville formation, Adams County, Ohio. On display at House of Phacops Rock Shop, Peebles, Ohio. Photos by author.

Burials

In the preceding pages discussion has focused on archaeoastronomy and landscape associations. In my opinion, however, the most important aspect of the site is that it is a burial ground. The importance of the site as a burial ground is attested to by the fact that it was used in that way for more than one thousand years by people of the Adena, Hopewell and Fort Ancient traditions. In fact, an even earlier occupation seems likely, given that more than two dozen Archaic period projectile points have been found at the site (Schwarz, 2020, Figure 19).

It is impossible to know the total number of people buried at Serpent Mound. Greenman (1957, pp. 14–18) counted the remains of 23 individuals mentioned in Putnam's 1890 report. However, there were, and probably still remain in the park, the remains of many more people in the form of cremated bone fragments and ashes.

Cremated human remains were documented by Putnam who excavated south of the effigy. For example, on his park map (Figure 28, above), Putnam (1890, p. 874) indicates "Cremation Places" at locations 27 and 28. And the figure caption for one of the sketches in his published report reads: "cremation place of clay below the dark soil" (Putnam, 1890, p. 884).

With reference to one of the many grave sites he excavated, Putnam (1890, p. 886) states: "The burnt material in this grave is of the same character as that found on the first fireplace, and among the burnt bones are many fragments which can be identified as human." Elsewhere in the same report, Putnam (1890, p. 879) described a deep grave that included "compressed into a mass of ashes and charcoal not over an inch in thickness…the fragments of a skeleton."

Further, Putnam (1890, p. 885) documented multiple ash beds and ash deposits — several of which contained "burnt bones." The most impressive of these features is the large bed of ashes that Putnam uncovered at the base of the conical mound (feature 26 on Putnam's map – see Figure 28, above). Putnam (1890, p. 880) described it as "thirty by thirty-five feet in diameter" and "a few inches in thickness." Among other things, it contained "pieces of burnt bone" (Putnam, 1890 p. 880).

Notably, Putnam (1890, p. 880) stated that "a burnt layer similar to this extended nearly a hundred feet north of the [conical] mound, and about the same width as the

mound." On Putnam's map (Figure 28, above), this burnt layer is identified as feature 25. Considered together, these burnt layers were massive.

Unfortunately we do not know what percentage of the bone fragments contained in the ash beds and burnt layers were human and what percentage were animal. Forensic examination of bits and pieces of bone by trained personnel using modern methods was not the case in the 1800s. However, cremation was common during Adena and Hopewell times. (For Adena cremation practices see Dragoo, 1963; Webb & Baby, 1957; for Hopewell see Baby, 1954; Brown, 1979). Certainly it is possible, even likely, that to this day, the ash beds, burnt layers and few remaining features at Serpent Mound that have not been disturbed hold the remains of ancestral Native Americans. What lends credibility to this is that a few years ago, septic system lines from park restrooms were installed in trenches dug near the conical burial mound and through Putnam's "burnt layer" feature 25. Test units and trenches in the impacted area found dozens of "prehistoric artifacts" (Schwarz, 2011, p. 41, Table 2). Additionally, Schwarz (2020, p. 30) identified "an ashy buried A horizon" north of the conical burial mound. Based on his test excavations, Schwarz (2020, p. 30) said: "I believe that the ashy buried A horizon [north of the conical mound] is a remnant of the 'burnt space" that Putnam (1890:874) excavated." Ground penetrating radar survey by Jarrod Burks (2008) revealed numerous anomalies in the burnt space area. Figure 35a shows the septic field and Putnam's "burnt layer". Figure 35b shows the conical burial mound.

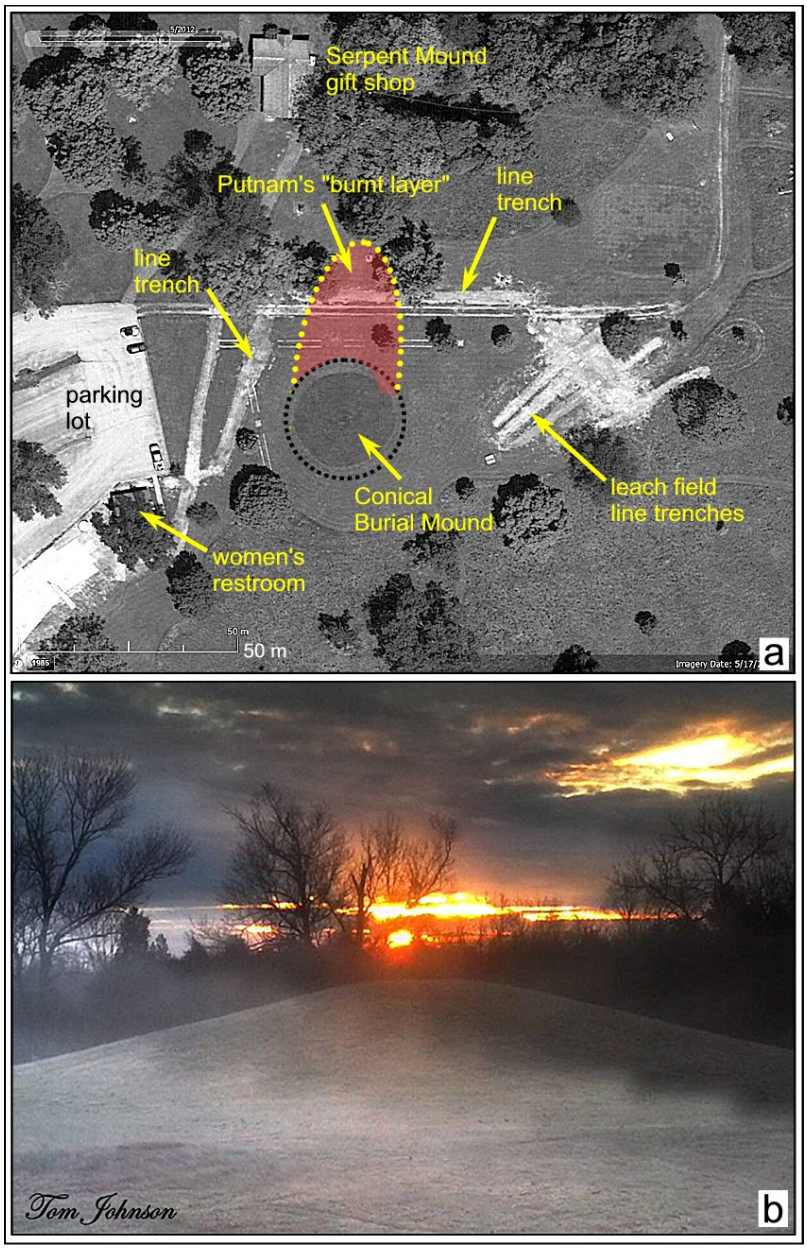


Figure 35a. Google Earth Pro view of Serpent Mound leach field area. Photo date 5-17-2012, eye altitude 446 m. Annotations by author. Footprints of the Windigo? *sensu* Kimmerer, 2013, pp. 303–309.
Figure 35b. Sunrise over 'restored' conical burial mound. This burial mound was excavated in the late 1800s by Frederic Putnam. Photo courtesy of Tom Johnson.

My personal opinion is that the Serpent Mound burial ground was not the end; but rather was the place of beginning for a journey of the soul to the Land of Ancestors. The effigy pointed the way to solstice portals to the Otherworld and from there to the Milky Way Path of Souls and Land of the Dead where one might be reunited with the

ancestors and loved ones. Belief in the reality of the journey is reflected in the thousands of hours of physical work and commitment needed by generations to design, build, and maintain the effigy.

For the people who knew, the Serpent Mound story as memorialized in tangible earthen form offered hope and the way to a continued existence. At the same time, the site was a portal between worlds not only for humans but also for the Great Serpent – ancient protector of the dead, guardian of the Milky Way Path of Souls, and gatekeeper to the Realm of the Dead.

Conclusion

In the preceding pages radiocarbon data for the Serpent Mound were reviewed with commentary offered in support of an Early Woodland construction date.

Also presented were archaeoastronomic findings to include: 1) the shape of the oval embankment as inspired by the flattening of the Sun phenomenon; 2) alignments through the Serpent's body to the Moon with the suggestion that the Serpent and Moon are manifestations of the same Below World entity; 3) alignment of the Serpent to Antares and the constellation Scorpius where Scorpius is understood as the celestial form of the Great Serpent; 4) observation that during the summer night sky Scorpius rises up out of the southern horizon and later that same night, descends back into the Below World; 5) orientation of the Serpent effigy to the Milky Way Path of Souls; 6) alignments of the effigy to the summer and winter solstices.

Landscape archaeology findings included: 1) the Serpent's location in an anomalous area of disturbed bedrock created by meteor impact; 2) physical proximity and matching shape of the effigy to Brush Creek (wherein rivers and streams are conduits to the Below World); 3) profile of the Serpent Mound promontory appearing as a Serpent rising out of Brush Creek (with rivers as dwelling places for the Serpent); 4) pooling of water in the Serpent's convolutions implying the Serpent's association with the watery Below World; 5) observation that the elevation of the effigy proceeds downslope from tail to head (implying movement toward the Below World); 6) proximity of the effigy to caves, fissures and sinkholes (all portals to the Below World).

Lepper and colleagues propose that Serpent Mound references a Dhegiha Sioux creation story. I doubt that. The Dhegiha Siouan interpretation fails to consider the astronomic alignments, landscape associations and cultural context of the effigy. As to this last point, there is clear evidence that serpents played an important role in certain Adena and Early Woodland burial rituals. As discussed elsewhere (Romain, 2018, pp. 8–11) there are known instances where snakes were intentionally placed with Adena burials – for example, at the Wright mounds in Kentucky, only 145 km (90 mi) from Serpent Mound (Webb, 1940, pp. 20–21). Similar instances are recorded for Early Woodland burials in Illinois (Henriksen, 1965, p.7; Winters, 1961, p. 81). In the Illinois cases, the snakes were decapitated before being placed with the burials.

In any case, and as Vine Deloria Jr. (2003 [1973], p. 65) has pointed out, “The structure of…[American Indian] religious traditions is taken directly from the world around them, from their relationships with other forms of life. Context is therefore all-important for both practice and the understanding of reality.”

Lastly, the Dhegiha Sioux interpretation glosses over the most important aspect of the site – namely that Serpent Mound is a burial ground.

What happens after death one of the most difficult questions that people seek answers to. My suggestion is that Serpent Mound memorialized an answer. That answer was found in the Path of Souls story. Correspondences as described above to the Sun, Moon and stars as well as landscape features gave visual substance and positive affirmation to the story.

Importantly the Path of Souls interpretation for Serpent Mound is not dependent on any one story plucked from among hundreds; but rather, is based on multiple beliefs and narratives common to indigenous peoples across the Eastern Woodlands and deep into ancient times. Perhaps the strongest support for the interpretation just offered, however, is that, as attested to by the burials surrounding the effigy, for more than one thousand years, people began their journey to the Land of the Dead here – at Serpent Mound.

I would like to close with a powerful observation made by an anonymous reviewer. The reviewer noted how I pointed-out that the solar, lunar and stellar alignments observed at Serpent Mound were basically the same for at least 1,400 years. The reviewer then

said: “That is a useful reminder that the place outlasts any one interpretation of its date, and that it can still be a sacred place today, not only a site of past belief.” I could not have said it better. Thank you.

Disclaimer

No ceremonial objects were illustrated in this paper. The Cherokee snake mask and serpent stone carving shown in Figures 6a and 6b were purchased at an Eastern Cherokee operated cooperative gift shop in Cherokee, North Carolina. The cooperative helps support Native American craftspeople.

Acknowledgements

The Serpent Mound Project was to culminate in a book. Along the way, however, devastating events happened that ended that promise. Three important chapter authors passed away before completing their work – G. William Monaghan, David Bell, and Horton Hobbs. This paper is dedicated to their memory.

The names of all those who gave of time, money, or expertise in furtherance of The Serpent Mound Project are many. My apologies if I missed someone – and I’m sure I did. Special thanks to: Bill Gustin, Andy Davenport, Stephen Reidel, Jim McKenzie, Beverly McKenzie, Jeffrey Wilson, Delsey Wilson, Kevin Pape, Kris Phipps, Ty Pell, John Dailey, Tom Johnson, Karen Leone, Ed Herrmann, Horton Hobbs, Jarrod Burks, Tim Schilling, Mathew Purtill, Al Tonetti, and Mike Zaleha.

Thank you to JAC associate editor, Andy Munro and anonymous reviewers for helpful comments. And thank you to my wife, Evie Romain for her patience and support.

I look forward to hearing from the several Tribal Historic Preservation Officers whom I asked to consult with for this paper.

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