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A most unusual petroglyph

by Nick Doe

Concretions in flat areas of sandstone in the interior of the island have often been eroded away,[1] leaving behind hollows in the bedrock, the size and shape of hand-basins. These hollows collect and hold rainwater, and in several cases they have been made an integral part of the design of a petroglyph. One particularly interesting example is the "sun" petroglyph (DgRw 228) shown *above*.[2] A natural hollow has been made the centre of four circles complete with seven petal-like rays. A better picture of it can be seen in Mary and Ted Bentley's book, *Gabriola: Petroglyph Island*, pp.81, Sono Nis Press, 1998 edition. I refrained from lifting the moss for my own photograph because the moss may offer some protection to the petroglyph. There is also a replica in the Gabriola Museum grounds on the right side of the entrance driveway. The orientation of the replica however is wrong; it shows the "fish", which I will come to in a minute, separately; and it doesn't show a probably-significant fracture.

What is quite startling about this petroglyph is that it has an astronomical alignment. The seven "petals" are equally spaced around the circle, except that there is a gap, which is equivalent in size to two missing petals. Although it is possible that the "missing"

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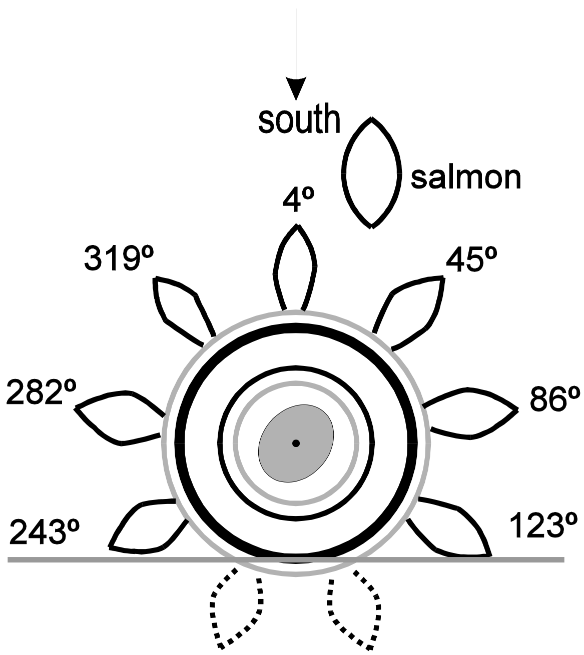
[1] *Great balls of stone*, *SHALE* 9, pp.6–11. Erosion is due to acids in rain and forest-floor litter.

[2] The Bentley's liken the design to a starfish, but as you'll see, I think it is the sun.

petals have been weathered away, I don't think so.[3] There is no trace at all of one of them, and only a very dubious pair of short lines at the location of the other. This "gap" gives the glyph an axis, and this axis runs directly (true) north and south. By my compass measurements, the "error" in the alignment of the glyph is only 3.1° clockwise, but the petroglyph carver might dispute that given that my compass is not absolutely accurate.



The "sun" petroglyph showing the measured azimuths of the tips of the seven petals. Just possibly there was originally also one at ≈160°, but there is no trace of a ninth one at ≈200°. The linear "fracture" runs exactly east-west (sunrise/sunset at the equinoxes).

The scale of the four concentric circles is approximate. Some lines are very faint. The circles may be an integral part of the geometry of the design.

[3] There are signs of spalling on the gap side and what appears to be a natural minor fracture runs across the petroglyph here, although the orientation of this "fracture" is quite precisely east-west.

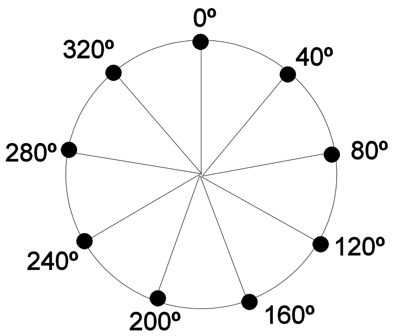
Now if you rotate the whole pattern slightly counter-clockwise to compensate for this "error", you find that three of the seven petals at azimuth 1° [0° intended], 120°, and 240° appear to divide the circle into three segments of 120° each. A further two petals, at 42° [40° intended] and 83° [80° intended], subdivide the first segment into three segments of 40° each. The remaining two at 279° [280° intended] and 316° [320° intended], similarly subdivide the last third into three segments of 40° each. The two "missing" petals, which would make the design completely symmetrical, are at 160° and 200°, and they bracket due south (180°).

Lest you think that this all fantasy, let me quickly add that the standard deviation of these conjectured azimuths from their "ideal" values is a mere ±2.1°. That's getting uncomfortably close to the accuracy of my compass! It really is hard to believe that these alignments are coincidental.

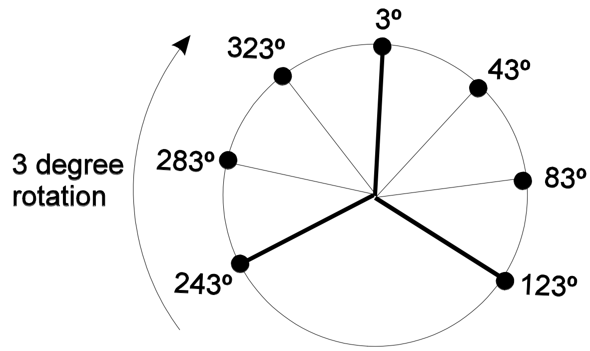
Associated with the main petroglyph is a smaller one—a "fish"—which the Bentley's identify as a salmon. This salmon is located slightly to the right of the north-pointing petal (corrected azimuth ≈ 5°) and a good picture of it is at the bottom of page 81 of the Bentley's book). The axis of the salmon is again pretty close to being north-south.

All this raises the intriguing possibility that the sun glyph is a calendar, divided into three seasons:
Spring (when the camas blooms, 240–360°, our Feb.20–Jun.20);
Fall (when the salmon run, 0–120°, our Jun.21–Oct.20);and
Winter, the third where there are no petals, (120–240°, our Oct.21–Feb.19).

According to this representation, the salmon is positioned end of June/early July, which is consistent with the annual departure of the Snunéymux[w] from Gabriola Island and the



The basic design of the petroglyph is a circle with nine equally-spaced points around it. The point at 0° corresponds to true north, and the points at 160° and 200° were not used.

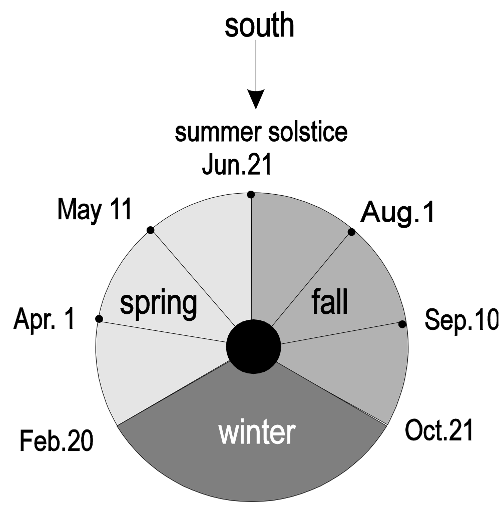


If you rotate the basic design *left* by a trivial 3° (a disagreement between the petroglyph carver and myself) you get a set of azimuths almost identical to those of the petroglyph itself (*previous page*).

Nanaimo area for their fishing grounds along the Fraser River.[4]

A 360-day year plus a few intercalary days, with months of 40 days, is not common in ancient calendars, but it is also not unknown (how many days did Noah's flood last?). The Mayan, Aztec, and Mowachaht calendars[5] used a base of 20 days, and the Egyptians divided their year into three seasons of 120 days each—*Pert*, season of growth; *Shemu*, season of harvest; and *Akhet*, season of inundation and sowing.[6]

Now before we go rushing off and claiming that not only was Sir Francis Drake here, but the Egyptians were too, let's consider the problem of constructing such a pattern with no measuring tools. Turns out it's fairly easy, and what's more—surprise—the diameters of the four circles around the bowl, which you might think were added as an artistic touch, may have been determined by the geometry of the design.



One interpretation of the glyph is that it is a calendar. There are three seasons of 120 days each, and three 40-day "months" in a season. The position of the salmon glyph corresponds to end of June/early July.

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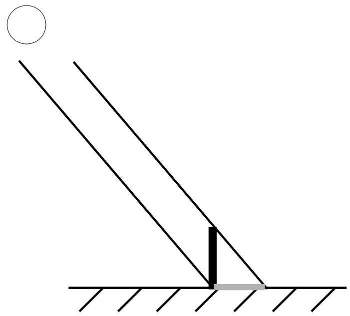
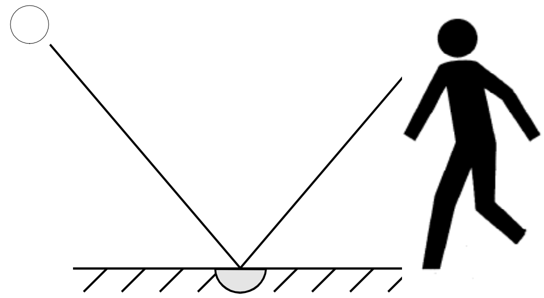
4 The Fort Langley Journal entry for Friday, July 4, 1828, for example, reads in part: "Some Nanaimans Came to the Fort who told us the whole tribe were arrived at their old village, and that they had a few Skins." Saturday, July 17, 1830: "Still the natives begin to arrive–The Nanimoos got to their old place yesterday." Wednesday, July 25, 1827: "At 2 p.m. we passed the Nanaimooch village…[which was at the time already occupied].

5 Iris H. Engstrand, ed., *Noticias de Nutka* (by José Mariano Moziño), Article 8, p.61 of 1991 edition, Douglas & McIntyre, 1970.

6 Michael S. Schneider, *A Beginner's Guide to Constructing the Universe*, pp.301–322, HarperPerennial, 1995.



Judging the height of the sun by the length of a shadow—the higher the sun, the shorter the shadow of the gnomon.



Another way to judge the height of the sun is to use a bowl of water. The higher the sun, the closer to the bowl you have to stand in order to be able to see the sun's reflection. The central, rain-filled bowl of the petroglyph makes a perfect mirror for this purpose.

The first step in the process is to establish a line running directly north and south through the centre of the bowl. Determining which direction is south is usually done, in the absence of instruments, by watching the length of shadows cast by vertical objects—sticks in the ground, people, trees, sundials…. The shortest shadows are at noon when the sun is highest in the sky, and the sun is then directly south. However, I don't think that this is what the petroglyph carver did.

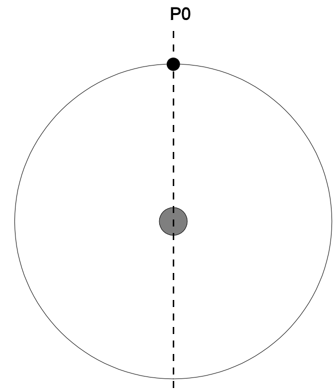
I suspect that he (I suppose I should say "or she", but I don't really think it was a woman) instead looked at the reflection of the sun in a pool of water in the central bowl, and took south to be when he was standing closest to the bowl. Why do I think this? Well consider the following.

Before I thought any of this through, I measured the distances between the centre of the bowl and the tips of the petals. According to my field notebook, they vary between 60–70 cm, with the north-pointing one at 70 cm. It's difficult to measure exactly because the bowl is not round. Now my wife Jenni's eyes are 1.5 metres (4 foot 11) from the ground, so how high in the sky would the sun be if she stood at the tip of the all-important north-pointing petal and she could see the reflection of the sun in the water in the bowl? I won't bore you with the math, but, if you take into account the gentle 5º slope of the site to the north, the answer is 64.1º.

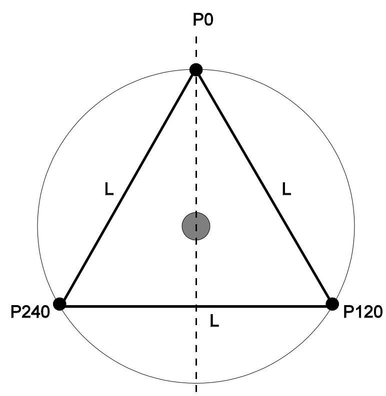
Does the sun ever get that high? Well, yes it does. On mid-summer's day actually. On June 20, 2004, at noon (12:17 PST) for example, the height of the sun at the petroglyph's location was 64.3º.[7] Standing at the petal tip, Jenni would have had no difficulty seeing the sun's reflection in the middle of the bowl, and at no other time of the day or the year, would she have had to move closer to the central bowl than that. And I don't think that's a coincidence.

Now, back to the geometry. How do you divide a circle into nine 40-degree segments? Here's a way that's not perfect, but not too bad (within 2 degrees).

[7] The small 0.2° error is easily explained as being due to the petroglyph carver being half an inch taller than Jenni, who's 5 foot 2. If you don't like this response, I won't mention that, 800 years ago, the sun was 0.1° higher and the error is even worse!

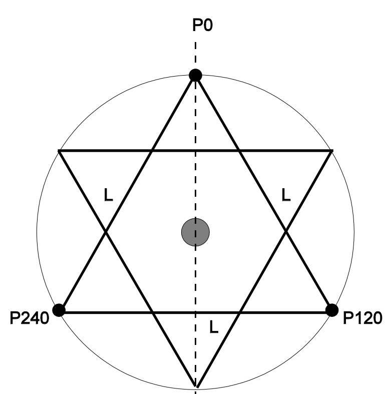


Step1: Draw a north-south line passing through the central bowl. Add a circle. You now have point P0.

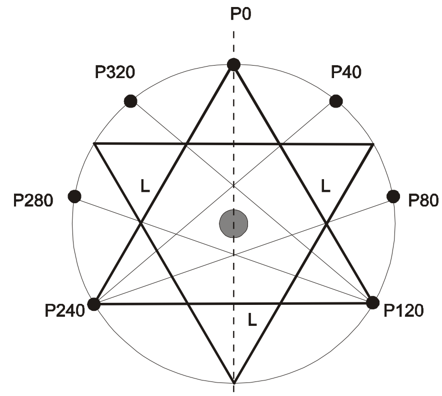


Step 2: Using 3 sticks of exactly equal length L, construct a triangle that exactly fits the circle. You now have points P120 and P240.

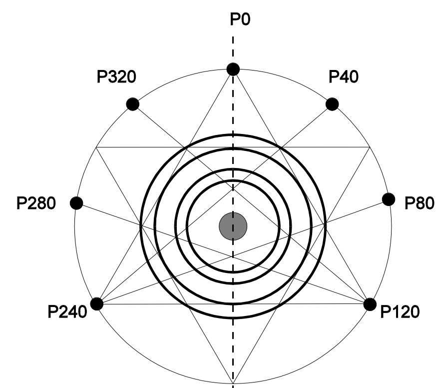
Make the P120-P240 line look like a fracture.



Step 3: Construct another triangle identical to the one made at step 2, and position it upside down in the circle.



Step 4: Project lines from P240 through the intersection of the two triangles to P40 and P80. Project lines from P120 through the intersection of the two triangles to P280 and P320. You now have the tips of all 7 petals.



Step 5: Draw the following 4 circles.

1. a circle through the intersections of the 2 triangles formed at step 3.

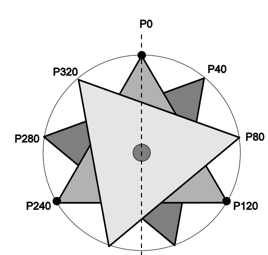
2. a circle that touches the insides of the triangles formed at step 3.

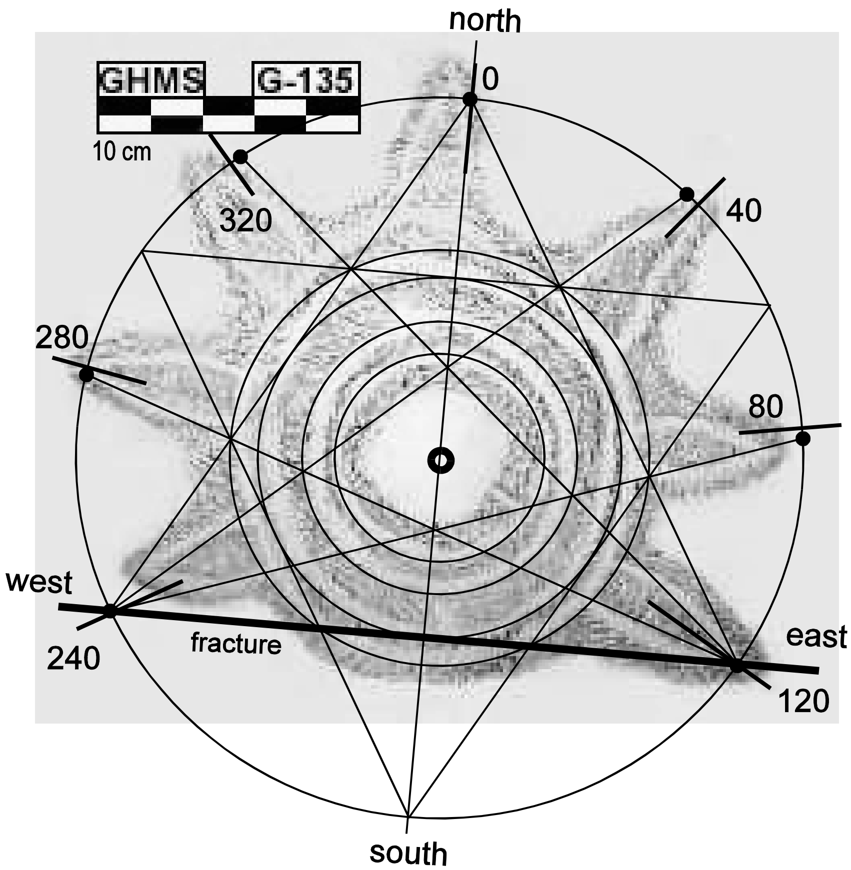
3. a circle that passes through the intercept of P240-P80 with P120-P320, and with the intercept of P240-P40 with P120-P280.

4. a circle with half the diameter of circle 1.

This method puts P40=38.3º, P80=81.7º, P120=120º, P240=240º, P280=278.3º, P320=321.7º (ideal ±1.7º).

Tip: If you prefer to eyeball it, find the positions of the petal tips by symmetrically overlapping 3 equilateral triangles.





The standard deviation between the values measured on the glyph and these theoretical values is ±3.2 cm; and the standard deviation between the averages of the rubbing used to produce the museum replica (shown *left*) and the theoretical values is ±1.2 cm. Not perfect, but intriguingly close.

Again, I don't suggest that this *is* how it was done, just that it *might* be. For one thing, as you can see, the "circles" in the real glyph aren't very good circles (diameters at various azimuths deviate statistically between ±6% for circle 1, and ±3% for circle 3). But when you look at the averages, it does appear that the circle dimensions were not chosen randomly by the petroglyph carver.[8]

	glyph	replica range	replica avg.	theory
petal-tips	134	123–144	135	135.0
circle 1	79*	73–86	77	77.9
circle 2	70	65–73	68	67.5
circle 3	46	47–50	49	51.0
circle 4	36*	36–40	38	39.0
bowl	23	23		
	* line very faint, spot measurement only			

"Whoa, whoa, whoa", I can hear you saying. "You're not suggesting that this is how the petroglyph carver made the glyph?" Well no, I'm not. It think it most unlikely that the carver took such a mathematical approach, but what I am saying is that it is possible to be precise without using instruments.

Take a look at the table on the *right*. It shows the diameters of the circles in centimetres, all taken from field notes before I'd developed any theories. Only one measurement per ring was recorded at the petroglyph, but seven per ring were taken from the Bentley's rubbing.

The numbers on the right are purely theoretical values of the circle diameters calculated from the geometry of the figure shown above in step 5, assuming that the diameter of the outer circle is 135 cm.

8 So far as I can tell though, the circles have no lunar or other obvious astronomical significance.

What about seasons. Three seasons a year? Here's what ethnographer Wayne Suttles has to say:[9]

"It is clear from the data from salt-water Halkomelem-speaking groups [which include the Snunéymux^{w}] that people took note of a variety of regularly occurring phenomena. The month names themselves refer to seasonal habits of animals, changes in vegetation, and human activities related to natural events. Also there is evidence that people observed the solstices and the changes in positions of certain constellations, especially the Pleiades.[10] These astronomical observations would provide the most precise points in time to start a month count from… [Wayne is referring here to the fact that lunar-based calendars don't correspond to the seasons because there are not an integral number of "moons" in a year. If you want a seasonal calendar based on moon-counts, you have to reset the count now and again in order to synchronize it with the movement of the sun]. But these observations also require clear enough weather for the sun or the Pleiades to be seen, conditions not always present on the Northwest Coast.

"There is, however, another phenomenon that occurs in a cycle that shows certain regularities with the solar year and yet is observable throughout much of the area in any kind of weather—the tide. …I need not dwell on the importance of the tide for salt-water fishing and shellfish gathering.

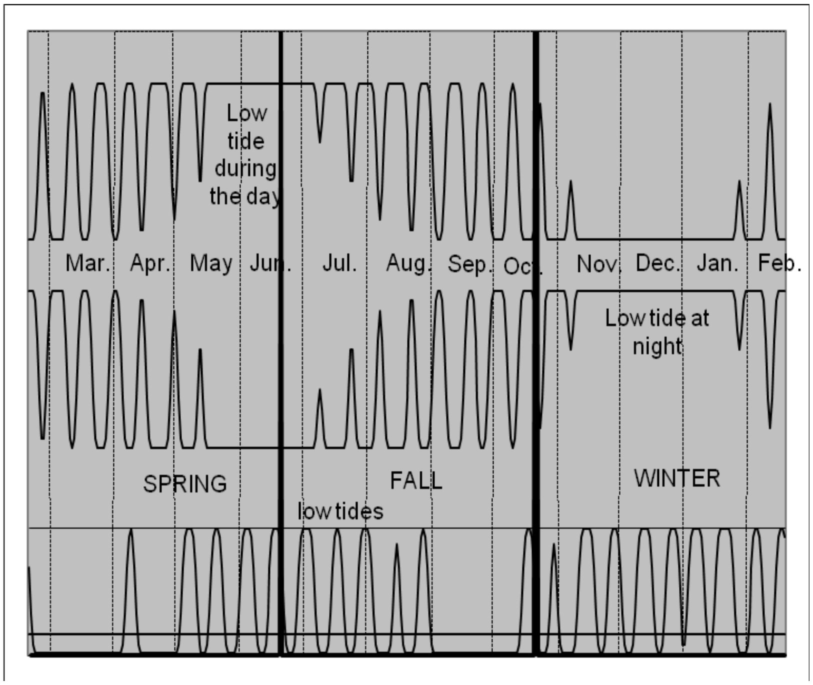
"The Coast Salish were of course aware of the co-occurrence of the greatest highs and lows with the dark and full moon…. They were also aware of the annual cycle in the tides…. On the Georgia Strait and Puget Sound the highest highs and lowest lows usually come within a month of the summer and winter solstices and these lowest lows come during the middle of the night in winter and the middle of the day in the summer. This fact seems to have escaped notice in anthropological literature in this area…. The economic significance of this cycle lies in the fact that the summer lows are most used for shellfish gathering, when people can camp and dry clams away from home—especially at the June low, while the winter lows at the dark of the moon are used for waterfowl hunting with flares, some species not even being present during the summer. [Two Halkomelem words describe this annual cycle, one meaning 'shift to daytime', which begins about March, and the other, 'shift to night-time', which begins about October.]"

Now I'm not so sure that Wayne's remark about shellfishing taking place only in the

The Gabriola Museum's replica of the "fish" glyph. The replica is displayed separately from the "sun" and with an arbitrary orientation. In the real thing, the fish is oriented with its spine running north-south. Its tail is positioned at roughly azimuth 5º from the central bowl, 115 cm away (L in step 2 perhaps). It's about 30 cm long.

[9] Wayne Suttles, *Time and Tide*, in *Coast Salish Essays*, pp.68–72, Talonbooks, 1987.

[10] The Pleiades (Seven Sisters) have almost the same declination as does the sun at the summer solstice.



a maximum when on five consecutive days the low low-tide occurs during the day.

The middle line is similar in that it shows how often the low low-tide of the day occurs between six in the evening and six in the morning. The scale reaches a maximum when on five consecutive days the low low-tide occurs during the night.

The bottom line shows how often the low low-tide, no matter when it occurs, is less than 4 feet (1.22 m). The scale reaches a maximum when on five consecutive days the low low-tide is less than 4 feet. In other words, "good clamming days".

summer, if only because on False Narrows here on Gabriola, not only is the shellfishing excellent, the people here would already be at home and would have no need to camp.

The first thought therefore is that the phenomena "low tide during the day", and "low tide during the night" would divide the year into two seasons. But this is not true, because around the time of the equinoxes, the two daily tides are more equal, and neither is particularly low. The combination "low tide at night" and "really low tide" therefore only occurs for less than half a year in the winter. "Less than half a year"! How about one third of a year?

The diagram above shows the tidal cycle for a complete year (actually 2004, but the choice doesn't matter) beginning with the conjectured start of spring on our February 20. The year is divided up into three seasons, as suggested by the glyph.

The top line shows how often the low low-tide of the day occurs between six in the morning and six at night. The scale reaches

Winter, defined as a period of "good clamming at night", neatly accords with the conjectured winter of the glyph, that is from roughly our October 21 to our February 19. That the "winter" depicted by the glyph has no petals is of course most easily interpreted as "no sun". José Moziño in his "Nootka notes, Article 8", written in 1792, records that the Nuu-chah-nulth winter ended near the middle of our February, and that the season of abundance (our spring) ended with the summer solstice.

So, I can't tell you how pleased I am that, on this "Isle of the Arts", it looks as though one of the Snunéymux^{w} petroglyph carvers was also a geometrician, and, to boot, solar calendarist *extraordinaire*. All that's needed now is to find the spot, several metres from the bowl, where he stood, cold but awed, watching the sun move through its winter solstice. I, for one, won't be too surprised if, somehow, he's marked that spot for us. ◊