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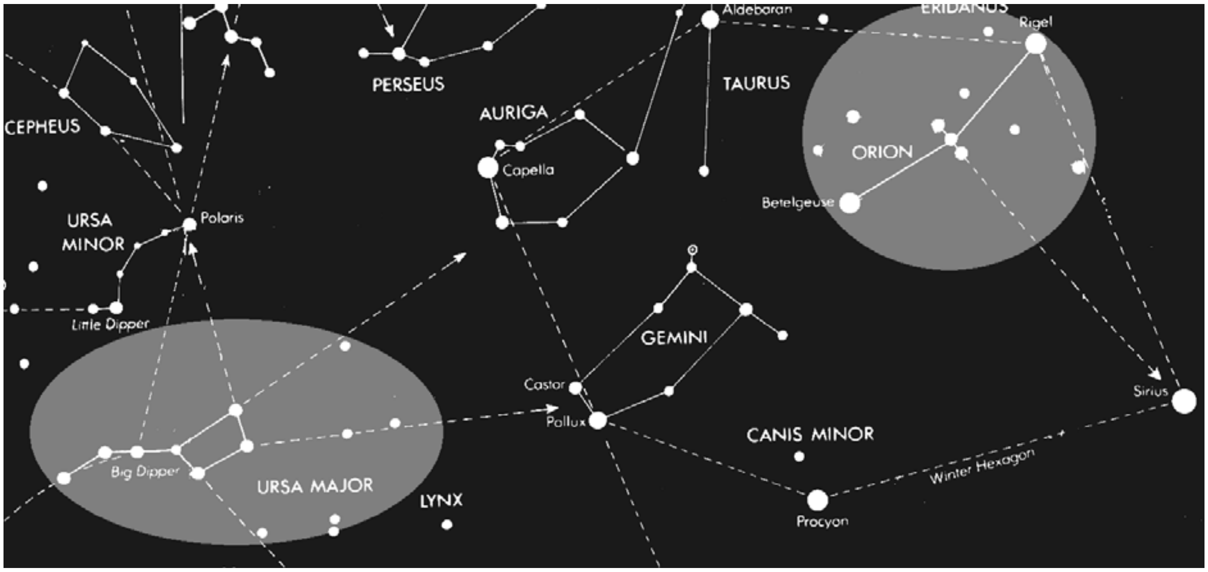
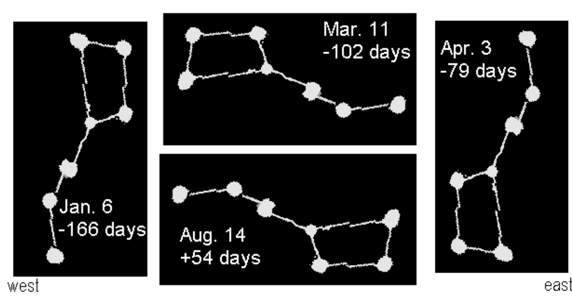


Peterson Field Guides, *Stars and Planets*

Stars in stone—*Ursa Major*, *Orion*, and *Gemini* petroglyphs at DgRw 230

by Nick Doe

In *SHALE* 17, I explained why I think that the "dragon" petroglyph at archaeological site DgRw 230 on Gabriola is a symbolic representation of the brightest stars in the constellation of *Orion*.[1] Further research has provided evidence that another petroglyph at this site represents the familiar asterism known as the "Big Dipper" in the constellation of *Ursa Major* (the Great Bear), and that "pitted dots" nearby represent bright stars in the constellation of *Gemini*. One dot is as far east of the "dipper glyph" as the glyph is east of the dragon's well-carved eye, so, as at other sites in this area, the arrangement of the petroglyphs is far from random.



The curious tumbling motion of the Big Dipper. Days are relative to the summer solstice and the time is midnight. If you're confused, look at the star at the end of the handle (ηUMa) as if it were stationary and in the same position in every snapshot. You can then see the asterism rotating around it, apparently counter-clockwise, but actually clockwise because the northern horizon (12 on the clockface) is at the bottom of these diagrams. One cycle is completed every sidereal day (a "star" day, which is four minutes shorter than a 24-hour solar day), but if we only look at the sky once a day at the same time every day, as if using a stroboscope, we see only the annual rotation shown here.

[1] *Paleoastronomy at petroglyph site DgRw230*, *SHALE* 17, pp.45–8. The glyph is a mystical creature sometimes identified as a "sea wolf" or "sea-serpent" though I prefer to think of it as a "dragon" with a fiery mouth chasing away winter. It faces north.

The Big Dipper, once pointed out, is an unmistakable feature in our nighttime sky, particularly when it appears "the right way up" as a ladle, with the handle on the left, around midnight in late-summer, quite low in the sky to the northwest.

At our latitude, the perceived annual cycle of the Dipper's revolution around the north start is curiously asymmetrical. Seen every night at midnight, the ladle begins a scoop, with its bottom vertical and handle pointing up, in early April. The ladle doesn't become horizontal until mid-August; and it doesn't return to having its bottom vertical, handle down, at the end of the scoop, until early January the following year. By early March, the ladle is upside down, and in less than a month, it is ready to begin another scoop. The time the ladle spends "upside down" in early spring is thus only 87 days, or three out of thirteen moons.

The petroglyph carver had quite a different view of the Big Dipper. He (I'm going to avoid awkward English by omitting "…or she" and the like) saw the asterism as a headless figure. Skeletal features were added to the glyph, perhaps to emphasize its "deadness". The cup of the ladle—which is the blade of the plough if you're from Britain and the box of the cart if you're from Germany—was seen as the figure's pelvis. Fainter stars, often ignored in Eurocentric depictions but quite visible when you look, were seen as its two legs. The "handle" of the ladle forms the left side of the torso of the figure (on the observer's right) and the stars in the handle were ribs.

The daily 361^{o} revolution of the asterism, commonly perceived as an annual 1^{o} per day cycle, was thus viewed as a never-ending circulation of the hapless figure around a point in the sky that, at Gabriola's latitude, brings it at times to being directly overhead. At other times, the figure is so low on the northern horizon, it can't be seen because of the trees.[2]

Earth's rotation and LST

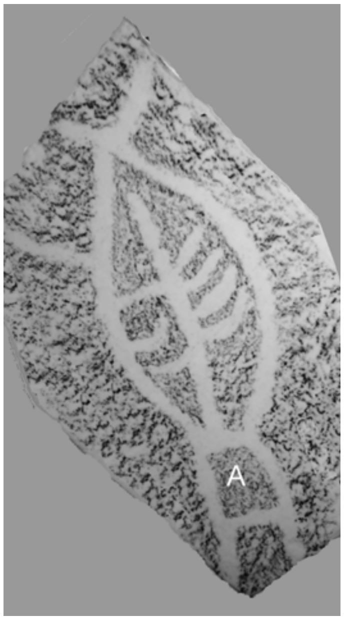
The heavens appear to wheel around the North Star, clockwise, once every 23 hours and 56 minutes (a sidereal day), a result of the earth's rotation about its axis. The sun moves east to west corresponding to "three, thro' six, to nine" on the clockface. Stars on the northern horizon move west to east corresponding to "nine, thro' twelve, to three" on the clockface.

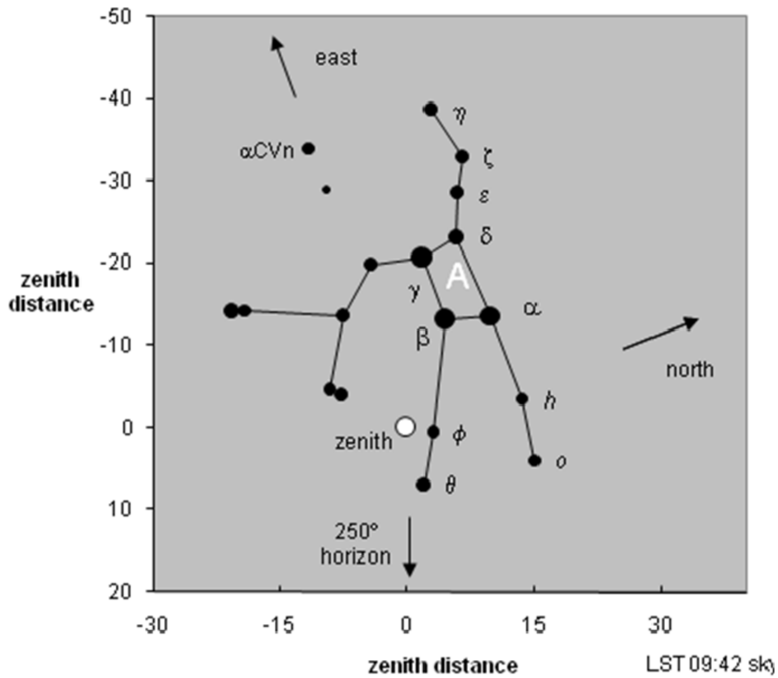
The sun also rotates around the earth in a counter-clockwise direction, but does so far more slowly completing only one revolution every year (forget this heliocentric nonsense, everything is relative, so it's quite OK to regard yourself as stationary if you want to). Because of this slow counter-clockwise rotation, if we wait one sidereal day to end the day, the sun, looking south, will fall short by one degree of where it was the previous day, even though the stars have completed their daily rotation. During the course of the day, the sun, looking south, has moved one degree toward the east, "nine, thro' six, to three" on the clockface.

By defining a day to be 24 hours, we ensure that the sun, on average, is in the same position every day at the same time. Because of the extra four minutes however, the stars will have moved clockwise by one degree at each day's end. A sidereal clock runs fast at the rate of four minutes a day so that at any given sidereal time, the stars are in the same positions every day.

By convention, local sidereal time (LST) is the same as local mean time (PST) on a 24-hour clock only at the autumnal equinox in September.

[2] The stars are circumpolar—they never set below the true horizon, but on Gabriola, the true horizon is always obscured by trees, hills, or mountains.





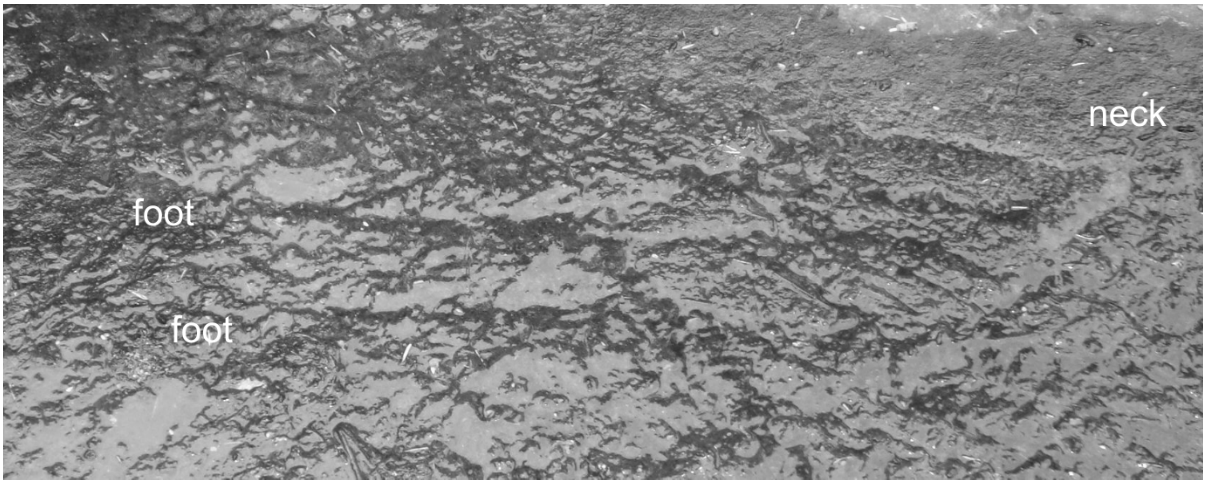
Unfamiliar visualizations of the Big Dipper. A rubbing of the glyph at DgRw 230 by Mary Bentley is on the *left*.* On the *right*, calculated positions of the stars at 9:42 LST (local sidereal time). The glyph is oriented toward 250º, which is where *Orion* is at this time just above the horizon. The stars are shown as seen if you faced 250º and then threw your head back to look straight up.

"A" is the "pelvis" of the (face up) figure represented by the rectangle of bright stars (α β γ and δ UMa); the figure's left side (on our right) is the handle (ε ξ and η UMa). There are no obvious stars on the figure's right side, though the rib count may be significant. The legs have unfortunately been truncated in this rubbing (α *h* ο and β φ θ UMa) but are unmistakable at the site and in the sky. The figure's raised right arm (on our left) may be represented by the stars α CVn (Cor Caroli in *Canes Ventici*) and β CVn, though the fainter star is not angled quite right.

* Just to complicate matters, the replica in the Museum grounds has been inadvertently mirror-imaged compared to the rubbing.

GHMS Archives G-138 August 1998

Unless you have a special interest in the stars, chances are that you don't relate the orientation of the Big Dipper with *Orion*, but I think the petroglyph carver certainly did. If you follow the direction the legs point right across the sky, there you'll find *Orion*. This relationship between the Big Dipper and *Orion* is fixed, no matter where the two asterisms appear in the sky. Since *Orion* only ever appears in the southern half of our sky, if the figure's legs point to anywhere in the northern half, *Orion* must

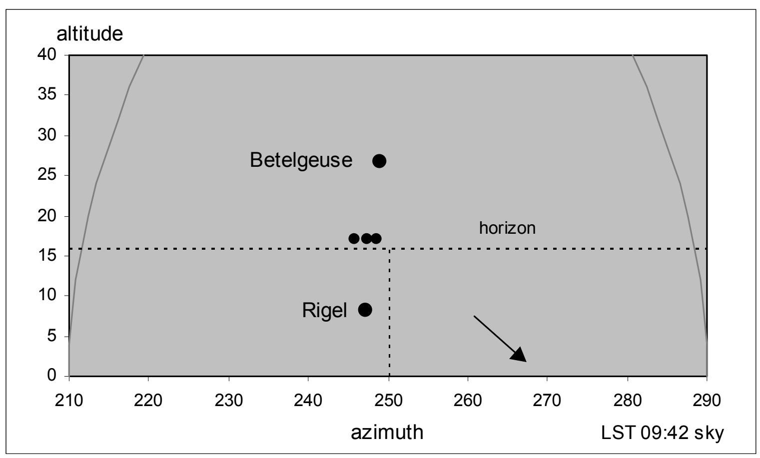


Since having its protective covering of moss removed, the "dipper glyph" is being rapidly eroded, and, like several others in the area, will soon be gone. It is difficult to find and photograph now. Note the elongated "legs" compared to the rubbing in the Museum archives. The right leg (assuming the figure is face up) points at pitted dots with the same geometry that the "right leg" of the Big Dipper points at the stars Pollux and Castor (see the banner on the title page).

be below the horizon, and it must be summer because that's the time of year when *Orion* can't be seen.[3]

The petroglyphs at DgRw 230 are arranged so that the north-facing dragon is to be viewed looking west. The dipper glyph is east of the dragon, and its legs point east, away from the dragon, not as might be expected towards it. There is a good reason for this is, as I'll explain shortly.

The axis of the dipper glyph points at 250º, which is where *Orion* sets. This is also the orientation of the small "deer's ear" glyph at this site;[4] and of the fracture in the sandstone that forms part of the "dragon" glyph at the nearby Molly Boulton site, DgRw 193.[5]

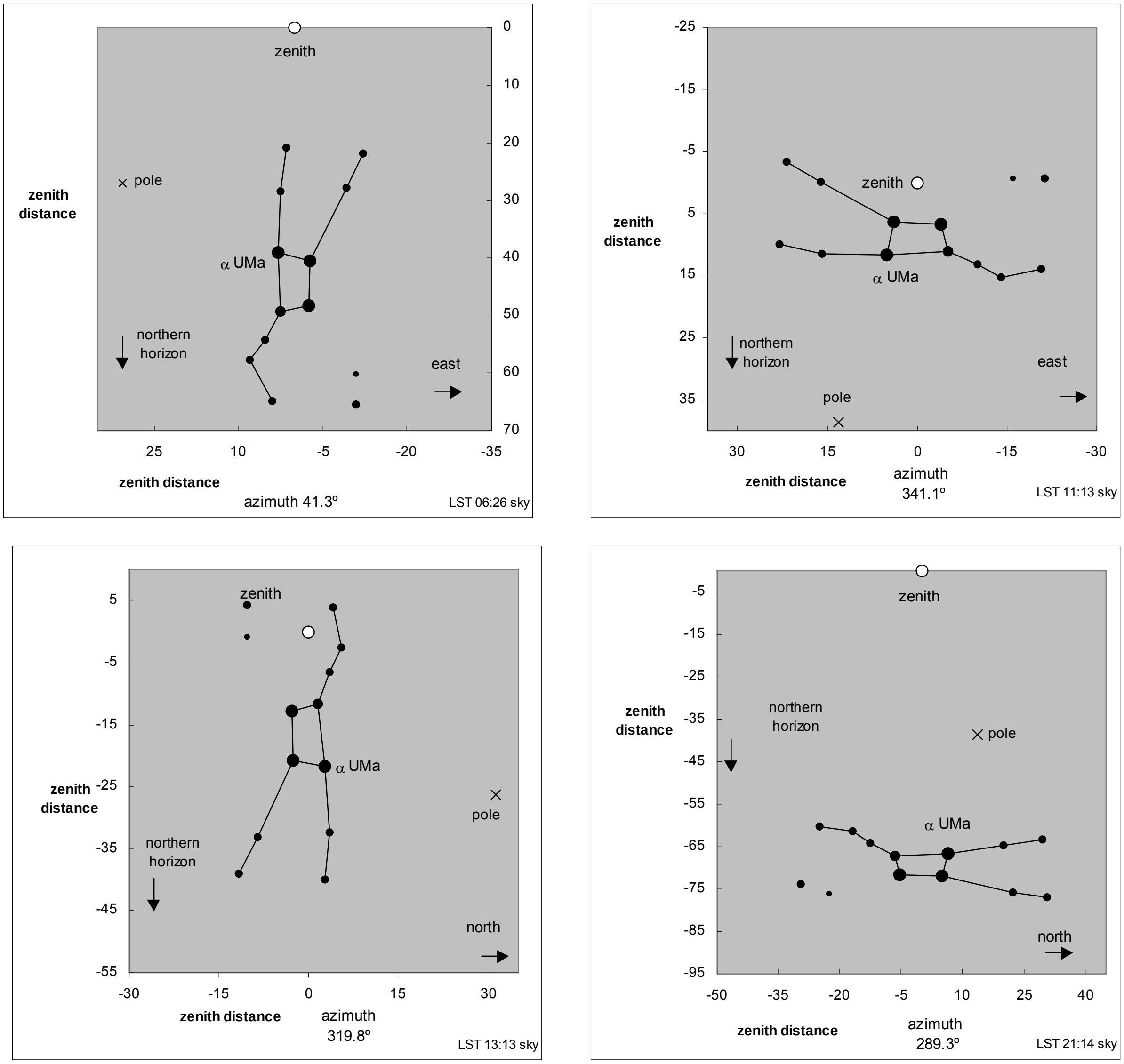


The view of *Orion* at 9:42 LST looking southwest, with west on the right. The belt hovers perfectly horizontal just above the trees on the horizon, which is quite stunning when you first see it because the stars look for all the world like three UFOs flying in formation. The dipper and deer's ear glyphs at DgRw 230 point at azimuth 250º (W20ºS), which is where the belt is seemingly headed, although at sea, with an unrestricted horizon, it sets at 268º.

[3] *Orion*'s disappearance begins about April 20, when, just after sunset, it is seen setting for the last time in the spring. It won't be seen again until just before dawn on or around August 10.

[4] *SHALE* 17, bottom of p.45.

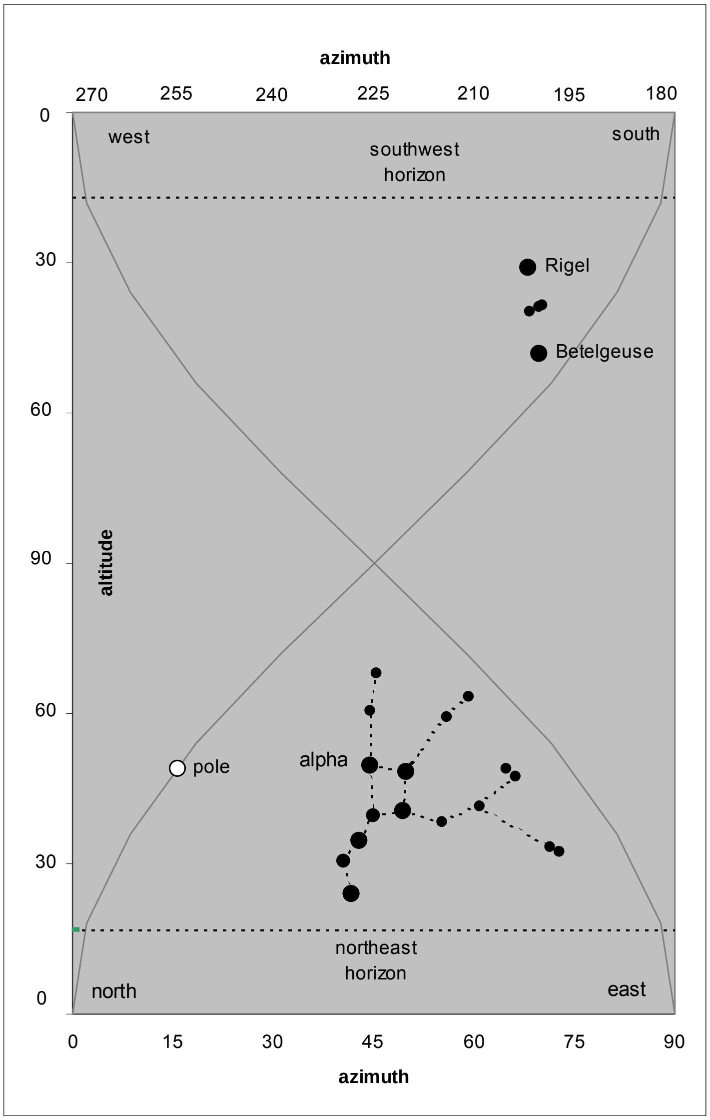
[5] Mary & Ted Bentley, *Gabriola: Petroglyph Island*, pp.72–4, 1998. Sono Nis Press.



The Big Dipper, seen as a figure, cart wheeling around the pole.[6] *Top left*, upside down; *top right*, laying down on its left side; *bottom left*, on its feet; and *bottom right*, laying down on its right side. Times are given in the bottom right-hand corners, for example, LST 11:13 (*top right*). This corresponds to midnight PST the night of March 13, four minutes before midnight on March 14, and so on until "just as it becomes visible in the twilight" on May 9.

The time the figure takes to move from one orientation to the other is not constant; the nearer the stars are to being overhead, the faster their orientation changes, just as does the longitude of a plane flying over the earth's north pole. From *top left* to *top right* takes 4:47 hours (or 10 weeks observed at the same time every night); *top right* to *bottom left*, 2:00 hours (4 weeks); *bottom left* to *bottom right*, 8:01 hours (17 weeks); and *bottom right* to *top left*, 9:12 hours (20 weeks). At Gabriola's latitude, you can never see all four positions in one night, but each year between early April and early June, you can see the first three. I find it hard to believe that the figure turning the right way up until its "heart" is overhead (coming alive?) in late-spring early-summer went unnoticed by the petroglyph carver.

[6] These are polar plots, so scales only apply at the centre. Orientation is defined by the altitudes of α–β and δ–γ UMa, or of α–δ and β–γ UMa. Different definitions may cause the times to vary by up to an hour.



In the earlier article, I surmised that the 250º orientation of the "deer's ear" glyph was a date on the calendar at DgRw 228,[7] and I still think that that might be so, but there is now a link with the Dipper. The time that *Orion* sets, 09:42 LST, is also the time when the Dipper is directly overhead.

Also in an earlier article, I surmised that the orion glyph in the face of the dragon, is oriented the way it is for a particular reason,

We generally don't relate the orientation of the Big Dipper with *Orion*, but I think the petroglyph carver did. The diagram shows what you see if you were to lie out on the lawn on your back, looking up, with your feet pointing northeast (45º).

The line starting in the bottom left-hand corner corresponds to the northern horizon, and the line starting bottom right-hand corner corresponds to the eastern horizon. As you change your gaze to look at stars increasingly above the horizon, stars to the north and east appear to be closer together and converge at the point directly above your head. In your world, this is the pole, your *zenith*.

Now, if you were, without moving, to bend your head backwards so you could see to the southwest, just ignore the pain, you would see the stars increasingly separate until you were back down to the horizon, this time with the southern horizon on your right and the western horizon on your left, but both behind you.

Now at some time (LST 6:21), the Big Dipper will come into view, and when it does it will be upside down if you think of it as a figure with its legs in the air. Follow the direction the legs point up across the sky and down behind you, and there will be *Orion*. This relationship between the Big Dipper and *Orion* is fixed, no matter what direction the two asterisms appear in the sky. On the way across you will pass through the constellation of *Gemini* and the heavenly twins, Castor and Pollux. The positions of these, and a third star, δ Gem, are marked at DgRw 230.

[7] *SHALE* 10, pp.25–32; *SHALE* 17, pp.41–44.

and now that a link with the Big Dipper has been made, I can expand on that.

Orion is at its magnificent best in the southern sky over Gabriola in early spring, shortly before midnight. As the season progresses, *Orion* appears earlier and earlier in the evening. Because the stars take a complete 360° turn around the sky once every day, which for them is four minutes shorter than the sun's day, we can only relate a particular position of the stars in the sky with a date in the (solar) calendar by knowing the (solar) time that the stars are in that position. And, of course, because we see the stars only at night, we have no direct way of telling the (solar) time by looking to see where the sun is.

Our solution to the problem of telling the time at night is pretty simple. We wear a watch. But the petroglyph carver had more of a challenge and I had to learn from him another way to do it.

Everyone, at one time or another, has watched a lovely sunset (on Gabriola, we do it all the time) and after the sun has sunk, watched for the first stars to appear in the gathering gloom (ignore Harmac). The time that you have to wait after the sun has set before seeing the first star (often Sirius, the Dog Star, α *Canis Major*) is remarkably well defined. I tried it just recently for a few evenings and had no difficulty in fixing the time relative to sunset to within a couple of minutes,[8] good enough to be able to fix the calendar date to within a day. And that's

Orientation of *Orion* and the glyph— a correction

"… *never give your reasons; for although your conclusions will probably be right, your reasons will likely be wrong*." adapted from Lord Mansfield with thanks to Judith Graham.

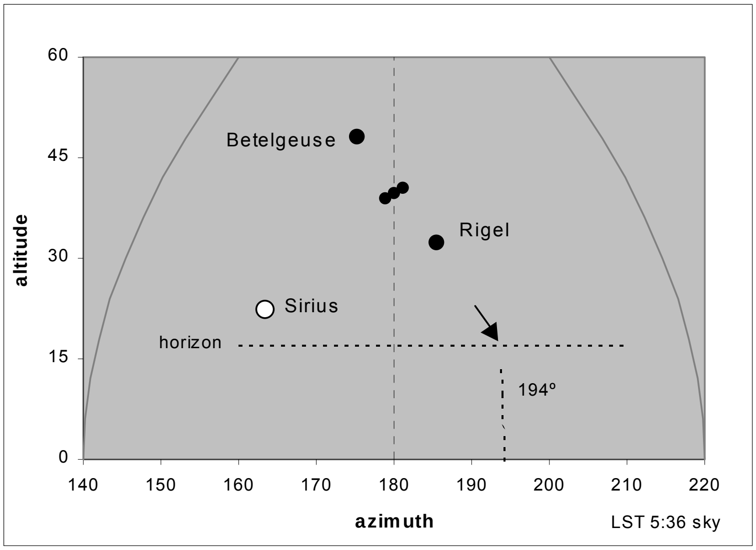
In *SHALE* 17, on page 48, I argued that *Orion*'s depiction in the face of the "dragon" was oriented to the observed 194º because this was the azimuth that *Orion* appears when it is highest in the sky after it first becomes visible 50 minutes after sunset. In making this case, I made two mistakes.

The first was to imply that the timing of when *Orion* becomes visible in twilight is rather vague. At our latitude, it isn't. *Civil twilight* begins at sunset and, in the spring on Gabriola, ends about 32 minutes later when the sun's altitude has sunk to –6º. During civil twilight, the brightest stars appear, including all those of *Orion*'s cross. The nearby Sirius, the brightest star in the sky pops, seemingly out of nowhere, about 20 or 21 minutes after sunset, and by 27 minutes after sunset when the sun is 5º below the horizon you can make out *Orion* if you know where to look.

The second error, given the first, is relative minor in effect, but is nevertheless embarrassing. Any object in the sky over Gabriola reaches its highest altitude when it is exactly south, that is, its azimuth is 180º. This applies no matter what the lighting from the sun. Everyone knows that. By luck, this *faux pas*, is inconsequential, because on March 13, ε Ori, the middle star of *Orion*'s belt, is due south just 45 minutes before it reaches azimuth 194º, and is almost visible, due south, 9 minutes after sunset when the sun's altitude is –2º, just after the start of civil twilight. It is still true therefore that *Orion* does first appear high in the sky in the evening, at about this date.

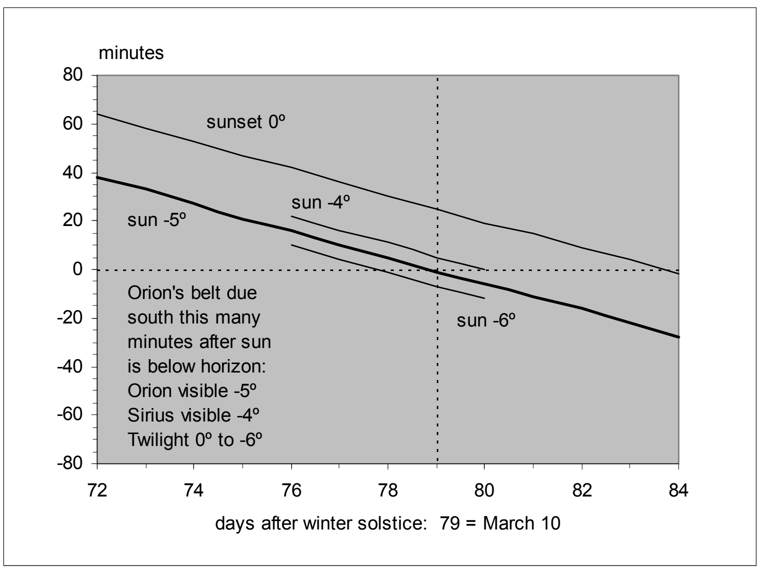
This leaves the question, why *precisely* 194º ? For the answer, and there is one, see the text.

[8] Nawar, S., *Solar activity and atmospheric attenuation effects on the visibility of stars and planets during twilight*, The Moon and Planets, 29, pp.107–116, 1983.



At 5:36 LST, the middle of *Orion*'s belt is due south and at the highest point in the sky it ever gets. It does this every day, though for a good part of the year in daylight. March 10 has special significance however. The belt is due south in the evening just as the stars pop into view after sunset. The brightest star in the sky, Sirius, does the same thing one day later on March 11.

The *Orion* motif on the dragon glyph points the horizon at 194º, which because of the trees and mountains, is what the stars also do at this moment.



what, I think, the petroglyph carver did.

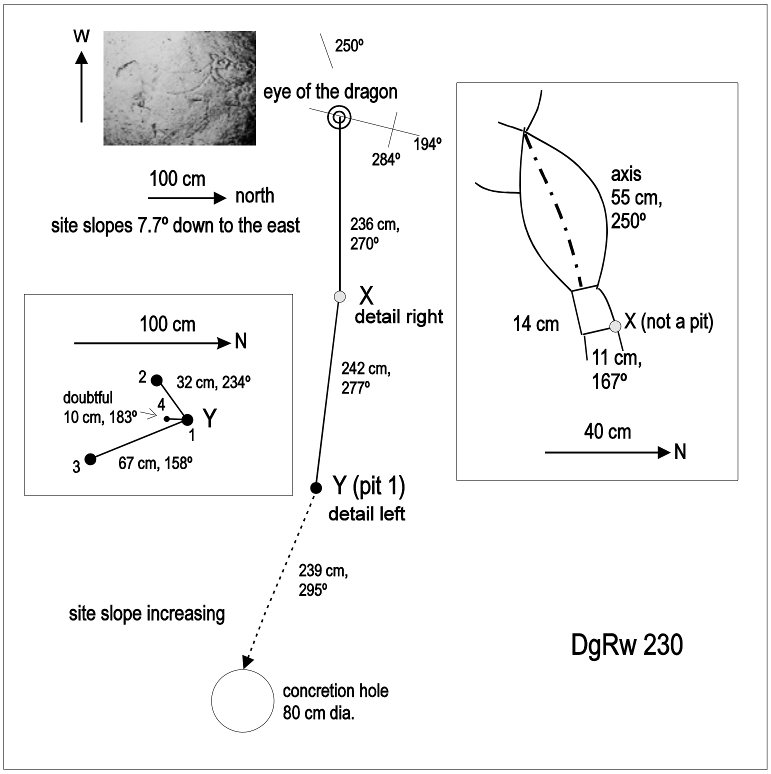
On March 10, [9] observation on Gabriola shows that *Orion*'s belt appears exactly due south at precisely the same moment that it becomes visible shortly after sunset when the sun is 5º below the horizon. Thereafter *Orion* will never appear east of south until early in the morning in the fall.

At the moment that *Orion* is due south, the asterism points at the horizon at 194º, and 45 minutes later, when the *Orion*'s belt has actually reached azimuth 194º at 06:21 LST, the dipper-glyph figure is upside down (*top left*, page 34) and about to "spring to life". The petroglyphs at DgRw 230 are thus an illustrated stellar calendar, reminding the viewer what happens to stars in the sky at an important time of year.

All that remains is to give a semi-plausible reason for the dipper glyph's legs pointing the wrong way (east). The reason is simply that there are two representations of *Orion* at this site, not just one, and the dipper glyph's legs point at the second representation, not the first.

Before I started this research, I would have been hard pressed to describe the relationship between the "heavenly twins"—Castor and Pollux—and the Big Dipper, the

[9] Those who think the petroglyph carver worked to a "40-day month" calendar will note that this within a day of being two "months" (80 days) after the winter solstice.



The site map; west is at the top (our convention is north at the top, but the petroglyph carver might have thought that odd).

Going down the page (east) there is the dragon glyph; the dipper glyph with reference point X; a group of pitted dots with reference pit Y; and a concretion hollow. The site slopes, but the survey doesn't take account if that.

reason being that the Twins in the constellation of *Gemini* are usually seen looking at the southern half of the sky, while the Dipper, if not overhead, is in the northern half and so you have to turn around to see it. Their relationship with *Orion* is much easier to explain because they appear, in the late-spring, like two chariot wheels following after *Orion*. When *Orion* is fading into the west and increasingly difficult to see in the glow of sunset, there are the Twins shining brightly to re-assure that you're looking in the right direction.

If you look at the banner at the head of this article, you can see that in tracing a path across the sky to *Orion* from the Dipper's legs, you pass *Gemini*, just about half way across. As shown in the accompanying diagrams, if you follow the path across the sandstone in the direction the legs of the dipper glyph point, you come to a small group of pitted dots, and these dots form quite precisely the same pattern as do the stars in *Gemini*. If you continue on across the sandstone, as if tracing the path to Betelgeuse at the top of *Orion*, you come to a hemispherical hollow in the sandstone. This is all that is left of a concretion that has been weathered away by runoff from the forest floor.[10]

My conclusion would simply be that this entirely natural, but striking feature of the sandstone has been used by the petroglyph designer to depict the <u>absence</u> of *Orion*—in other words, the concretion hollow symbolizes, perhaps a cave, or the underworld, in which *Orion* hides or hibernates during the summer months.

While I could go on to discuss the method used by the petroglyph carver to map the stars, I won't as not everything is clear yet; suffice it to say that the height of his eyes above the ground (1.5 meters) seems to have been the same as that of the designer of the calendar at DgRw 228, and that his inside leg measurement *might* be 65 cm (26 inches)—certainly less than mine. ◊

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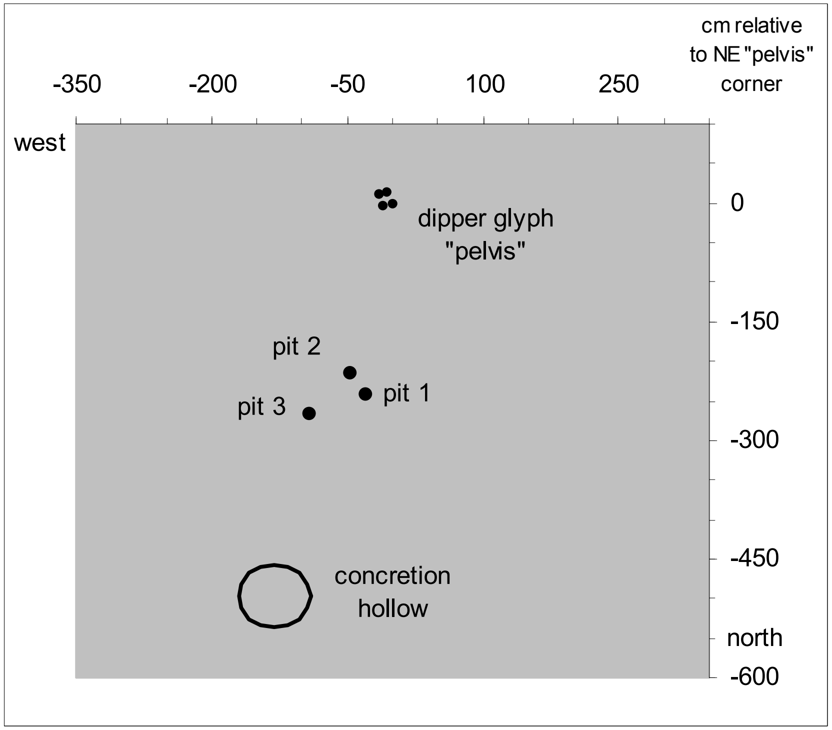
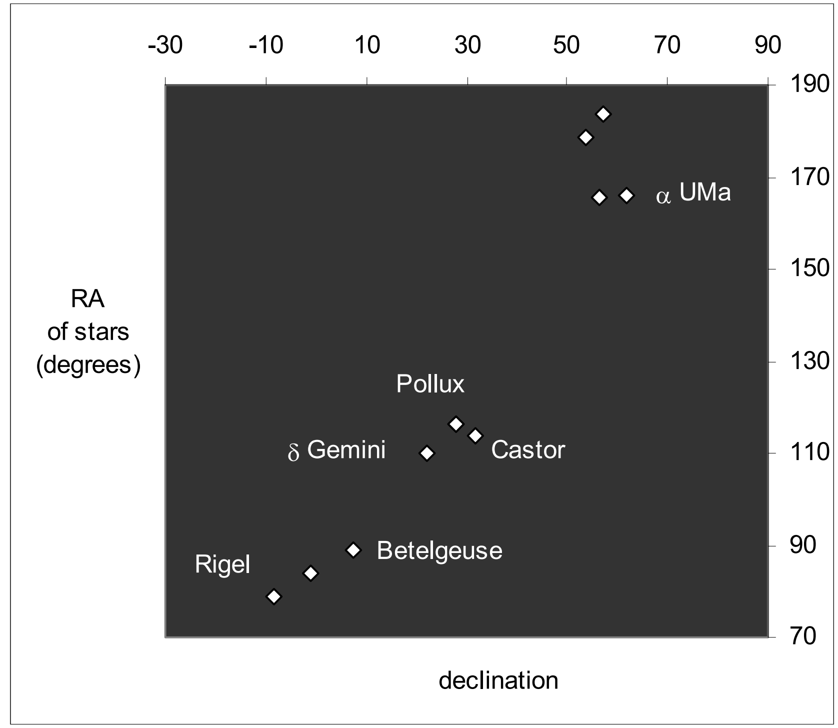
[10] See *SHALE* 13, pp.39–44 for more details. The photograph at the bottom of page 42 in this issue was taken very near to DgRw 230.



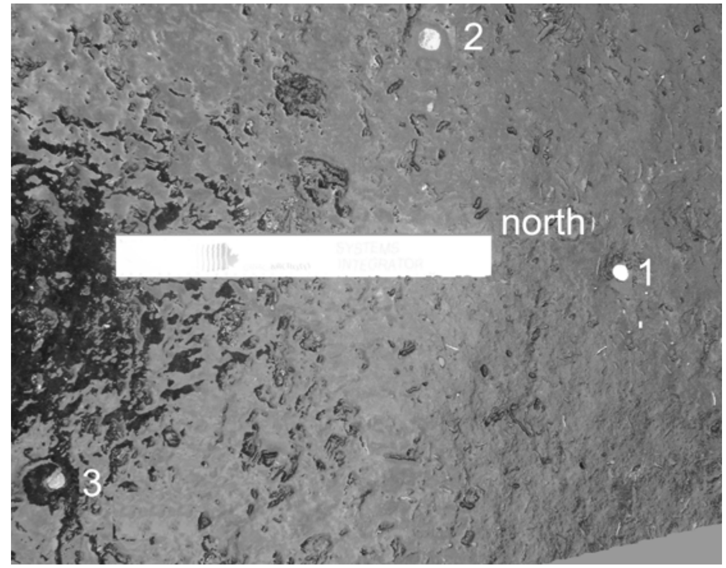


Small "pitted dots" at the site provide more evidence that the petroglyphs are to do with the stars. *Left* a site sketchmap showing the "pelvis" of the dipper glyph (not shown are legs pointing east, down the page); the three most prominent pits; and a circular concretion hollow at the bottom (to scale). *Right* the celestial co-ordinates—right ascension (RA) and declination—of the four brightest stars of *Ursa Major* at the top; the three bright stars of the constellation of *Gemini*—β Gem (Pollux), the brightest; α Gem (Castor); and δ Gem—and at the bottom, Betelgeuse and Rigel in *Orion*. Castor and Pollux are the "heavenly twins". Both Castor and δ Gemini are double stars, although you need a small telescope to see that.[11]

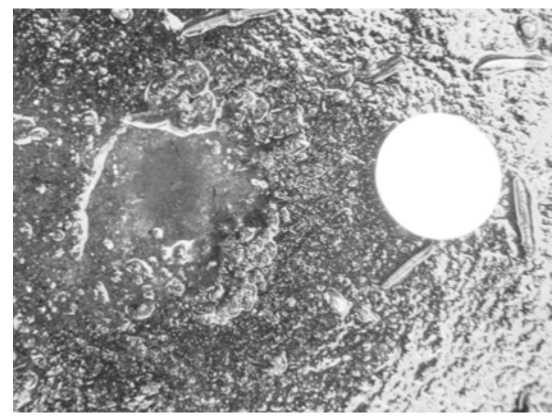
Even though both diagrams contain distortions, some known and others still under investigation,[12] the match between them is remarkably close. In the field, long before I had made these connections, I measured the triangulated-corrected bearing of pit 2 relative to pit 1 as 233.9º. Much later, I was astonished to find that the observed equivalent bearing of Pollux from Castor in the sky is at 235.3º, only 1.4° different.

[11] Recommended is a visit to Brickyard Beach, Friday nights when the Gabriola Astronomy Group meets. Mike Hale or Sue Saunders will show you.

[12] The star map is in Cartesian not polar co-ordinates (MS Excel needs an upgrade); the site map takes no account of the slope of the site (though that has been worked out), or the geometric distortion introduced by sighting stars against the top of a long stick or tree (because I'm not sure yet what the carver did).



The scale in the picture top right is just over 40 cm long. The coin on the right is a quarter (25¢).



Left a view of the DgRw 230 site from what was once a spherical, calcareous concretion in the sandstone now weathered away by the slightly acidic runoff. It is filled with silt and mud. The main “dragon” glyph, to the west, is just beyond the piece of tree branch that someone has put down for protection on the top edge of the photograph.

Top right three pitted dots containing coins. There may be others.

Bottom right close-up of a water-filled pitted dot, to the left of the coin. Although the edge of the dot is rough where the carver has broken through the case-hardened surface layer of the sandstone, the bottom is unweathered, smooth, and rounded—focus on the circular patch of dark sediment at the bottom of the dot. Petroglyph dots are quite distinct from the crescent-shaped gouges left behind by glaciers and heavy machinery.