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More about... runnels

by Nick Doe



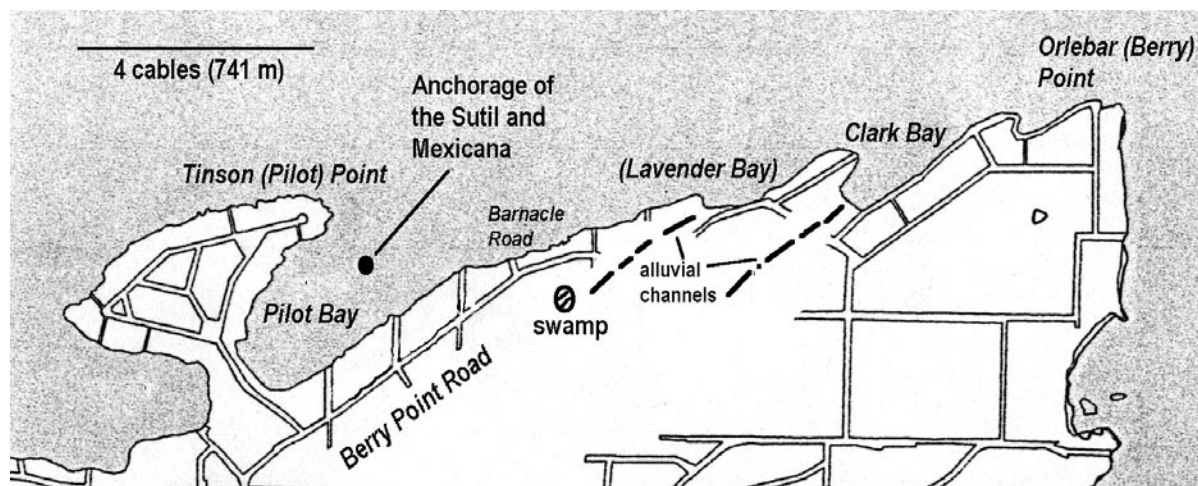
Photograph by Anna-May McKellar

The famous Canadian-born physician, Sir William Osler, used to begin his lectures with the admonition that 50% of what he was about to say was wrong. But, he would add, his problem was that he had no idea which 50% that was.

I'm reminded of this when I think about runnels. On the face of it, there's not a whole lot one can say about runnels—in fact I'd thought I'd said most of it in *SHALE* 9, p.25—but, as I hope to show, I was wrong.

The origin of Gabriola's runnels is a bit of a mystery. They may be linked to unusual groundwater chemistry in the area; and what's more, if that doesn't turn you on, they may have a place, albeit a tiny place, in the human history of the island.

Now, according to the feeble dictionaries we have around these days, a runnel is simply a gutter. But for me, the word "gutter" carries connotations—downspouts, rotting leaves, miserable rainy days, fag ends and discarded bus tickets. Runnels, on the other hand, are wholesome, rural entities; watercourses carved by crystal-clear rivulets, rills, trickles, sparkling streamlets, ...that sort of thing. Runnels are also trough-like hollows on sandy beaches that carry water back to the sea as the tide retreats. But although Gabriola's runnels may resemble such ephemeral ripples, that's not what they are. Our runnels have been worn and weathered into the bedrock. You'll find them off Berry Point Road near to its junction with Seagirt Road at the north end of the island.



The runnel site, Lavender Bay (a local name), is off Berry Point Road by Seagirt Road. Alluvial channels, shown on the map, probably served as meltwater channels during deglaciation and run into both Lavender Bay and Clark Bay. The Spanish naval ships *Sutil* and *Mexicana* commanded by Galiano and Valdes anchored not far away at the entrance of Pilot Bay (*Puerto del Descanso*) in June 1792. Here they loaded 30 barrels of fresh water a day for several days from a source Galiano says was further out along the beach. The Spanish were shown the source by the Snunéymux^w. The shore of Lavender Bay is a registered archaeological site, a midden (DhRx34).

In *SHALE* 9, I foolishly suggested that these runnels were primarily the work of the wind and the waves; an error that made itself painfully apparent, as such errors are wont to do, one day after the issue had gone to the printer. Standing on the beach with my back to the sea, it immediately became clear that these runnels are not made by the surf. They have been created by freshwater runoff.

The bank at the top of the beach (photograph *right*) is honeycombed, except where fresh water runs down to the pools below. These runoff routes by the way are not deeply eroded; the lack of honeycombing is

due to fresh water washing away the salt that causes it. When the pools overflow, which they always do when it rains, the water runs down to the sea in the runnels.

At the top of the bank, well above the high tide mark, there are more pools in rounded hollows—*pozitos* the Spanish explorers





Hollows at the top of the bank above the beach at Lavender Bay filled with fresh water. The hollows are former concretions that have been eroded away. The runoff channels of some of the holes are remarkably deep, but, strangely, there is no equivalent erosion on the inflow side. The Spanish explorer, Dionisio Alcalá Galiano, described the fresh water they found on Gabriola as coming from *lagrimaderos* (tear ducts), and I like to think that they were these.

called them—that look very much as if they were once spherical concretions, but have now been almost completely eroded away.

When you look at the runnels in the right light, and when the water in them is the right depth, you can see that they too seem to have evolved from (or developed into) a series of eroded concretions.

These series of hollows, connected to form grooves, are curiously reminiscent of the lines in petroglyphs, which were made by

pecking a series of holes, and then abrading the rock between the holes.¹

The fresh water comes from an alluvial drainage channel (see map), known locally as “the swamp”. Even in the driest summers there is standing water there.

Fresh water—*agua dulce*— was almost certainly the first thing that the Snunéymux^w traded with the Europeans who came to Gabriola in the late-eighteenth century.

¹ Mary & Ted Bentley, *Gabriola: Petroglyph Island*, pp.55,128–9, Sono Nis Press, 2nd Edition, 1998.



The beach in this area has a very high density of small concretions (*SHALE* 9, pp.6–11). These have been eroded away, probably by acid in the runoff. The hollows left behind have then been connected to form runnels, but how or why is a bit of a mystery.



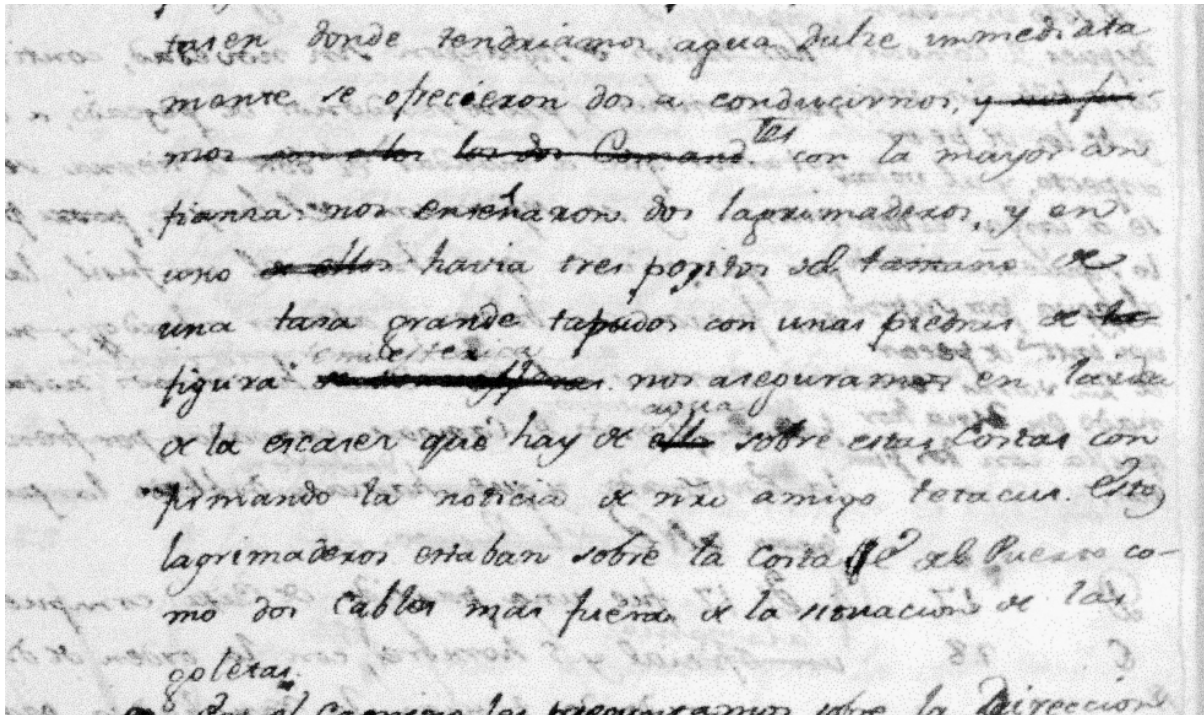
When Alcalá Galiano and Cayetano Valdés arrived in June 1792, they were shown where they could find it by the Snunéymux^w who were living in the village in Taylor Bay.²

Galiano's account of this transaction reads as follows:

"...once at the beach [Pilot Bay] we made signs to them [Snunéymux^w] for them to show us where we would get fresh water. Immediately two offered to take us [...] with great confidence they showed us two trickles [literally "tear-ducts"], and in one there were three small pools the size of a large cup covered with stones in the form of a hemisphere. They assured us of the idea of the scarcity of water that there is along these coasts confirming the news from my friend Tetacus [a Salish Chief whom the expedition had picked up at Neah Bay]. These trickles wandered over the east shore of the port about two cables beyond the location of the ships."

[Translation by Mike Layland]

² Nick Doe, *Alcalá Galiano's sketchmaps of Gabriola*, *SHALE* 1, pp.12–21, November 2000.



Notes from Galiano's notebook on the source of the fresh water they found on Gabriola Island.

Borradores del Diario del viaje...Galiano Ms. 144, f.440. Courtesy MUSEO NAVAL Madrid

"...taron donde tendríamos agua dulce inmediatamente se ofrecieron dos a conducirnos [words deleted] con la mayor confianza nos enseñaron dos lagrimaderos, y en uno ~~habia~~ ^{habia} tres pozitos del tamaño de una taza grande tapados con unas piedras de figura semiesferica. nos aseguramos en la idea de la escases que hay de agua sobre estas costas con oprimando la noticia de mio amigo tetacus. Estos lagrimaderos erraban sobre la costa del Puerto como dos cables mas fuera de la situación de las goletas."

This account is from an unpublished manuscript in the Museo Naval in Madrid (see *above*) and, if not the original, is as close to it as any published version I have seen.³ Wagner (*Spanish Explorations...* p.255) says "...three small holes covered with semi-circular stones", but Kendrick (*The Voyage of Sutil and Mexicana...* p.119) says "...three huge reservoirs in large basins

paved with round stones". Needless to say nobody has ever found "three huge reservoirs" in this area; however, the word "lagrimaderos" (tear-ducts) is I think an apt description of the hollows at Lavender Bay.

Whether or not it really was this bay where the Spanish got their water is hard to say. The one thing against it being this site is that Galiano says the source was two cables, that is two tenths of a nautical mile (370 metres), beyond the anchorage of the ships. Lavender Bay is further out than this. A possibility exists therefore that the watering location was somewhere in the neighbourhood of the beach at the end of

³ There are several versions in the Spanish archives, but some of these manuscripts are clearly not field notes or first-hand accounts, but manuscripts generated by editors during the preparation of the book *Relación del Viaje...* published in Madrid in 1802.

Barnacle Road, and certainly there is runoff there from the swamp on the other side of Berry Point Road whenever it rains heavily. Perhaps there were once pools here too that have now been covered by the residences and their gardens along the shoreline. There is a small midden nearby (DhRx35).

Now, the big question that has been answered by all of this is, if the runnels were carved by the backwash of the surf, why don't we see runnels everywhere? Answer: they weren't carved by the backwash of the surf. And the big question posed by all of this is, if the runnels were carved by runoff, why don't we see them everywhere? Answer: ...well we'll have to think about that.

One part of the answer is that the runoff at Lavender Bay is fairly acidic (by my measurements, pH 6.0).⁴ This is fairly unusual because runoff usually reaches the top of the beaches by seeping through the bedrock, and any prolonged contact between rainwater and the bedrock makes the water more alkaline. Most wellwater on Gabriola is alkaline (pH greater than 7) for this reason, and some wells in the Berry Point area have groundwater pH's of more than 8.5, which is quite high.⁵



Buster, the border-collie dog, who's good at finding water, cools off at the height of summer in the "swamp" (enlarged in the 20th century) that feeds the "tear-ducts" that Spanish naval officers used to water their ships, at the invitation of the Snunéymux^w, when they anchored in Pilot Bay (*Cala del Descanso*) on Gabriola in June 1792.

The Lavender Bay runoff maintains the acidity it has at source because it isn't true groundwater. It flows at or near the surface through an area with organic rich soil and alluvial clay that minimizes the contact the water has with the bedrock. The initial acidity comes from rain, which typically has a pH of between 5 and 6, and from the decay of organic matter in the swamp. This decay adds fulvic, humic, and many other organic acids to the water.

Concretions⁶ are particularly susceptible to erosion from acids because the grains of sand in a concretion are cemented together with *calcite* (calcium carbonate)⁷ in place of

⁴ Pure water has a pH of 7. Anything less is acidic; anything more is alkaline. See the endbox for more details. Measured seep pH (9 sites) is 7.0±0.2.

⁵ Data from the survey conducted by Dr. Steve Earle and Dr. Erik Krogh of Malaspina University-College. *SHALE* 7, pp.34–42. High pH's are associated with high levels of boron and fluorine.

⁶ *SHALE* 9, pp.6–11.

⁷ CaCO_3 . It dissolves in, and neutralizes acids, releasing carbon dioxide in the process:
 $\text{CaCO}_3 + 2\text{H}^+ \Rightarrow \text{Ca}^{++} + \text{CO}_2 + \text{H}_2\text{O}$. Both calcium humate (from humic acid) and calcium fulvate (from fulvic acid) are soluble in water; however, the calcium in solution exists as a organometallic complex rather than as a simple Ca^{++} ion.



Above & right: Not totally convincing perhaps, but here are some *pozitos* (small pools, hollows, pits?) at the top of the beach collecting freshwater runoff from the site shown on the previous page, and there is a stone partially covering one of them. It's not clear from the Spanish notes what the purpose of the covering stones, if any, was.

Below: A "grand canyon" runoff channel. This one is over one foot (30 cm) deep.



the usual clay and fine-grained minerals. The *calcite* originated from the decay of fossil organic material in the sandstone, possibly fragments of wood in this case. Calcium carbonate, which is the chemical composition of several rocks and minerals including *limestone*, *aragonite*, *marble*, and *chalk*, is quite soluble in acids—it's why the shells of hard-boiled eggs dissolve in vinegar when you pickle them.

All very straightforward, except for one thing. Why does the water in the concretion hollows erode the sandstone so readily when it flows out of the hollows? It didn't while it was acidic on the way in; so why should it after the *calcite* has made it more alkaline (pH 8.5) on the way out? Answer: I really don't know. Possibly it's due to abrasion. When the *calcite* cement of a concretion is dissolved, the sandstone reverts to grains of

sand, and in running water these might abrade the grooves. But this explanation has a “got-to-be-more-to-it” feel about it.

Perhaps, since salty groundwater is involved, the runnels are another form of honeycombing. Whatever causes cavenous

weathering and sandstone galleries, might also be at work here. Yet another idea is that it's not the outflow erosion that's unusual, but the (lack of) inflow erosion. As I say, I really don't know. More research is clearly needed. ◇

The pH (potential of hydrogen) scale

The pH scale is a measure of the acidity of a liquid [technically its hydrogen ion (proton) concentration]. Pure water, which is regarded as being neutral, has a pH of 7.

Because the scale is logarithmic, and the numbers are understood to be negative, each tenfold *increase* in hydrogen ion concentration is represented by a one point *decrease* in pH. Thus all acidic solutions have a pH lower than 7. Orange juice, for example, has a pH of around 4, and lemon juice a pH of around 2. Dangerous acids, such as those used in car batteries, have a pH less than 1. These are more than a million times more acidic than water ($10^6 \times 10^{-7} = 10^{-1}$).

An alkaline solution has a pH of more than 7; milk of magnesia, an old-fashioned antacid medicine, for example, has a pH of around 10. Dangerous alkalis (oven and drain cleaners) have a pH more than 13. These are so depleted in hydrogen ions that they freely rob them from any material, especially organic material, they come in contact with.

In the natural world, mildly acidic solutions (pH 4–7) are produced by dissolved carbon dioxide (carbonic acid), low levels of sulphur dioxide (sulphurous and sulphuric acid), and many compounds associated with the decay of organic material (fulvic and humic acid). Rainwater in BC is acidic (pH 4.5–6), the acidity being from both natural and human sources.¹

Mildly alkaline solutions (pH 7–9) are produced by dissolved carbonates and bicarbonates. Groundwater on Gabriola is often alkaline for this reason. Seawater is also slightly alkaline and normally has a pH of around 8.²

The solubility of some minerals is very dependent on the pH of the water. Silica (*quartz*) is normally regarded as being completely insoluble, but its solubility begins to climb if the pH rises above 9, as it may do in a confined underground limestone or chalk environment. Calcium carbonate (*calcite*) on the other hand is insoluble when the pH is high and only dissolves in acidic (low pH) solutions.

The balance point of a mix of calcium carbonate, atmospheric carbon dioxide, and water is pH 8.3, and this is exactly the measured pH of pools of rainwater in holes in concretions.

1. Here on False Narrows, the pH of the rain also seems to depend on the strength and direction of the wind. It is more neutral in winter storms, possibly due to the presence of saltwater aerosols.

2. The pH of the surface seawater in False Narrows is slightly less (pH 7.7) than the global average due to the heavy rain in winter, and dilution with freshwater runoff from the Nanaimo River.