

Context:

Petroglyphs, cemetery, facing east, salt weathering

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Errors and omissions:

Caption p.57 should say 109° not 119°.

Later references:

<http://www.nickdoe.ca/pdfs/Webp289c.pdf>

Date posted:

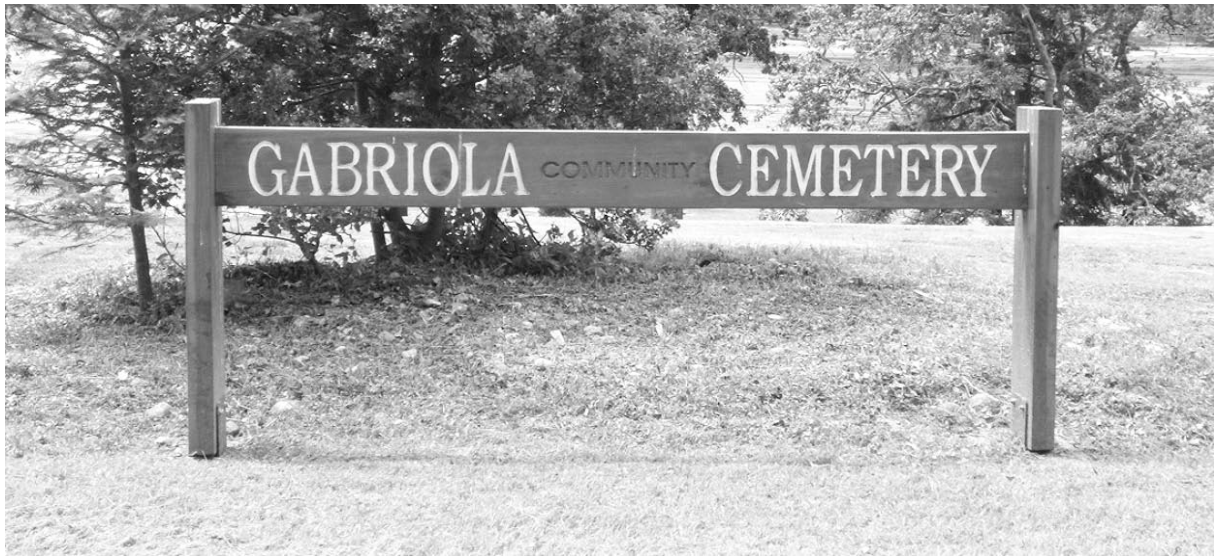
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The sign at the cemetery is oriented $E20^{\circ}S$, which was magnetic east at the turn of the 21st century. An alien could deduce from this its date (magnetic east changes over time); that east was of some importance to the people buried here; and that the people's technology included use of a compass. Can we discover such things about the petroglyphs and their designers this way?

Petroglyph studies in the cemetery

by Nick Doe

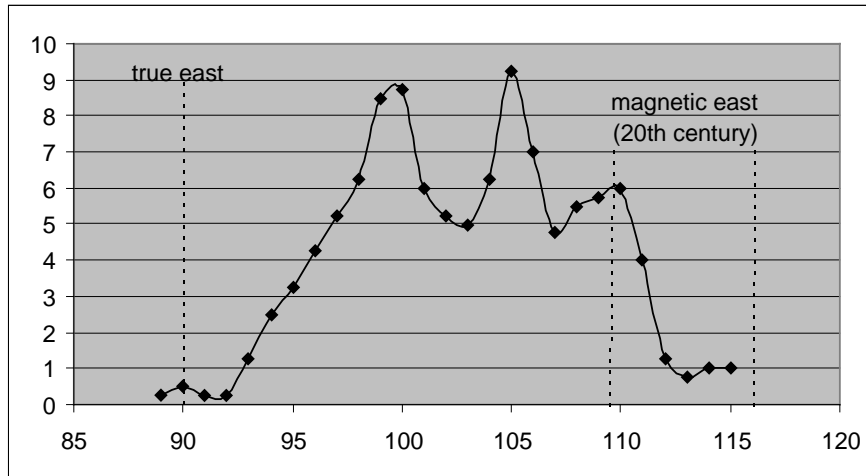
That a cemetery can be an interesting place for local historians to linger is no surprise, but cemeteries can also provide some contemplative moments for geologists and archaeologists too. It is seldom that a geologist has the opportunity to study the weathering of rocks that have been conveniently labelled with their calendar dates; and it is seldom that an archaeologist has the chance to ponder petroglyphs whose cultural setting is so well known.

One of the questions I have about the gravestones—and I have asked this before—is why are they so badly eroded? They are all less than 120 years old, but many of the inscriptions are verging on illegibility. This is in stark contrast to the island's petroglyphs, which, although on fairly soft

sandstone, some are happy to claim as being “thousands of years old”.¹

Another question that I have, arising out of the results of recent research on the geographical alignment of some of the petroglyphs in the southern interior of the island is, is it true that graves are aligned facing east and, if so, how accurately was this done? Did people determine the true direction of east as a surveyor might? did they use east as indicated by a compass? did they rely on maps? or did they follow some

¹ *SHALE* 13, pp.2–6, 2006. I always get wry amusement from the Church site sign which says the petroglyphs are eroding “quickly” due to “wind, rain, and foot-traffic”; yet, the sign itself, which is fairly sheltered, is also weathering badly. Despite this assertion, the sign adds that the petroglyphs “...may be up to five thousand years old”.



The orientations of graves that face approximately east or west in the Community Cemetery. The horizontal scale runs from 85° (5° north of east) to 120° (30° south of east). True east is 90°; magnetic east has varied but has not been less than 119° (19° south of east) since 1880. The vertical scale is the number with that orientation. The curve has been filtered slightly to smooth out insignificant measuring errors.

more complex method, either consciously or without thinking about it too much?

Of course, I could have asked—but my interest was more in understanding what conclusions I would have come to if I had been an alien parachuted in from another time and culture, which is all we are when we seek to understand the petroglyphs.

Alignments

Let's take this alignment question first. With compass in hand (a newly calibrated Silva probably good for $\pm 2^\circ$), I spent several pleasantly quiet afternoons recording the orientations of 113 graves in the Community Cemetery on South Road.²

None of the 113 had a “random” orientation. Two faced north (358° and 12°) and the

² A few family graves were in integrated blocks with identical orientations and I counted these as only one grave. A few had collapsed or slumped and are not as they once were and these I did not include. Some graves were magnetic so I had to measure carefully.

remaining 111 were more or less oriented east-west, though 20 faced west rather than east. For the purposes of alignment analysis, I subsequently ignored which way the east-west ones faced. These 111 had orientations between 90° (E) at one extreme and 116° (E26°S) at the other.

Very surprisingly, I found only one grave that was within $\pm 2^\circ$ of true east. None were oriented north of true east, which leads to the suspicion that the graves

might be oriented toward *magnetic* east rather than true east. In our part of the world, magnetic compasses, have, since 1880 (it varies with time), pointed to between about 19° and 26° east of north, so anyone using a compass to find east without correcting for this would be pointing 109–116° (E19–26°S).³

So, were the graves pointing 109–116°? Well, some were, but not many. Of the 111, only twenty had an orientation in this range. What at first seemed an almost silly question was starting to become interesting.

The graph above shows the distribution of orientations for the range 85–120°.⁴ The two “popular” orientations are at 100° (E10°S) and 107° (E17°S).

³ It is currently around 109° and falling.

⁴ South Road runs by at 121° (E31°S) and I see no evidence of the northern fence being used as a reference.

Now, there's a lesson here for me. If I were an alien parachuted in from another time, and I had established that the orientations were not true east, I would very soon advance the theory, as we have already done, that these mysterious graves were oriented to magnetic east. I would then go on to propose that, because magnetic east changes with time, we have a way of dating them—being an alien, I wouldn't understand what was written on the stones.

The last time magnetic east was around $E10^{\circ}S$ was in the early 1600s, and the last time it was around $E17^{\circ}S$ was around 1730. Thus, I would triumphantly conclude, the graves in this cemetery must date back to the early-17th and early-18th centuries. And all the students in the land would write that down.

I didn't want to go down this path too far, but I couldn't resist asking what the cause of the variations in orientation were (again, without asking—I'm an alien remember).

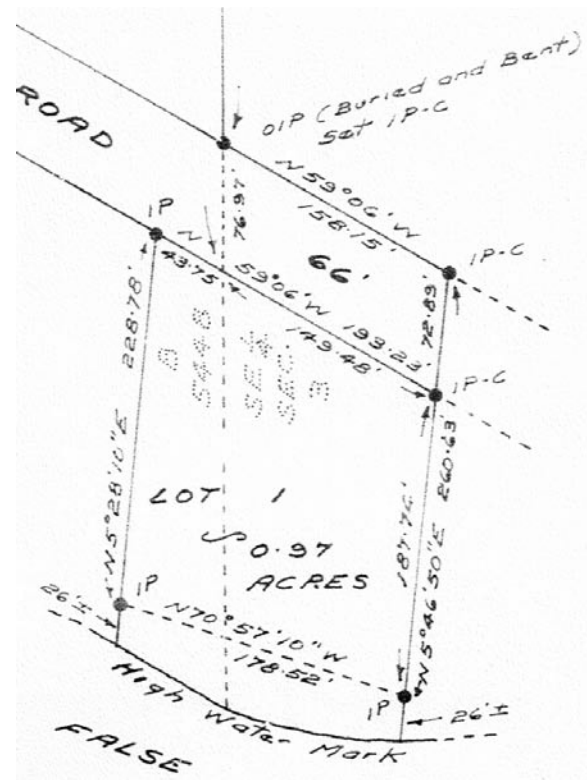
Several lines of enquiry suggested themselves.

A trip to the Regional District of Nanaimo offices produced, with the help of friendly staff, a survey of the cemetery dated June 26, 1962 (PL.15573). It shows the west boundary running at $N5^{\circ}28'E$ and the east boundary at practically the same orientation $N5^{\circ}47'E$. Anyone making the reasonable assumptions that the fences followed the legal boundaries and that they ran exactly north-south would therefore end up identifying east about $5-6^{\circ}$ south of true. As you can see from the lack of graves oriented at around $95-96^{\circ}$ in the graph above, that wasn't what people did.

But what about those fences? Any survey post that once existed in the southwest corner of the lot would be overwhelmed by a large Douglas-fir that grows there now. And

the line from it to the northwest corner along the fence is, according to my compass, about $N8^{\circ}E$. The line of the fence on the opposite side, from southeast to northeast, is overgrown and harder to follow, but runs about $N10^{\circ}E$. So here is the likely origin of the 100° peak. People used the fences as north-south references, not knowing, or caring, that the tree in the corner had not grown in exactly the right legal place. There was no hint, by the way, that the fence references first started in the 20th century. When the present-day fences were built, they were evidently set in the same positions as the earlier 19th-century ones must have been.

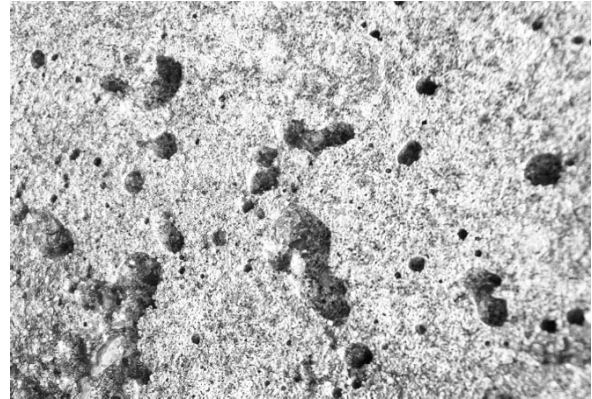
Progress on the other peak at 107° was made when I noticed that of the 37 graves that were within $\pm 2^{\circ}$ of 107° , only one was dated before 1960. So, why 107° , remains a bit of a mystery, but a simple explanation might be that a compass measurement was once made too close to something metallic in the



ground—I found it easy to introduce a $\pm 5^\circ$ error this way—and once one grave had been set, people set adjacent ones parallel to it for neatness sake. Clustering was common for this orientation.

Geology

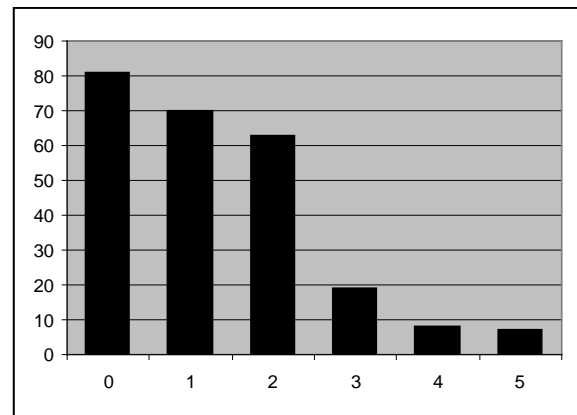
The geology studies of the gravestones were interesting, but didn't produce much in the way of quantitative information about petroglyph erosion because none of the gravestones are made of sandstone. Some stones were originally faced with marble, but acid rain has all but destroyed these facings. It has left a delicate lacework pattern on one stone. What I eventually found most interesting at the cemetery—weathering-wise—was the way that the concrete fence posts around the perimeter had weathered. Some of the faces of the



Weathering starts with small round pits, which increase in number and depth and eventually amalgamate.



The "back" of a fence post facing south and showing grade 5 (the most severe) weathering near the top. The side facing west (on the left) shows only grade 1.



Number of faces (248 total) in each weathering grade (0 = none, 5 = severe).

posts were severely weathered, but other faces were pristine. Here was an almost perfect experimental set-up to discover why. Posts were set at various distances from the sea, and facing in all four geographical directions—east, west, south, and north.

All in all, I examined all four faces of sixty-two posts. I also noted which side faced where. Fortunately, the posts are asymmetrical, so identifying which side was which was easy. Weathering that rotated whenever the post was rotated would have indicated a manufacturing flaw, and it was this possibility I wanted to eliminate. I also noted how far each post was from the sea.

The weathering is in the form of small pits. In the initial stages, the pits are scattered and isolated. As the weathering gets worse, the density of the pits rises, and they get deeper, though they don't increase a lot in size. Eventually, the density of pits becomes so great that they overlap and individual pits are no longer recognizable. This is the way that the sandstone on our beaches weathers into first honeycombs and then galleries, so it's likely the root causes are the same.

I used a scale of 0–5 to quantify the weathering; it was just an eyeball assessment, nothing too scientific. A face with grade 0 showed virtually no weathering; one with grade 1 was almost flawless but with a few scattered pits; and so on. A face with grade 5 was rotting with no sign of the original surface.

Having amassed my base of data, I was then able to ask my computer to figure out how much the weathering grade depended on which direction the face faced; how much on what side of the post it was⁵; and how much on how far from the sea it was. The answers are shown in the table above, and are the average contribution each factor makes to the weathering grade.

The easiest results to interpret are in the bottom row. The closer to the sea you get (on the south side of the cemetery), the more severe the weathering. Clearly, as I had suspected all along, the prime suspect is salt.

The middle row is satisfying in that it shows no difference between weathering on the left and right sides of the post—one wouldn't expect any. It is interesting though that the "front" side weathers less than the others.

⁵ The tops of the posts slant. "Back" was the highest side; "front" the lowest side; "right" and "left" as seen looking at the front. The fronts of all the posts face into the cemetery.

west	east	north	south
0.82	0.85	1.07	1.15
front	back	left	right
0.53	0.87	0.92	0.93
far (north)	middle	near (south)	
0.81	1.55	2.44	

Not sure why—something to do with rain running off the sloping top? Or maybe the cement was formed in a way that left the fronts less porous? I don't know.

The top line shows that weathering is most severe on faces looking south, toward the sea and winter winds although weathering on the opposite side is also bad.

There are a couple of flaws in the experiment that might be influencing these numbers. For example, all posts nearest the sea have their backs to the sea, so these particular posts provide no information for separating out geographical and design-of-the-post effects. Also, the east side of the cemetery is more sheltered than the other sides and this wasn't factored in. Maybe the faces looking south and east on the east side have benefited from being sheltered from the SE winter winds. But enough of the quibbling! All in all, I'm pleased with the results. It's salt that does the damage.⁶

Final word? I think it should go to William Goodall. He died in 1921, aged 28, as the result of war wounds received at Le Sars, France, in October 1916. Contrary to popular myth, his grave by the sea, with military precision, may be the only non-Native one on Gabriola to be facing exactly east. ◇

⁶ See *SHALE* 16, p.48, 2007 and *SHALE* 9, pp.12–40, 2004.