MARSHES, GHOSTS, AND FLYING CLAMS: A MICROSCOPIST'S ALPINE ADVENTURE

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West Portal, 1900 Cascade Tunnel, Stevens Pass, Washington

This is a story about a creature that isn't truly microscopic. But it's pretty small. And you're gonna meet this little critter whether you like it or not. So don't you think you ought to be introduced before you find it clinging to your socks?

A haunted old tunnel, a tiny alpine marsh, and tiny creatures that traveled thousands of miles and shouldn't be there. What more could a wandering microscopist need?

Protozoological perambulations often lead to offbeat and fascinating destinations, of which Washington's Iron Goat Trail - No. 1 on the 10 Most Haunted Hikes in Washington site and No. 6 on America's Most Haunted Hiking Trails - truly qualifies.

When the last spike of the Great Northern Railway was pounded home on June 6, 1893 in the little Cascade mountain town of Scenic, just east of Seattle, one of the greatest engineering feats of the nineteenth century was completed. The Great Northern Railway leaped the Mississippi River, steamed across the plains, and chugged through the Rocky Mountains. Just east of the little town of Scenic in northwestern Washington, it crept over its last obstacle, the Cascade Range, then

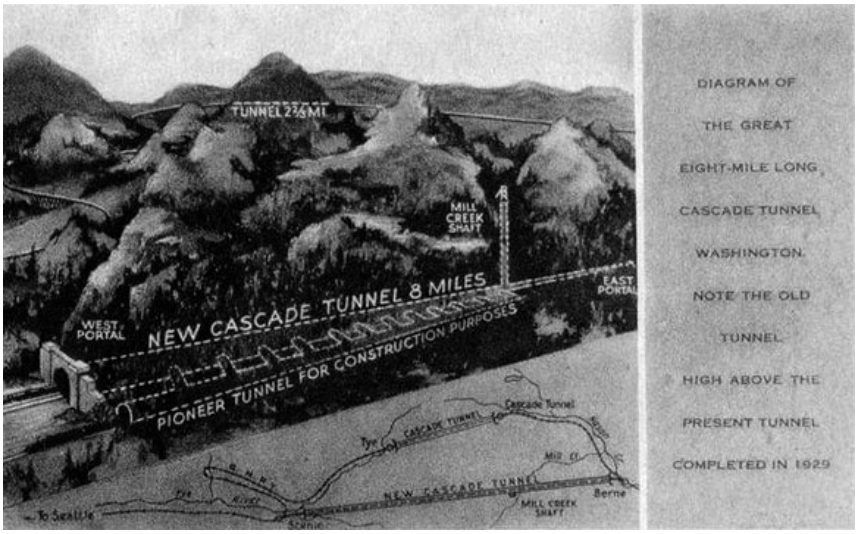
through Stevens Pass and down the western slope to Seattle. The pass was a winter nightmare in the Cascades' feet-deep wet snow, and the first crossing was via an intricate and treacherous series of switchbacks over the pass.

The name of the Cascade Tunnel is still visible over the portal. Hooks held electrical wires to power fans.

In 1900, completion of the Cascade Tunnel bypassed the switchbacks, but trains still fought severe winter conditions on high mountainsides. In 1910, storms stranded two trains at the little town of Wellington, just west of the tunnel's mouth. Two days later, a vast landscape of snow broke free from the side of Windy Mountain above the railway, sweeping both shattered trains into Tye Creek with the loss of 100 lives. Many bodies were not recovered until July, and the Wellington Avalanche is still the worst avalanche disaster in U.S. history.

Wreckage from the Wellington Avalanche

This catastrophe, one of America's worst railroad disasters, prompted the blasting of a new, 7.1 mile Cascade Tunnel at a lower elevation, replacing the old 2.63 mile tunnel with its overhanging mountain slopes. With the opening of the new Cascade Tunnel in 1929, the old lines were abandoned. Thanks to the efforts of many volunteers, the old lines and tunnels were recently reincarnated as the Iron Goat Trail, with the old Cascade Tunnel as its star attraction.



1930s postcard of the old and new Cascade Tunnels

But the old tunnel still has its ghosts - or does it? I researched and hiked the old railroad, drove bits of old highway, and explored until an unmarked fragment of abandoned highway led me to the west portal, finally arriving at the tunnel mouth as light dimmed and shadows crept out from the trees. Armed only with a cell phone and small headlamp, it was clear that the phrase "...creepy old tunnel..." could have been coined just for this place, with its dark, echoing interior, fallen rock littering the floor, walls oozing moisture, water trickling out of the tunnel mouth, and impenetrable darkness beginning just a few feet inside.

As water dripped from the ceiling, I shone my headlamp down the tunnel, aiming the feeble flash of my cell phone camera into the opening. The flash blinked, but the screen showed only a ghostly blur:

I looked at the tunnel - I could see clearly 50 feet into the gloom. Another flash, another blur. Flash. Blur. Looked again. Clear tunnel. Flash. Blur. Night was falling, and this was getting truly creepy. Ghosts of dead engineers? Did someone or something not want to be photographed? Puzzled, I drove the dark mountain roads back to Seattle.

Examining all of these perplexing images, I found one that was at just the right angle, and understanding began to creep in:

Just by chance, my camera had pointed directly into a stream of tiny particles. Two weeks later, I returned armed with a powerful light, and was able to video an invisible mist of tiny droplets streaming out of the tunnel mouth. My poor camera had been trying to focus on this flow, and had failed miserably. Later images with a powerful lamp showed this flowing mist as a fine fog, streaming out of the tunnel like an invisible river.

No ghosts, but the mist and the water flowing out of the tunnel mouth had created a wonderfully green and marshy oasis:

Naturally, I had some pickle jars in my pack, and naturally, I took some samples of mud and moss to put in soda bottle aquaria. What else do you do in a ghostly railroad tunnel?

The next evening, the water had cleared, revealing a fibrous bottom of mud, rootlets, and plant fibers. The microscope showed a rich fauna of protozoa, diatoms, and one delightful colony of peritrichs:

But another mystery quickly emerged in the form of tiny ovoid, grey to brown kernels, 3-8 mm across, appearing in the mat of fibrous dead vegetation: *tiny clams!*

Moreover, these clams were doing very un-clammy things - like climbing plants, and inching up the side of the aquarium. And they were living in a fibrous mat of dead vegetation rather than staying decorously down in the mud!

Now I was looking for these tiny creatures - and finding them. Up in the middle of a mat of weeds, or climbing a stem, or on the tip of a dead leaf:

Search carefully for clams - they can be anywhere!

And they are ***tiny*** - an ambitious little clam climbing the aquarium glass is dwarfed by a planarian worm:

So what are clams doing in a mountain pass at 4,000 feet? And a mile from a ski area where there is four feet of snow and freezing temperatures five months of the year? How did they get there, how do they survive in a mat of moss and roots under the snow, and why did they go there in the first place?

The answer: these are European Fingernail Clams, one of the most ubiquitous, ambitious, and amazing little creatures on the planet. Any muddy microscopic sample from any ditch, pond, or even seasonal puddle worldwide is likely to contain these tiny bivalves. If you have a jar of pond water sitting on your desk, they may well be lurking in your office:

European Fingernail Clams (*Sphaerium corneum*, Linnaeus, 1758)

Fingernail clams are thought to have originated in Eurasia, and are found worldwide in shallow lakes, slow-moving rivers, ditches, and ponds. In some German lakes, their density can reach over *76,000* clams per square meter, and they can burrow as deep as ten meters (USGS Fact Sheet). Officially, they reached eastern North America in the 1900s in ship ballast, but I'm convinced that they sneaked in the cellar window a ***long*** time before that.

The Bug Lady at the University of Wisconsin says of these nonconformist molluscs:

"...FnCs are tiny (most are less than ½"), but there's a lot going on in that little bitty space. They are beige, smooth, thin-shelled creatures. They have a foot—a muscular appendage that they extend and contract in order to move ahead and down—but no head, and they have muscles that open and close their shell. They use a two-siphon system for feeding, breathing, and eliminating. Two, two-lobed gills are fastened on their ventral (lower) side... and they have sense organs that help them maintain equilibrium. Where the .... mantle sticks out past the shell edges, it can sense touch and light, and the FnC steers away from both.

FnCs are filter-feeders, taking in oxygen and very small pieces of organic matter—mini-plankton and tiny pieces of leaves that were broken down by other leaf-feeders—through one siphon and releasing wastes and indigestibles through the other. FnCs are food for fish, crayfish, aquatic amphibians, waterfowl and shore birds.

Their life span is a year or two. They are slightly more tolerant of pollution than other clams, and like other Mollusks, FnCs like water that is calcium-rich, the better to build shells with. They survive the winter cold and the seasonal drying of temporary ponds by retreating as deep as 8" (16+ times their body length) into the muck. If you happen to be pawing through the dead leaves in a dry depression in the woods in fall, the shells of dead FnCs will tell you that you are in a vernal pond.

FnCs are hermaphroditic (to review—hermaphroditic means that they house both genders in the same cute little body). Not only are the Sphaeriidae hermaphroditic, they are also self-fertilizing (no lines; no waiting), so the genetic apple doesn't fall very far from the tree. It reminds the BugLady of a classic folk song called "I'm My Own Grandpa."

Young are produced all year long and the two to twenty offspring that result from each "reproductive event" are confined in the water tubes of the gills. The egg/offspring-swollen gill is called a marsupial sac or marsupium, and several cohorts may be present simultaneously. Mom/Dad provides nutrients that supplement the yolk material. Within each of those brood chambers, there are young of different sizes, because they don't all hatch at the same time within the marsupium.

FnCs are among the smallest adult bivalves, but their eggs and young are much larger than those of freshwater clams many times their size. A young FnC may be one-quarter to one-third the size of the adult size...! If they do complete their development, juvenile FnCs are released into the water as fully-formed mini-clams (other freshwater clams release young in a temporarily-parasitic larval stage)..."

Fascinating! But HOW did these clams make it up the side of a mountain range????

"The concept of a barely-half-inch wingless, aquatic critter starting out in mid-country and taking over America (and the world) is fairly astonishing, no matter how much geologic time you give it, but it turns out that FnCs "think outside the pond." They attach to water plants as tiny juveniles, and the water plants attach to the feet of water birds, and water birds DO have wings. Sometimes the clam-ettes clamp directly onto feathers, amphibians, or mobile aquatic insects (clam and clamp both derive from Old English "clamm," "to bond or fetter"). In addition, some species of FnC are ingested by ducks but not digested, and they may be regurgitated alive at some distance from home."

We know much about fingernail clams, but enormous riddles persist, especially regarding their almost inconceivable ability to travel. In North America, the USGS fact sheet claims only a coastal and Great Lakes distribution, but they are reported all over Kentucky and New England, and are significant in eastern Canada (Leung, 2015). In New England, they occur in large numbers in vernal (seasonal) woodland pools (see Susan Shea's article "Clams in the Woods"); Ms. Shea suggests that

they hitch rides on waterfowl, amphibians, mink, or even large insects. When these shallow woodland pools dry up during the summer, the clams burrow into the mud (Abugattas, 2015). Once transported to a new pond, their ability to self-fertilize permits a single tiny clam to populate an entire pool by itself. Golidad Farms, a Texas tropical fish hatchery, reports them suddenly proliferating in their hatchery vats. Elsewhere in the world, the National Biodiversity Network's map shows them distributed across the British Isles, including offshore islands. Landcare Research lists them as a species in New Zealand.

Despite the obvious fact that these tiny creatures have spread themselves across much of the world, most of what is said about fingernail clams' ability to travel seems to be based on conjecture, with no published images or documentation of them actually accomplishing these epic journeys. However, I was fortunate - one day a tiny amphipod swam through a specimen with a minute, 2 mm clam clamped onto one leg. Although this unlikely pair disappeared into the weeds before I could grab my camera, clearly these tiny acrobatic molluscs CAN travel in this manner. Other mysteries persist: it is easy to imagine how a clam might reflexively clamp its shell onto a weed, foot, or mink hair, but if the clam is to climb a slippery stem or the smooth glass of an aquarium, the foot must attach to these surfaces. How do they do it? Is the foot inherently sticky, or does the clam use the suction of the siphon?

Next time you pick up your pickle jar of mud and slime to look for Paramecia and Vorticella, pause and look for the slightly bigger critters. You may find them just as fascinating as what's under your microscope!

Historical Note:
For a fascinating glimpse of images of the construction of the 1929 Cascade Tunnel, and life in the little town of Scenic, browse the University of Washington Libraries' image collection for this site.

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