Ancient Celestial Correlations at Poles Hill

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ABSTRACT

A collection of altered glacial erratics on Poles Hill in Gloucester Massachusetts that function as a solar observatory for viewing solstice events is shown to fit into a broader celestial context. The locations of these and a number of other erratics that also appear to have been altered are correlated with bright stars in several northern constellations including Draco and Hercules. We describe a method for mapping the sky to the ground using stars in the serpent constellation, Draco, as tie points. One star, Thuban, the former pole star, is associated with the central marker in the observatory; another, Rastaban, the "eye" of the serpent, is associated with a large boulder that resembles a snake's head and faces west. A result of this mapping is that the line of site (the “gaze” of Rastaban) is directed toward a collection of boulders that appear correlated with a group of bright stars in the constellation Hercules (the “keystone” asterism). The snake head sits atop a section of serpentine bedrock that looks like a coiled snake when viewed from above. An adjacent semi-circular “U”-shaped bedrock formation correlates with another star, Etamin, in Draco. The line of sight from this observation point passes through the same boulder that serves as the summer solstice sunset marker in the solar observatory. The continuation of the line passes in between the ground projected constellation Ophiuchus (“the serpent bearer”) and Serpens Caput (“the serpent’s head”). We show that this pattern on the ground lines up with the actual constellations in the sky at sunset on the autumnal equinox about 4000 years ago.

Introduction

Poles Hill is a rocky plateau in Gloucester, Massachusetts adjacent to the Annisquam River, a tidal, salt-water estuary (Figure 1). In a previous paper evidence was presented supporting the hypothesis that Native American people constructed a solar observatory atop Poles Hill (Lepionka and Carlotto 2014). The observatory consists of four large boulders: a central observational reference stone called the "gnomon" surrounded by three markers located at the summer solstice sunrise, summer solstice sunset, and winter solstice sunrise (Figure 2). The gnomon (Figure 3a) is a glacial erratic that could have been placed by the builders at its current location to align with the much more massive summer solstice sunset (Figure 3b) and sunrise (Figure 3c) boulders.

As at other sites in New England (Ballard and Mavor 2006, Leonard 2010) the builders at Poles Hill took advantage of available material – large granite boulders transported and deposited by glaciers during the last ice age – sculpting and moving them to suit their purposes. The bottom of the gnomon has been shaped to fit closely the underlying granite bedrock surface. Both the gnomon and the sunset boulders have scalloped-shaped surface concavities that appear to have been sculpted by fires at the base of the rock to cause spalling (Bellini 2015).

Figure 1 Satellite image of Poles Hill in Gloucester, Massachusetts (Imagery courtesy MassGIS and Google Earth.)

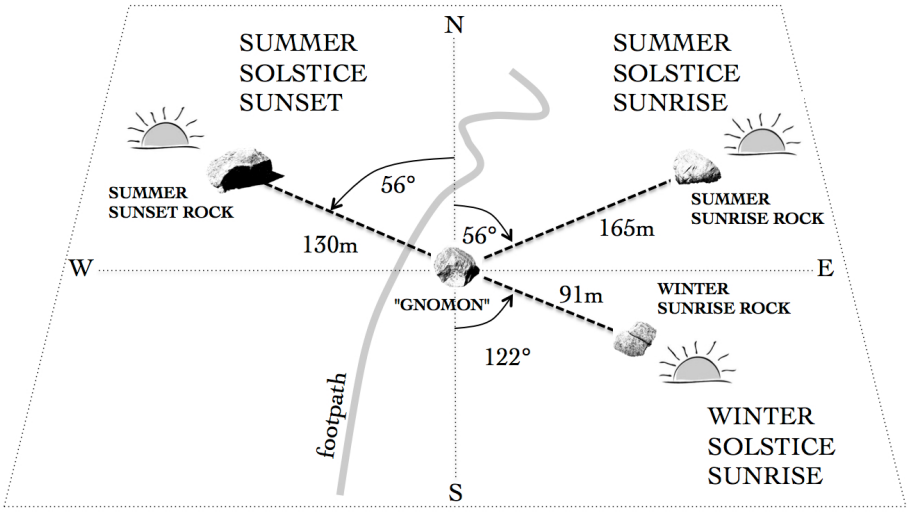
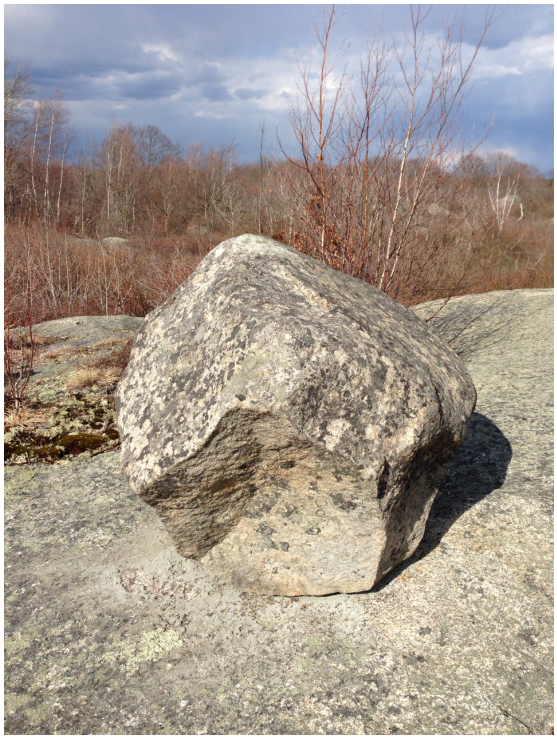


Figure 2 Schematic of solar alignments at Poles Hill



a) Gnomon

b) Summer solstice sunset rock

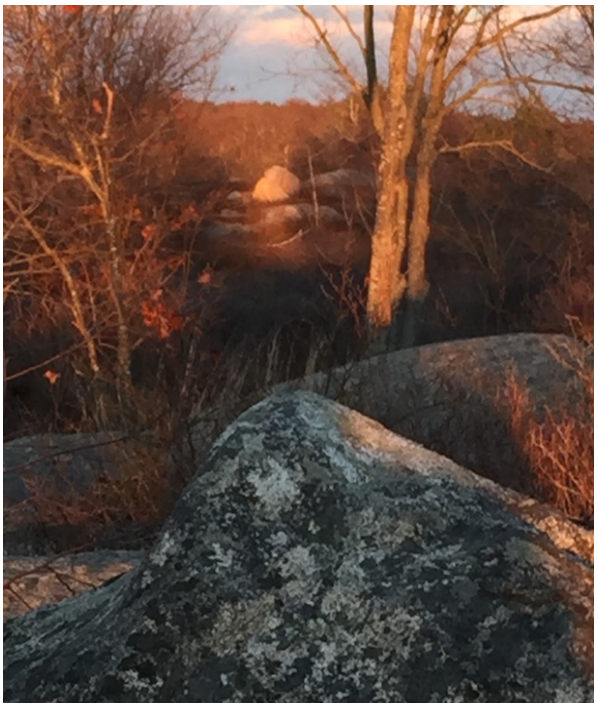
c) Summer solstice sunrise rock

d) Winter solstice sunrise rock

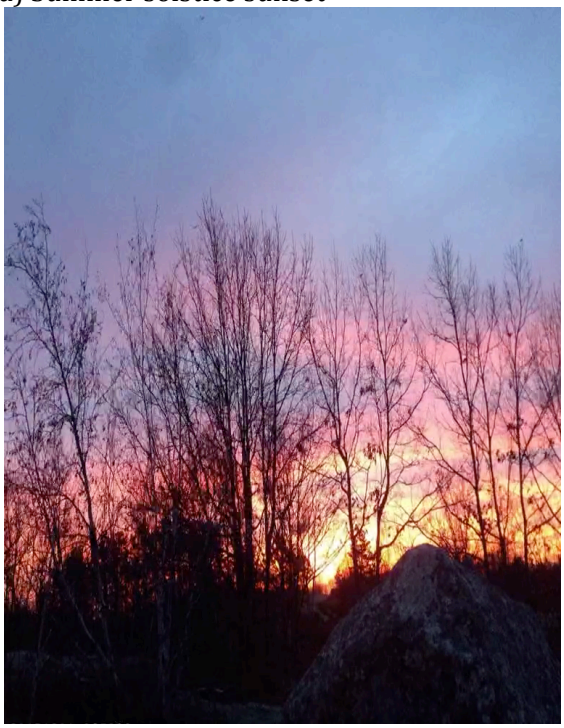
Figure 3 Rocks comprising Poles Hill solar observatory

Unlike sites constructed more recently, the summer solstice sunrise and sunset markers do not align exactly with the rising and setting sun today – the sunrise alignment is off by 0.54° and sunset alignment is off by 0.44°. Using archaeoastronomical dating based on changes in Earth's obliquity, the summer markers were found to line up to within 0.07° of the summer solstice sunrise and sunset 2000-4000 years ago. The winter alignment, which is marked by two stacked flat slabs of granite (Figure 3d) on an elevated ledge to the southeast is close to today's winter solstice sunrise, suggesting the winter marker was added more recently.

a) Summer solstice sunset



b) Summer solstice sunrise rock illuminated at winter solstice sunset



c) Winter solstice sunrise

d) Winter solstice sunrise sightline

Figure 4 Solstice events and sightlines (2015)

The investigation of Poles Hill as an archaeological site began with photographs of the gnomon and the summer solstice sunset rock (Lepionka 2013). After locating these two rocks, plotting their geographic coordinates, and drawing a line between them, the summer solstice sunset alignment became evident. This led to the search for a matching sunrise boulder on the east side of the plateau. Finding both this boulder and the stacked stones marking the winter solstice sunrise completed the initial survey. Although a line drawn east from the gnomon passes within a few meters of the highest point on Poles Hill, marked at one time by a pole (one of two poles that were erected for navigational purposes), no true equinoctial marker either east or west of the gnomon were found.

At the time, a large erratic was found several hundred feet north-northwest of the gnomon. Like a number of other boulders encountered on Poles Hill that appear to have been altered by spalling or other means, its shape resembled a snake's head, particularly when viewed several meters from above (Figure 5a). Figure 5b shows the location of what I will refer to as "snake rock" (E) with respect to the gnomon (A), summer solstice sunset (B), summer solstice sunrise (C), and winter solstice sunrise (D) markers. Since snake rock did not appear to have any obvious solar significance it was not considered further at that time. However, new discoveries on Poles Hill suggest the possibility that this site may fit into a broader celestial context, in particular, that the locations of snake rock, the gnomon, and other erratics, which also appear to have been altered, might be correlated with stars in several northern constellations, including Draco and Hercules.

a) Aerial view of snake rock

b) Location of snake rock (E) in context of other boulders (A-D)

Figure 5 Large boulder shaped like snake head north-northwest of gnomon

Celestial Context

Serpents appear in many Native American mythologies as seen in the form of petroglyphs, effigy mounds, lithic formations, and other representations (Boutet 2011). Effigy mounds, built during the Woodland Period (1000 BCE to European contact) are piles of earth constructed in the shape of a stylized animal, symbol, or other figure. Great Serpent Mound in Ohio is one such example, which recent radiocarbon dating evidence suggest was built more than 2000 years ago (Herrmann et al 2014). Covering an area of several acres on a southeastern facing slope of Overlook Mountain in Woodstock, New York, a grouping of very large, carefully constructed lithic formations, when connected together and taken as whole, appear to create a serpent effigy that may represent the constellation Draco (Kreisberg 2011).

The Giza–Orion correlation theory (Bauval and Gilbert 1993) is a hypothesis that claims there is a correlation between the location of the three largest pyramids of the Giza pyramid complex and Orion's Belt in the constellation Orion, and that this correlation was a design element in the construction of the Giza pyramids. Moreover it is claimed that that the time the pyramids and sphinx were originally constructed, in the astrological era of the Age of Leo, the sphinx, which originally may have fully resembled a lion, would have been looking directly due east at it's celestial counterpart as it rose at dawn of the vernal equinox in 10,450 BC.

The evolution in our discourse here is toward the concept of a terrestrial, or landscape zodiac wherein the landscape has been altered to match the pattern of stars such as those in the signs of the zodiac. Perhaps the best example is the alleged Glastonbury Temple of the Stars, situated around Glastonbury in Somerset, England (Maltwood 1934). The temple is thought by some to depict a colossal zodiac. A less known but more relevant example perhaps is the "Atlantic Trace Settlement" – a pattern of seventy stars grouped into three Algonquian constellations replicated in stone on landscapes in maritime Canada and New England (Ring et al 2013).

Methodology

Archaeoastronomical dating of the summer solstice alignments (A-B and A-C in Figure 5b) revealed that the solar observatory on Poles Hill was constructed 2000-4000 years ago (Lepionka and Carlotto 2015). At that time Thuban, a star in the constellation Draco, would have served as the pole star. Although there is no obvious overhead representation of Draco or any other serpent-like figure on Poles Hill, the number of altered boulders with a snake or serpent-like appearance encountered at the site leads one to wonder if the native people could have referenced Draco in some other way. Specifically, if snake rock had some significance, ceremonial or otherwise, could it be associated with a star in Draco?

If one gazes up at the sky at night, stars appear as points of light on the inside of a vast celestial sphere. As the earth rotates around its axis the celestial sphere appears to rotate once a day around a point in space that is today close to the star Polaris in the constellation Ursa Minor. The phenomenon known as "precession of the equinox" is caused by the precession or "wobble" of the earth's axis over a 26,000 year period. Thousands of years ago the earth's axis was pointed toward Thuban (α-Draconis), a relatively faint, 3.5 magnitude

star in the constellation Draco. Back then the celestial sphere would have appeared to rotate around a point near Thuban.

Figure 6 is a map of the sky above Poles Hill. There are many possible ways to map the sky to the ground. Associating three stars in Draco – Thuban, Rastaban and Etamin – with specific ground features leads to some interesting results. Specifically, Thuban is associated with the gnomon. Both are reference points: Thuban was the former pole star as noted above, and the gnomon is the central sighting stone in the observatory. Snake rock sits atop a section of serpentine bedrock that looks like a coiled snake when viewed from above. Next to snake rock is a horseshoe or "U"-shaped bedrock formation. We associate these two locations with Rastaban (β-Draconis) and Etamin (γ-Draconis), two stars on the head of Draco. This mapping is also consistent with the relative magnitude of the corresponding stars - snake rock is considerably more massive than the gnomon and corresponds to the much brighter (apparent magnitude 2.8) Rastaban.

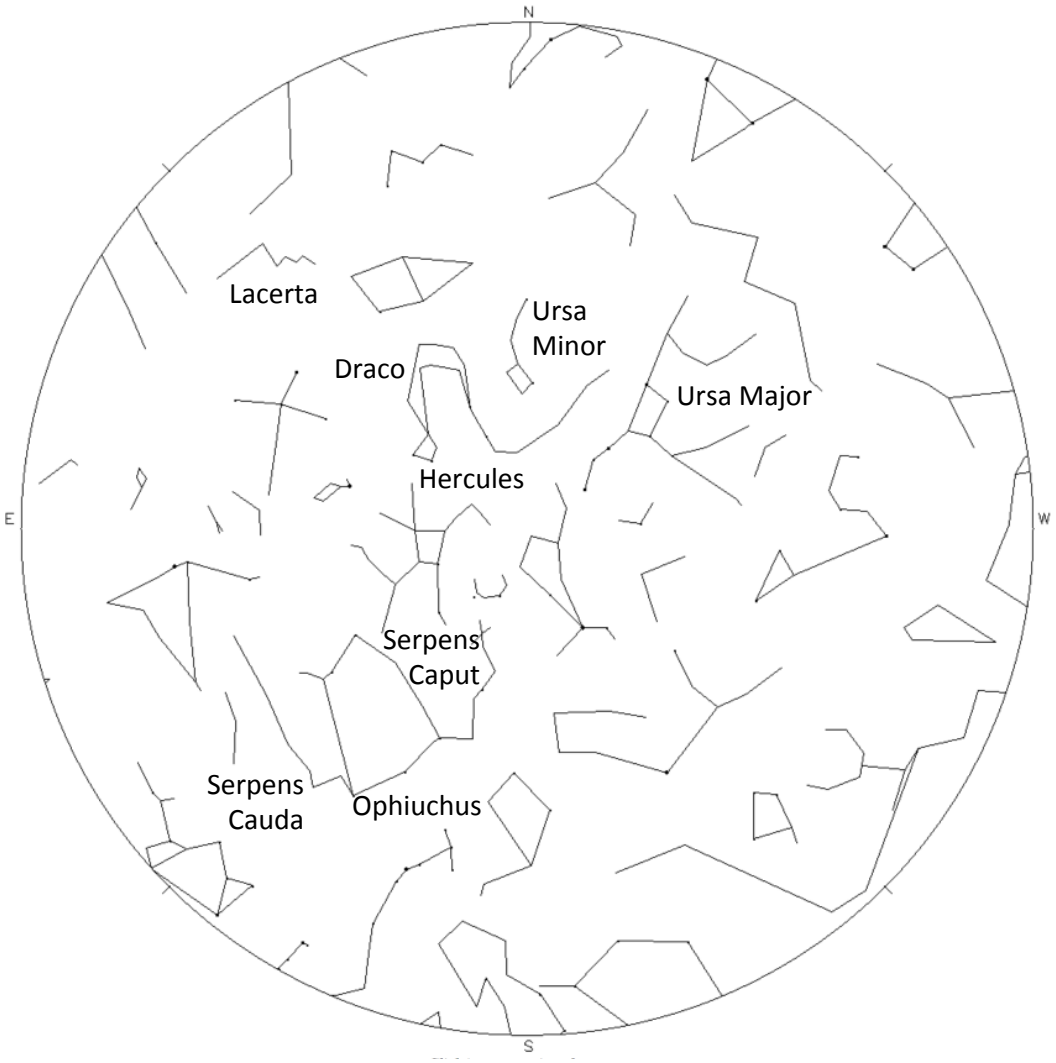


Figure 6 Sky above Poles Hill on Tuesday 2016 Jul 26 23:30 UTC (Courtesy True Sky)

Figure 7 is the star map in Figure 6 projected on to the landscape at Poles Hill. Thuban maps to the gnomon (A), Rastban and Etamin map to snake rock (E) and the adjacent "U"-shaped

bedrock formation (F) respectively. The constellations Serpens Caput and Ophiuchus project to the extreme western end of Poles Hill (not shown in Figure 7). Between these constellations and Draco lies the constellation Hercules, part of which is shown in Figure 7.

Figure 7 Star map registered to Poles Hill aerial image using two three stars in Draco (A, E and F) as tie points. North is up. (Courtesy Google Earth)

As stated above, the sky can be mapped to the ground in many different ways; i.e., any three stars can be associated with any three points on the ground. If the three stars and corresponding ground features chosen are indeed significant they should lead to new (unexpected) correlations between other stars and ground features. A set of erratics west of snake rock that appear to correspond with several stars in the constellation Hercules is one such correlation.

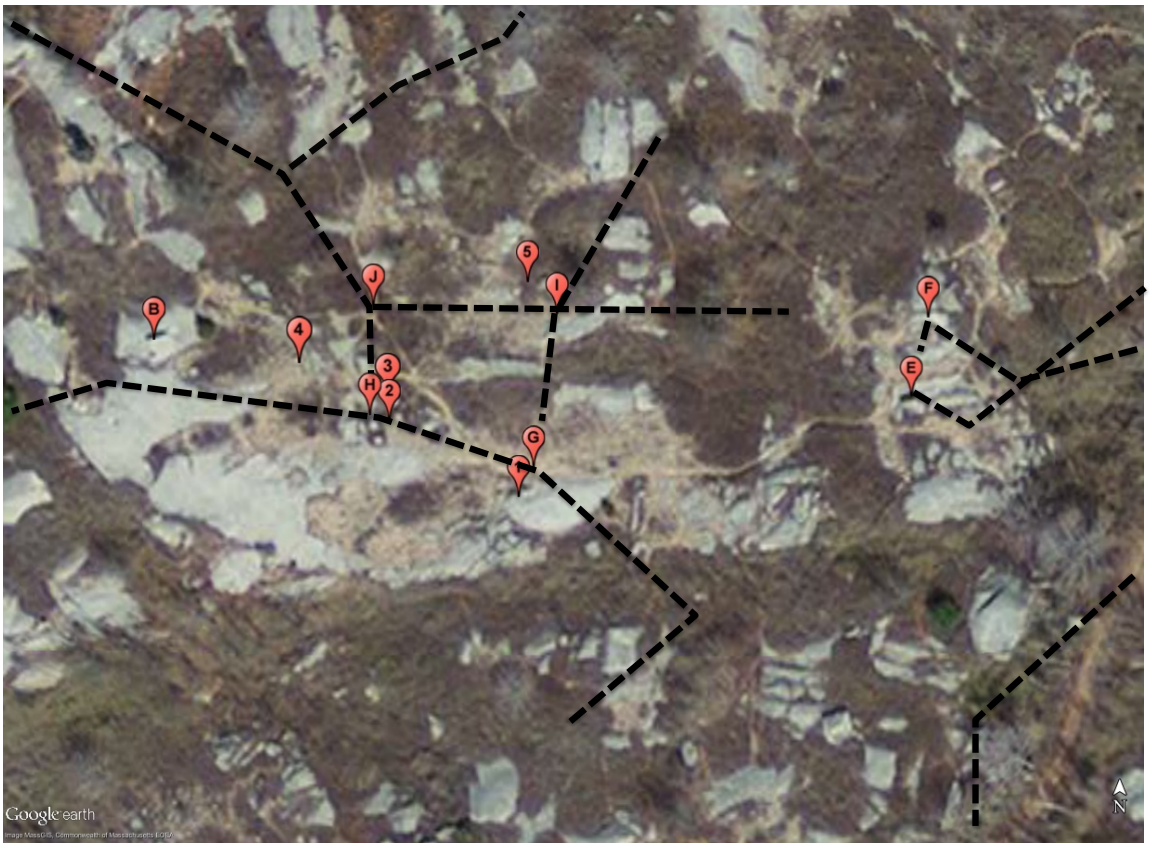


Figure 8 Projected stars (G-J) in the "keystone asterism" in Hercules. Numbered placemarks (1-5) are locations of nearby boulders. North is up.

Figure 8 shows the locations of five smaller erratics (1-5) near the projected ground locations of the four stars η-Herculis, ξ-Herculis, π-Herculis, and ε-Herculis (G-J) that comprise Hercules' torso (the "keystone asterism"). The rocks are smaller than the gnomon and so could easily have been moved from their original positions. Two of the rocks (Figure 9a and Figure 9d) appear to have had significant surface alteration. Two other rocks (Figure 9b and 9c) have cleaved sides. The magnitudes of the four corresponding stars (3.16-3.92) relative to Rastaban (2.79) is in accord with their relative sizes.

a) Erratic 1 near location G (η Herculis)

b) Erratic 5 near location I (π Herculis)

c) Erratic 2 near location H (ξ Herculis)

d) Erratic 4 north of location J (ε Herculis)

Figure 9 Erratics that may correlate with stars in the keystone asterism

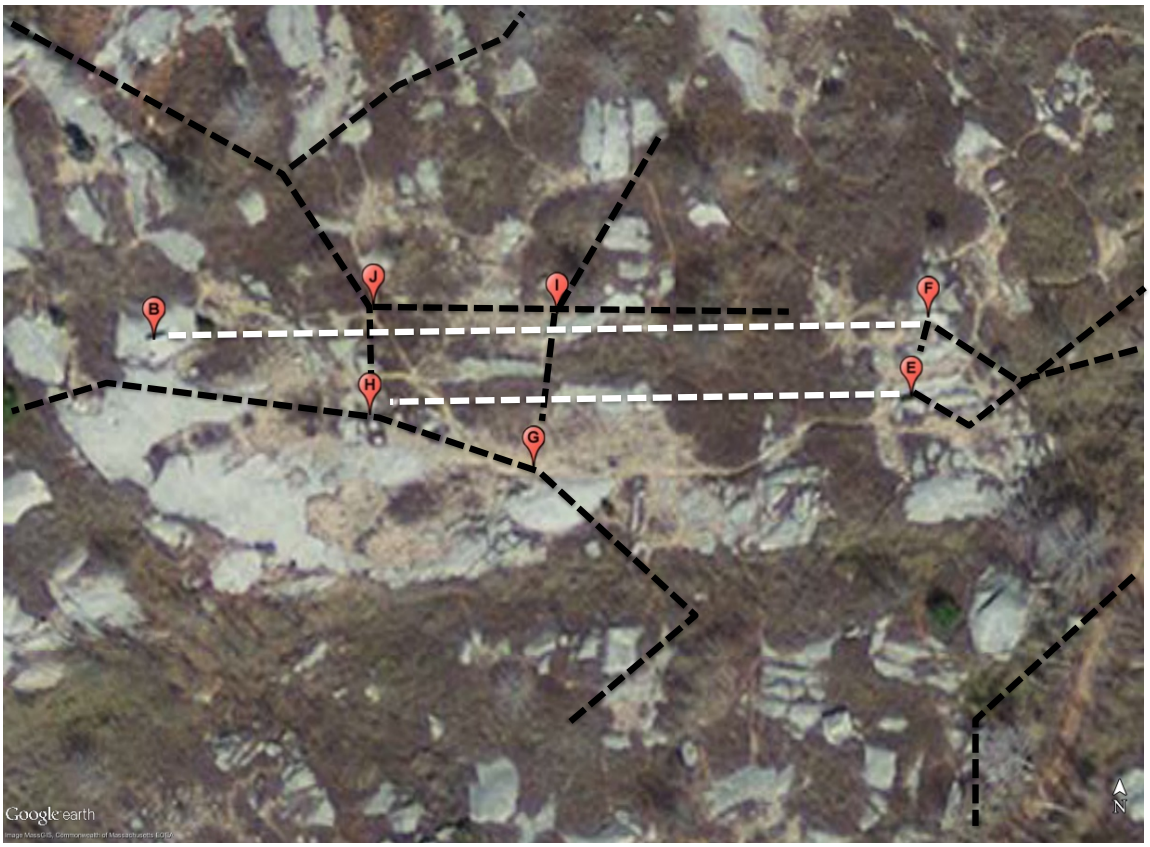


Figure 10 Parallel east-west sightlines from Rastaban (E) and Etamin (F) pass through Hercules to circular feature near rock (H) and summer solstice sunset boulder (B). North is up.

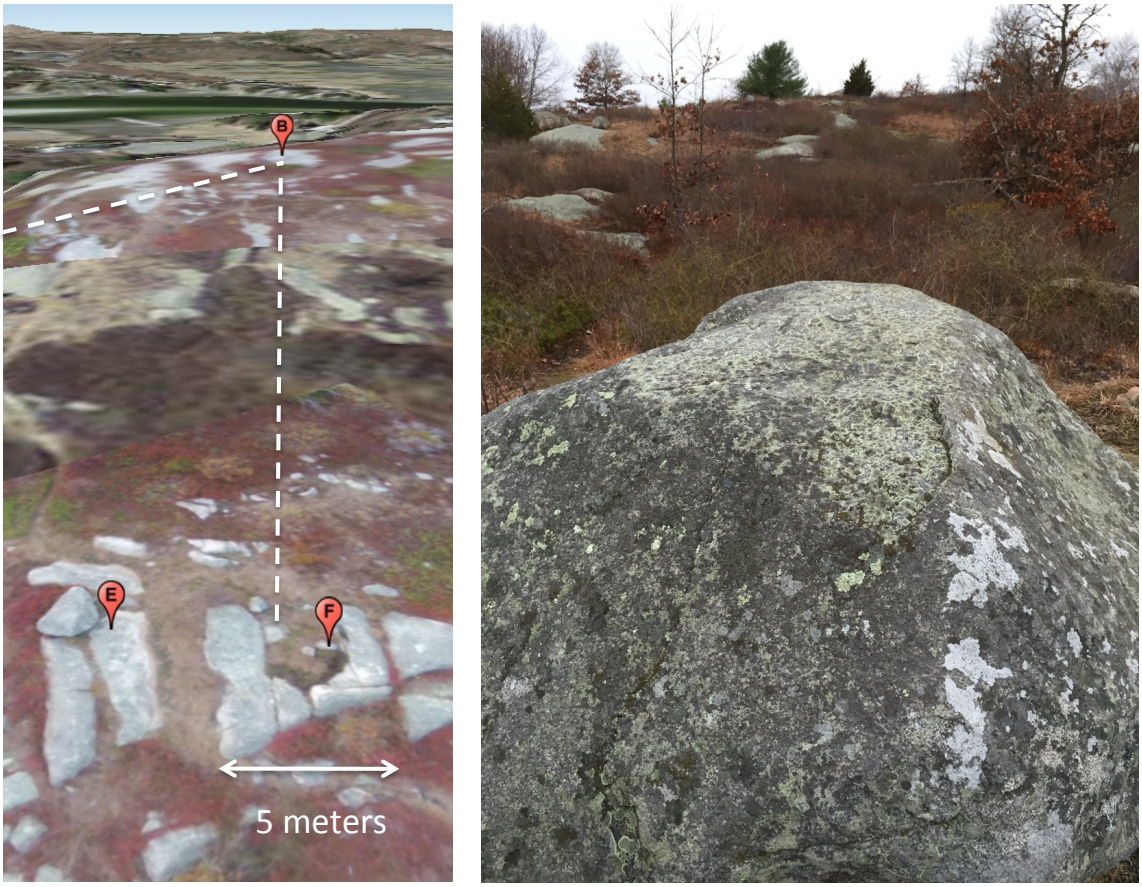


Figure 11 Sightline from the viewing area (F) to the summer solstice/equinox sunset boulder (B). As this sightline is currently obscured by trees a parallel sightline from snake rock (E) looking west is shown for reference.

Figure 10 shows two sets of sightlines oriented east-west from snake rock (E) and the nearby "U"-shaped bedrock formation (F). One sightline from snake rock passes through a circular feature near location H. It is not unlikely that one of the erratics (Figure 9c) might have once been placed at that location. Another east-west sightline from a point within the semi-circular bedrock feature (F) passes through the summer solstice sunset marker (B).

The associated ground location of the star Kornephoros (β-Herculis), the brightest star in the constellation Hercules is very close to the large boulder (B) marking the summer solstice sunset. Recall there were no equinoctial markers found in relation to the gnomon. One could argue that early native inhabitants, who migrated to Cape Ann in the summer to plant crops, did not mark the equinox. Nevertheless it is possible that marker B could have served two purposes: 1) positioned at the correct angle with respect to the gnomon (A) to mark the summer solstice sunset , and 2) placed at that point along the summer solstice sunset sightline where it intersects the east-west sightline from circular bedrock feature (F) to mark the equinox sunset (Figure 11). The bedrock feature has a semi-circular shape with an opening toward the west that is similar to horseshoe or "U"-shaped stone structures that function as viewing areas for various celestial events (Ballard 1999).

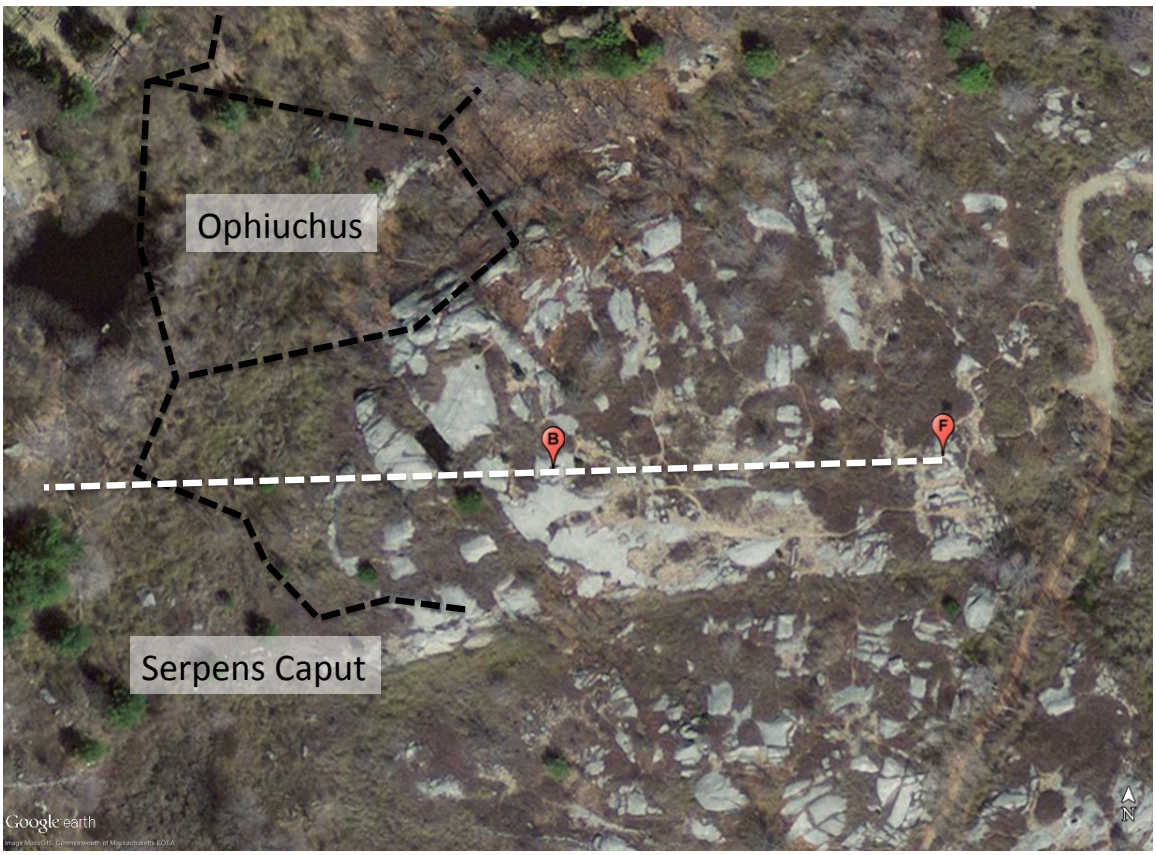


Figure 12 Equinox sightline is between the ground projected locations of the constellations Ophiuchus and Serpens Caput.

This second unexpected correlation leads to another, independent method of dating the alignments on Poles Hill. In the sky (Figure 6), between Hercules and the horizon are the constellations Ophiuchus ("the serpent bearer"), Serpens Caput ("the serpent's head"), and Serpens Cauda ("the serpent's tail"). Projected onto the ground, these constellations lie at the extreme edge of Poles Hill. The equinox sightline on the ground passes in between Ophiuchus and Serpens Caput (Figure 12). One might ask when does this same alignment occur in the sky?

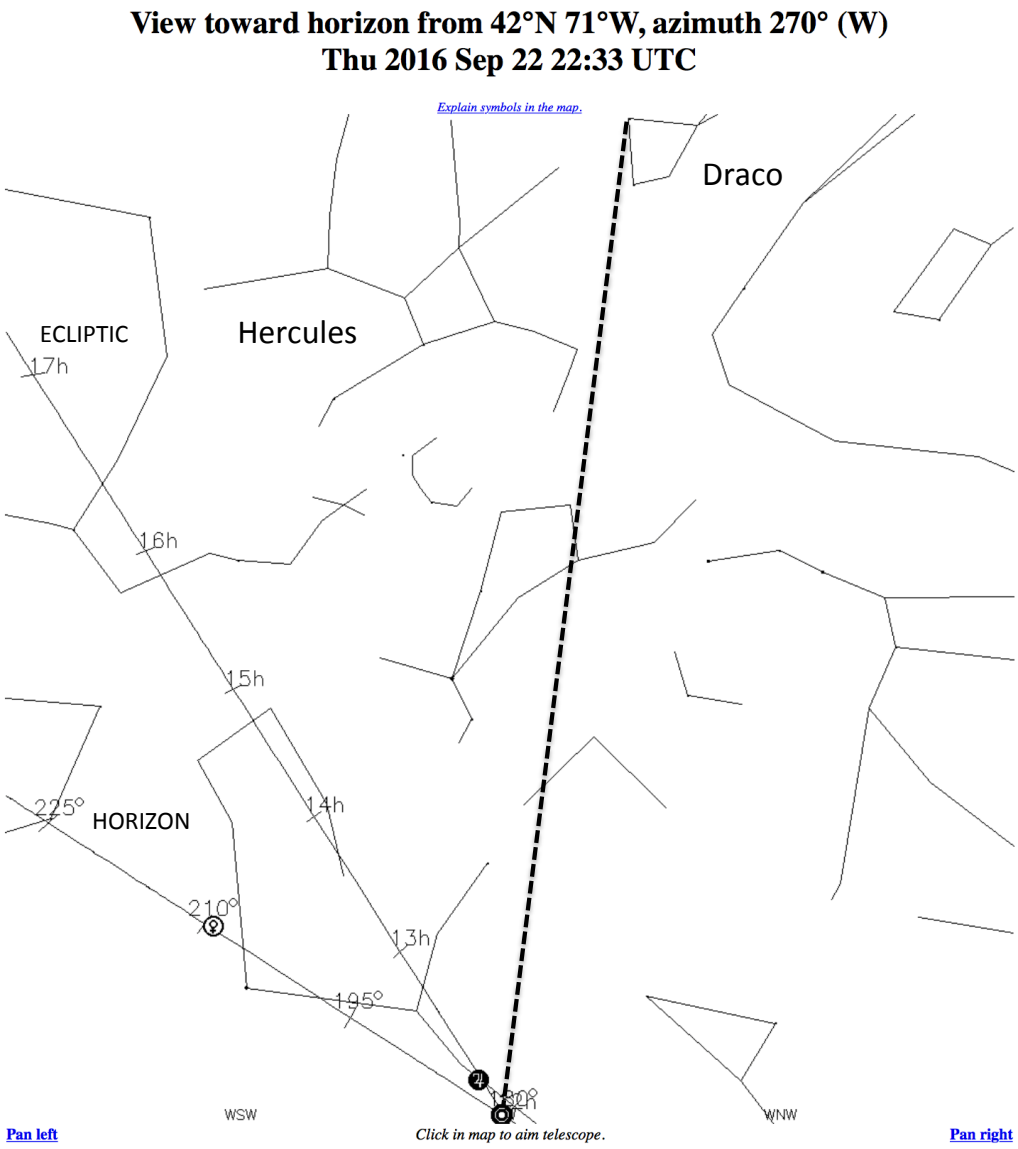


Figure 13 The sky today at sunset looking west on the fall equinox 2016 CE

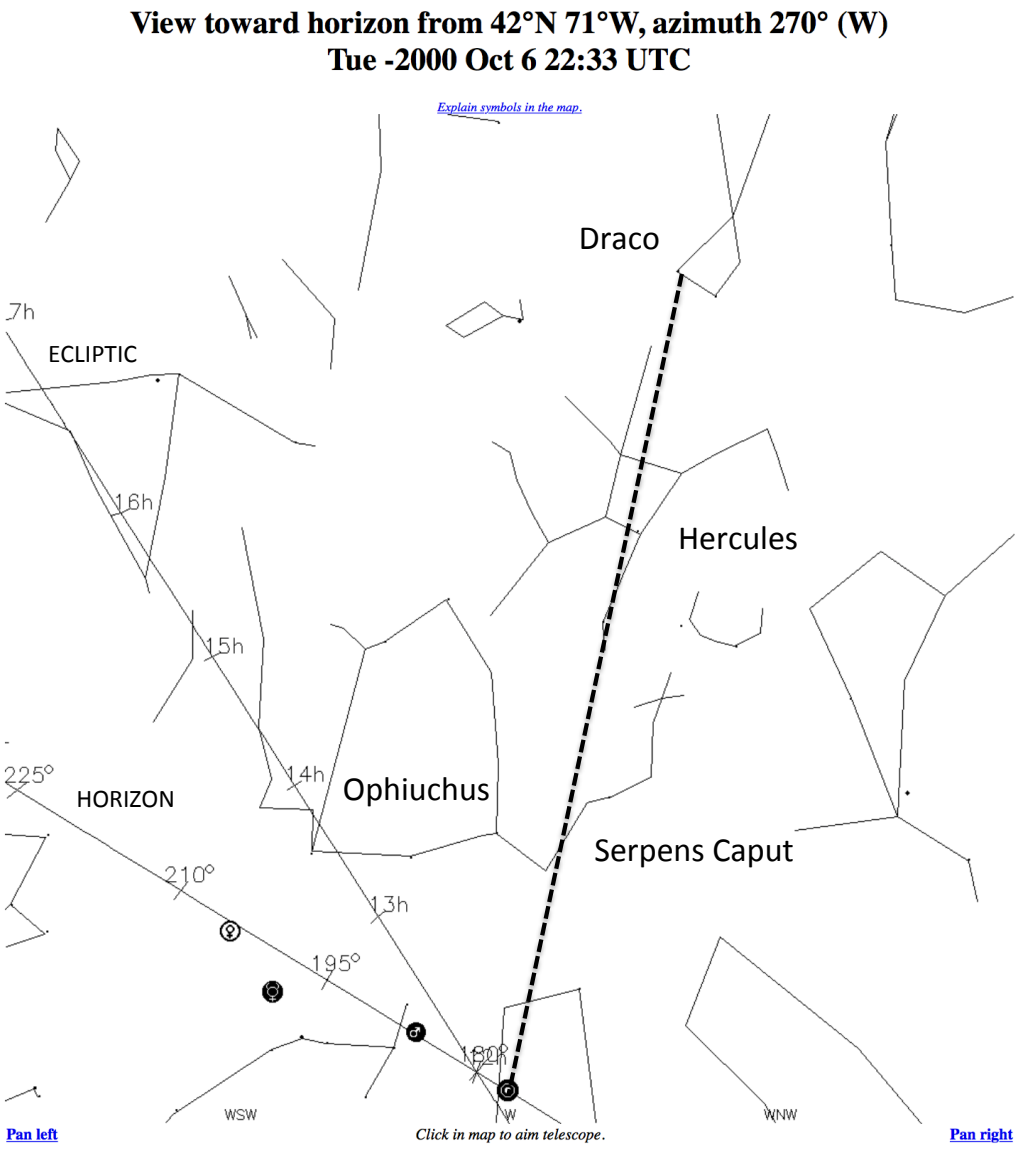


Figure 14 The sky at sunset looking west on the fall equinox 2000 BCE

At the time of the spring and fall equinox the plane of Earth's equator passes through the center of the Sun. The constellation located at this point at sunrise on the first day of spring defines the "astrological age", which is now in the constellation Pisces. In sky today looking west at sunset on the fall equinox (Figure 13), the line between Etamin and the sun passes through Virgo, the zodiac constellation opposite Pisces.

As earth's axis precesses over a 26,000 year period, the constellations shift relative to this point. Serpens Caput and Ophiuchus are between Draco and Scorpius, which is opposite Taurus. The astrological age of Taurus occurred about 4000 years ago. Figure 14 shows what the sky would have looked like at sunset on the first day of fall 2000 BCE. Notice the line between Etamin and the sun passes through Hercules and between Serpens Caput and Ophiuchus – the same pattern that exists on the ground at Poles Hill. Although there is no evidence any of these constellations were observed by the Native people, or had any

significance in their mythology, the fact that these patterns occurred in the sky and on the ground and did correlate around 4000 years ago is interesting.

Discussion

Archaeological finds at nearby Riverview (Lepionka 2013) indicate the area was occupied by native people over a considerable period of time from the middle Archaic to some time after the English settlement was established in Gloucester in the 1630s. Solar dating of the site on Poles Hill showed the summer alignments A-B and A-C are older than the winter alignment A-D (Lepionka and Carlotto 2015). The gnomon and summer markers (A-C) appear to be the first elements of the site, moved into place 2000-4000 years ago during the time native people visited Cape Ann in the summer. The winter marker (D) was added later after area was occupied year round.

Solar dating exploits changes in the earth's obliquity to determine past solstice sunrise and sunset angles. Earth's tilt changes about 0.1 degree every thousand years making a precise determination of age from limited accuracy measurements of sunrise and sunset angles difficult. Here we have exploited earth's precession, which changes at a greater rate – about 13.8 degrees every thousand years, to determine when the pattern of stars in the sky at the fall equinox matched the pattern of their corresponding ground features. This second more accurate method of dating reveals that the gnomon, summer solstice sunset marker, snake rock, and other features were among the original elements of the site constructed about 4000 years ago.

One can only speculate on why the builders at Poles Hill used a set of glacial boulders to represent the Western constellations Draco and Hercules, or their correlates in Algonquian astronomy. Draco (Olcott 1911) is a universal symbol in human mythology all over the world. Its representation in North American native petroglyphs, effigy mounds, lithic formations, and other representations (Boutet 2011) is not surprising. Glooscap was the benevolent cultural hero of the Wabanaki people, who according to Micmac legend (First People, 2016) taught the native people how to fish, cultivate the ground, and raise animals. He also taught them about the stars and constellations. Legend tells us he lived in the west on a road that ran between two serpents. Is it possible that Draco and Serpens Caput are those two serpents and the constellation Hercules that is located in the sky between Draco and Serpens Caput represents Glooscap?

In addition to the stones associated with the solar observatory, Draco, and Hercules there are several other unusual features on Poles Hill that may be correlated with the stars. Another boulder with a snake or serpent-like shape (Figure 15a) lies at the edge of a cliff. This location is near the projected ground locations of several bright stars at the head of Serpens Caput. Perhaps nothing more coincidence, a large fractured boulder containing a serpentine quartz intrusion (Figure 15b) found by Ken Leonard on a recent expedition is near the ground projected location of the constellation Lacerta ("lizard").

a) Stone at the edge of Sunset Hill that may correspond to a star in Serpens Caput

b) Quartz intrusion in a large boulder near the projected ground location of the constellation Lacerta ("lizard")

Figure 15 Other unusual sky-ground correlations

Acknowledgements

I would like to thank Bill Mueller for introducing me to Mary Ellen Lepionka, who in turn, introduced me to the mysteries atop Poles Hill. I also thank Tim and Nick Fohl, Ken Leonard, and others for their observations and insights. Thanks also to Martin Del Vecchio and Allan Stanish for aerial drone imagery, and Nick Holland, Matthew Natti, Sandy Barry, and other members of the Cape Ann Trails Stewards for clearing sightlines and trails on Poles Hill. I also appreciate Curtis Hoffman's observations concerning the sizes of the stones in the site and the relative magnitudes of the corresponding stars, a correlation that I had overlooked.

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