

Context:

Gabriola Island. *SHALE* “walk/talks”, 2006 series.

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N/A. Notices were posted in the *Gabriola SOUNDER* and (not all) in the *Flying Shingle*.

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That the GHMS/*SHALE* should hold “walk/talks” was a proposal first made by Judith Graham.

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False Narrows, May 13, 2006

## 1. Museum sponsored walk/talk along False Narrows

The Gabriola museum is sponsoring several walk/talks on Gabriola this summer and this is to announce the first of these.

Nick Doe, editor of the Museum’s Journal *SHALE*, will lead a group along False Narrows on Saturday, May 13, beginning at 2:00 p.m. The walk should take between 2 and 3 hours.

We will start at the beach by the Pioneer Cemetery and walk along to the beach at the Brickyard. Nick will talk about the island’s geology along the way, and we will look at fossils, faults, shale formations, the False Narrows midden, ending up at the historic brickyard. Questions, discussion, expert opinions—all very welcome.

For those not up to the whole walk, it would be possible to go down to the Pioneer Cemetery, then go back to South Road and along to the boat ramp at El Verano, but you do need to be able to get down to the beach.

The walk will be free to all comers, so tell your friends and neighbours, but, as always, donations to the GHMS or to *SHALE* will be gratefully accepted. The walk is “at your own risk”; the tide will be low and the beach should be dry, but you nevertheless will need to pay attention to your footing.

For last-minute information and to leave enquiries, please call the museum at 247-9987.

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Berry Point, June 10, 2006

## 2. Museum sponsored Berry Point walk/talk

The Gabriola museum is sponsoring several walk/talks on Gabriola this summer and this is to announce the second of these. Nick Doe, editor of the Museum's Journal *SHALE*, will lead a group along the north shore of the island on Saturday, June 10th, beginning at 10:00 a.m. The walk should take between 2 and 3 hours.

We will start at Berry Point and walk along the beach toward Pilot Bay. Nick will talk about the geology of this part of the island, and we will look at sandstone formations, Eocene fractures, concretions, and turbidites. We will also stop at several points where the Spanish explorers Galiano and Valdes met with the Snuneymuxw in the late-18th century including the original Cala del Descanso. Questions, discussion, expert opinions—all very welcome.

For those not up to the whole walk, it will be possible to bail in and bail out at several points along the way.

The walk will be free to all comers, so tell your friends and neighbours, but, as always, donations to the GHMS or to *SHALE* will be gratefully accepted. The walk is "at your own risk"; the tide will be low and the rock will hopefully be dry, but you nevertheless will need to pay attention to your footing.

For information and to leave enquiries, please call the museum at 247-9987.

### REVIEW of Berry Point walk/talk by Joyce White

Saturday, June 10th, about 30 people joined *SHALE* editor, Nick Doe, for the second Museum sponsored walk/talk along the beach; from Berry Point to Pilot Bay. Along the way, Nick spoke of the geology and the history of the region and we learned for example that, according to Spanish maps, Pilot Bay is probably the original Descanso Bay, where Galiano and Valdes anchored. We also learned that Gabriola sandstone is made up of sediment from rivers flowing through the Coast Mountains about 65 million years ago. For those who missed this walk/talk, or were there and wish for more, then watch for announcements of walk/talk #3 coming soon.

### REVIEW of Berry Point walk/talk by Kit Szanto

We met at Berry Point just before 10 a.m. and five minutes later, there were enough of us that we started. Some 25–30 of us were there for the walk. It was a lovely day—sunny with a light breeze and a nice low tide.

Nick led us out onto the beach. Looking west into Pilot Bay, he explained that it was there, not at the ferry terminal in Descanso Bay, that Spanish naval officers Galiano and Valdes and the crews of the *Sutil* and *Mexicana* landed in 1792. Early interpreters of the Spanish records had thought that the islet passed on their way to a refuge on Gabriola was Snake Island, but it was, in fact, Entrance Island. Nick backed this up with compelling evidence that included an unlabelled sketch map drawn by Galiano that Nick and a friend, John Crosse, had found in the Spanish naval archives in Madrid. Galiano and Valdes were not the first European explorers to visit this area; it had been charted in 1791 by Narvaez, but the journal he kept has been lost.

Captain Vancouver had been exploring the mainland coast at the same time as Galiano, and he crossed over from the mouth of the Fraser River to Gabriola a few weeks before the Spanish landing in Pilot Bay. Nick pointed out the small rocky islet, known locally as Submarine Island, off shore a bit to the east of us, where Vancouver may have spent the night. Vancouver's journal records that the tide was high when they approached cliffs on Gabriola in the middle of the night, and Vancouver and his men spent an uncomfortable few hours in their small boat tied up to a rock with no room to put up a tent. Evidence for this comes from Peter Puget's rough logbook in the British Library.

Nick produced two reproductions of flags in use during the 18th century, one the flag of Spain, brilliant red and gold with the emblems of Castile and Leon (a castle and a lion), and the other the flag of Britain—like the modern Union Jack but without the cross of St Patrick. They looked splendid, and enabled us to imagine the 18th-century expeditions in the strait with these glorious colours waving from their masts.



Photos: Anne Buttrick



While exploring the Strait of Georgia, the captains (Vancouver, Galiano, and Valdes) and their senior officers often dined on each other's ships and served each other the national beverage, beer from the British, wine from the Spanish. Nick also pointed out "Punta de Gaviola". This is not a mistake for "Punta de Gaviota" which is what many people assume the name was intended to be. From where we were, the point (actually the Flat Top Islands) appeared, as it would have to the 1791 expedition, like a low headland reaching out from the southern end of the northeast coast of Gabriola.

Nick then went on to talk about the geology of the beach, and explained the various (natural) cements used to hold sandstone together. Nick found some good examples of concretions and explained their formation. We also saw green basaltic rock and other igneous rocks brought here by glaciers. He also explained the basic geology of BC. Originally, the west coast of the North American continent was where the Alberta-BC border is now. With the westward movement of the continent as the Atlantic Ocean opened up, the continental shelf was pushed up as the Pacific Ocean tectonic plate moved eastward down under it. This rucked up continental shelf became the Rocky Mountains.

Nick explained the "ease" with which the continent rock is uplifted by saying that the continents are like scum, made of light (felsic) rocks rich in silicon, aluminum, and sodium that "float" on top of the darker heavier (mafic) rocks, richer in potassium, iron, and calcium, that make up the floor of the world's oceans. BC is a collection of mini-continents (terranes), former islands, seamounts, and shallow marine bedrock from disparate parts of the west and south Pacific accreted to the west coast by the movement of the Pacific Ocean floor beneath the North American continent. The arrival of Vancouver Island (part of Wrangellia) off the coast is relatively recent—90 or so million years ago. The subsequent arrival of smaller terranes about 55 and 42 million years ago, moved Vancouver Island closer to the mainland, pushed up

mountains, and folded the floor of the Nanaimo Basin creating the Gulf Islands. Some of the long linear fractures one sees in the sandstone on Gabriola today are a reminder of these long-ago events.

Nanoose is one of the oldest rock formations around, some 200 plus million years old (late Triassic), originating as an underwater seamount—the cone of an undersea volcano which rose high enough to come close to the surface, and was rich in aquatic life. If it looks like a tropical island, that's because that's close to what it once was.

Some of this information was given in the first walk/talk, but for most of us, the repetition was very helpful. The bedrock of Gabriola was laid down in the late Cretaceous, and is sedimentary rock, alternating layers of sandstone and mudstone (shale), with occasional layers of conglomerate. At Berry Point, the sandstone was laid down at the estuary of a large river, originating in the Coast Mountains, about 65–66 million years ago. At that time, the area had been a warm shallow sea, the sedimentary layers (which form the bedrock of Gabriola) forming below sea level. At the end of the Cretaceous, sea levels fell dramatically, and the Strait of Georgia region was above sea level for millions of years. Then, about two million years ago, the ice ages began, shaping the land yet further. Gabriola was at times covered in ice about a mile thick; the latest ice only receding about 13,000 years ago.

As we walked toward Pilot Bay, Nick explained the beach here is some of the youngest rock on the island, perhaps even formed slightly after the event that killed off so much of life on the planet including the dinosaurs at the end of the Mesozoic. We skirted Sea Girt peninsula (went up to the road then back down to the beach, since it is a bit of a climb over boulders to go around by the waterfront there) and Nick pointed out where the Snuneymuxw took Galiano and Valdes to find water, beyond the entrance to Pilot Bay where they had moored their ships. Some reports suggest he found abundant water there, a large pond or stream, but in fact it was just more or less what one can see today, trickles of water originating in the marshy area inland, seeping down to the sea across the beach. Most water gathers in hemi-spherical hollows at the top of the beach and when these overflow, the freshwater runs down to the sea in runnels. Galiano called the places where he collected water *lacrimaderos*—tear ducts—a very evocative term for these pools. The hollows are concretions that have been eroded away by the slightly acidic runoff from the marshy areas on the other side of Berry Point Road.

We ended up at Pilot Bay where some of us had left cars, and those whose cars had remained at Berry Point either went back a bit sooner or got ferried back to Berry Point from Twin Beaches parking area. One of the discomfoting events in the history of this period is the smallpox epidemic, which swept up the coast from Mexico, hitting this area about 1782/3. Its aftermath was noted by the Spanish in 1792. The people who showed him how to find water were in a small settlement in Taylor Bay, a small remnant of the several thriving communities on the island, which had existed earlier. Vancouver especially had noted beaches around the Juan de Fuca Strait littered with skeletons, grisly evidence of the speed with which the devastation occurred. One can only imagine the impact it must have had on the morale of the survivors.

All of these stories Nick told were supported with historical evidence, and much of the fun of the walk was in hearing the details of the evidence, seeing how he had learned why earlier accounts of Galiano's visit were inaccurate, or how it is possible to know that Nanoose is so much older than the surrounding geologic area. It really made a huge chunk of history come alive to hear

Nick's stories while standing there with him looking at the spaces he described, and enjoying his wit as well as his learning. "You had to have been there."

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Whalebone beach, July 22, 2006

### 3. Museum sponsored walk/talk along Whalebone Beach

The Gabriola museum has been sponsoring walk/talks on Gabriola this summer and this is to announce the third of these.

Rufus Churcher, a retired (but still very active) palaeontologist, will lead a group along Whalebone beach on Saturday, July 22, beginning at 2 p.m. The walk should take between 2 and 3 hours.

We will start at Bell's Landing on the west end of The Strand and walk along the beach, ending up at the Killerwhale Lookout beach access (the path starts by the STOP sign).

Rufus will talk about the geology of the Strait of Georgia and Gulf Islands, and we will look at fossils and features of this shale formation. A particular attraction of this beach is the large variety of igneous and volcanic cobblestones brought over from the Coast Mountains by the glaciers of the last ice age. At the end of the walk, there will be an opportunity for us to show and sort interesting-looking pebbles that we've picked up and pocketed along the way.

The walk will be free to all comers, so tell your friends and neighbours, but donations to the Gabriola museum, or to its journal *SHALE*, will be gratefully accepted. The walk is "at your own risk" and your footwear should be suitable for walking a stony beach.

For last-minute information and to leave enquiries, please call the museum at 247-9987.

#### REVIEW of Whalebone Beach walk/talk by Kit Szanto

Walk/talk with Rufus Churcher on July 22, beginning at the beach just down from the access path at Bell's Landing at the west end of the Strand.

People assembled on the beach and by two o'clock there were approximately 50 people there. It was a hot sunny day, but the beach area was mostly in the shade and with the breeze off the water, it was very pleasant. Nick Doe set the geologic context for the upcoming walk/talk, and introduced Rufus.

Rufus began by discussing the late-Cretaceous origins of Gabriola, and talked about the sea life there likely would have been here at the time. Back then, the sea was about as warm as the Persian Gulf is now, and dinosaurs roamed the mainland. Since Gabriola was formed underwater, in a warm and pretty stagnant sea, the largest creatures here would have been the large marine reptiles (the *Plesiosaurs*) up to 60-feet in length, examples of which are *Mosasaurus* and *Elasmosaur*—there is a fossil of an *Elasmosaur* in the museum at Courtenay—turtles probably a metre in diameter, fish possibly, ammonites, as well as the very big clams that we saw the remains of on the False Narrows walk/talk, the *Inoceramids* (see *SHALE* 4).

Rufus showed us the remains of one inoceramid nodule and then showed us the broken pieces of shells which were scattered quite liberally over the beach. Several people picked up some nice examples of these inoceramid fossils.

Rufus then talked about the ice age which began slowly but eventually covered this whole area with ice over a mile deep. There were three major periods of glaciation that we know of (there must have been many more but evidence of their passing has been obliterated by more recent ones). The last glaciation ended about 10–12 thousand years ago. As the ice sheets moved they ground down the bedrock, carving out and widening valleys, which later were filled by the sea. You can still see grooves in the bedrock on Gabriola made when the glaciers picked up hard stones and dragged them along as they moved.

Rufus pointed to the channel (the Strait of Georgia) we were all looking at, the water between us and Bowen Island, and the extension in both directions, as an example of a valley cut by glaciation. The Juan de Fuca Strait dates from the same period. The glaciers also brought “erratics”, that is, stones that are not part of the local geology. The pebbles and boulders of granodiorite (salt and pepper rock) and other igneous and metamorphic rock we see on the island are erratics, brought from the Coast Mountains and Vancouver Island by the movement of ice. Whalebone Beach has quite a number of these erratics, possibly brought here by a glacier moving down Howe Sound.

Rufus also discussed the rocks that had been smoothed and rounded by the action of water pounding these rocks against one another, and showed us examples of these. Some he called river cobbles—stones that are rounded by tumbling over and over in the rivers—and others are beach cobbles—like flattened river cobbles. The beach cobbles slip back and forth as the waves pull and push them, but don't tumble over and over as they do in rivers, so the characteristic shape is more disc-shaped than round. Rufus illustrated the cobbles, the sedimentary rocks (sandstone, shale, and conglomerate) and erratics with examples he had gathered so we could see the differences that he talked about.

Then we all got up to look for interesting rocks, to show them to Rufus or Nick, and some people began moving east along the beach a bit—but we did not get close to Killerwhale Lookout. In part, people were having a good time where they were, and also as the tide began to come in, the route to Killerwhale Lookout was not feasible. The only pity in this was a few people had decided to join the walk/talk part way toward the end point, and the walk/talk never reached them.

People donated over \$100—a lovely sum for both *SHALE* and the GHMS.

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Drumbeg Park, August 27, 2006

#### 4. Museum sponsored walk/talk in Drumbeg Park

The Gabriola museum has been sponsoring walk/talks on Gabriola this summer and this is to announce the fourth and likely final one of these.

Nick Doe (editor of the museum's journal *SHALE*) will lead a group around the beach in Drumbeg Park on Sunday, August 27, beginning at 2 p.m. The walk should take about two hours. Because of the tides that day, we'll start at the end of Stalker Rd., but parking is limited there and you may want to consider using the main park entrance and taking a short walk through the trees along the shoreline to the start.

We will talk about the geology of the Strait of Georgia and Gulf Islands, and look at some of the "tramline" fractures in the sandstone that give clues as to the island's origins. Particularly intriguing are the cavernous weathering patterns of the sandstone known as *tafoni* or honeycombing.

The walk will be free to all comers, but donations to the Gabriola museum, or to its journal *SHALE*, will be gratefully accepted. The walk is "at your own risk".

For last-minute information and to leave enquiries, please call the museum at 247-9987.

#### REVIEW of Drumbeg Park walk/talk by Kit Szanto

Walk/talk on August 27, 2006 - beach at Drumbeg Park with Nick Doe

We met at 2 p.m. on the beach at the end of Stalker Road, and walked over to the west, or to the right, as one faces the water, of the little bay there. There were somewhere between 50 and 60 people who came for this walk/talk. The edge of the bay ends in a short abrupt cliff where the layers of sandstone and mudstone (shale), with some conglomerate, are clearly visible. These layers were laid down about 68 million years ago, at the delta of a large river, some 300-feet below sea level.

Nick said that the geography of that era was different from what we know now and explained that even when it seems similar there are some significant differences. For example, there were mountains more or less where the Coast Mountains are now. However, the Coast Mountains we see now are not those that were there 68 million years ago and he used the analogy of a person's fingernail to help explain the idea. Nick said one could say of a fingernail, it is the same nail I had a year ago. However, this is only partially true. Since it is constantly growing and being trimmed, it could also be said that it is not the same nail at all. The message is that the geography of the mountains changes, even though the mountains persist. Often people have assumed that the large river that laid down the layers of sandstone, mudstone, and conglomerate on its delta that became Gabriola was an ancestor of the Fraser River. Its current proximity makes this idea easy to accept. However, we know that the heavy, coarser rocks, like those in conglomerate, fall close to the mouth of the river that deposited them, while the sand is carried further, and mud yet further, by the currents, so geologists looking at the pattern of conglomerate deposit that the river which deposited the sediment that eventually became the Gabriola Formation in Gabriola's bedrock conclude that the river had its mouth near Hornby Island, not near the present day mouth of the Fraser. Just to complicate matters however, other studies have shown that currents carrying the sediment were moving from south to north; one of several

unexplained contradictions that make “real” geologists hesitant to say anything at all about the ancient geography of the Strait of Georgia.

Nick reminded us that Vancouver Island is not, historically, part of North America. It arrived from west in the Pacific, a 100 million years ago, carried by the tectonic plate that was moving east, and under North America. Originally, there was no Atlantic Ocean. The old continent of North America moved west as the land that eventually became BC was moving east across the ocean. It is possible, even probable, that at the time of its arrival much of Vancouver Island was just above, or just below, sea level and that mountains started to grow only after it made contact with the mainland. The Coast Mountains are the massive intrusive lava flows that provided the “glue” for the accretion, and these have since been lifted up.

At the end of the Cretaceous, sea level dropped as the climate cooled and polar icecaps formed. Sedimentation in the Nanaimo Basin stopped. Then between 55 and 40 million years ago, new continental-like landmasses arrived from the south-west (the Pacific Rim and Crescent terranes) and pushed up against Vancouver Island. The collisions created the Olympic Mountains and folded the floor of the Nanaimo basin, creating the stress fractures, which are visible on Gabriola today. Later in the walk, Nick pointed out some of these stress fractures, showing that the stress that folded the island came from the southwest. With the arrival of, the new terranes, the Strait of Georgia lost perhaps 15–20% of its width.

For those who wondered how the ice ages fitted into this history, Nick pointed out that glaciation only began much, much later, about two million years ago.

Nick used several pieces of pre-cut wood to illustrate the impact of stress for us, a long narrow one to show how, under pressure, it can bend either up or down creating anticlines (up) and synclines (down). It can also break, as Nick’s piece of wood did. Two triangular pieces were used to show that if pressure does not fold or break rock, it can push two discrete sections in different directions along their common border—a strike-slip fault—one northwest, for example while the other slides southeast. The collision of newly arrived terranes with Wrangellia is not the only cause of stress fractures on the island. A few years ago, Nick measured some 850 fractures on the island and, from this measuring, he has concluded that there have been three different major stress events. At Berry Point, it is common to see X-shaped (conjugate) fractures, which have at some time after their initial formation evidently been stressed again but from a different direction with the result that the two halves of the conjugate fractures no longer have mirror symmetry.

The sandstone on Gabriola was formed when the climate was semi-tropical; the strait was just an inlet with very little circulation (there was no Juan de Fuca Strait), a warm stagnant sea with very little oxygen, and deposits of sand and gravel were carried rapidly from the mountains into it before they had time to chemically mature. This makes the sandstone very vulnerable to modern-day weathering. Sandstone does not form simply from putting sand under pressure, Nick reminded us. There has to be a cementing process, and the cement in Gabriola’s sandstone is clay.

We looked at several sandstone formations, concretions, spherical holes in the stone where concretions had been formerly, and some examples of what is often called *tafoni* or honeycombing—multiple small holes that make some people think it is volcanic. The concretions—spheres of harder sandstone which sometimes protrude out of the surrounding sandstone—are cemented by calcite (calcium carbonate). You can demonstrate this by applying

a few drops of dilute acid such as lemon juice or vinegar to the rock, and if it contains carbonate it will usually fizz as  $\text{CO}_2$  is released. The calcite is formed when organic material, a shell or a piece of wood, is buried in waterlogged sand. Its decomposition creates a halo of carbon-dioxide rich water that creates a sphere concreted with calcite as the sand is gradually turned to rock.

Nick explained the formation of *tafoni* and, in fact, also the larger areas of sandstone erosion like Malaspina Galleries, by explaining that salt weakens the cement binding the sand together, and as the grains become separated, they wash away, leaving these holes. The reason for the weakening is not fully understood; it may be because the sodium in the salt replaces calcium in the clay cement and reduces its binding ability, or it may be that as the salt crystallizes it expands and exerts pressure. Although some of the salt comes directly from contact with the sea, most of the *tafoni* (plural of *tafone*), as well as the recesses of the Malaspina Galleries are above the high tide line. It is rainwater that soaks into the rock in winter as if it were a sponge that carries the salt. It is then drawn out to the rock's surface as the sun's heat evaporates it. The moisture in the rocks is salty because rain captures the salt spray in the air during storms. When this water evaporates, it leaves behind the damaging salt, and as more water is drawn to the back walls of the holes from deep within the rock, it leaves yet more salt, thereby deepening the holes being formed. The process is most effective on rock faces facing the sun where evaporation is highest, which is why the southern sides of the Gulf Islands always have more honeycombing than the northern sides.

The "roof" or overhang on the Malaspina Galleries and on other similar formations on Gabriola and other nearby islands is the result of a harder outer shell on the sandstone cemented by hematite, an oxide of iron, which is a weathering product of iron-rich minerals, mainly biotite and hornblende, which are part of the blend of minerals in the sandstone here.

As we walked east across the beach, Nick pointed out a large piece of "pillow lava"—basalt extruded while molten from the sea floor, then pushed up at a later date by movement of the tectonic plates, and eventually brought to Gabriola by the action of glaciers. It is very shiny, smooth to look at and touch (except for the barnacles on it), and this is because it is an extremely fine-grained stone, almost glass, the result of its having cooled very rapidly after being extruded. Nick added that Mount Benson is basalt, and was originally formed on a submarine lava plateau.

As we walked along the beach, two geologists, who were along on the walk/talk, joined in the discussion of the rocks we stopped to look at, and discussed the various factors that might have led to the green crystals (olivine, epidote, pyroxene?) of several mafic igneous rocks being the size and colour they were. The discussion made us all realize geology is not a simple science, but it certainly is fascinating.

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