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Vent Worms Podcast and Scientist Interview

Riftia pachyptila

Host Ari Daniel Shapiro dives deep to discover a white worm as tall as your refrigerator that breathes through bright red feathery “lips.” This isn’t a creature from outer space. Meet *Riftia*, a tube worm that lives in deep-sea vents, and learn the surprising lessons this denizen of the abyss is teaching scientists about life on Earth.

Transcript

Ari: For 30 years, scientists have traveled to the very bottom of the ocean thanks to Alvin, an underwater vehicle.

Cavanaugh: Yes, Alvin is, I always say it's the submarine, not the chipmunk.

Ari: Colleen Cavanaugh is a biology professor at Harvard University, and she's spied on the seafloor from inside Alvin a number of times.

Cavanaugh: It's a so-called manned, which I call it a “womanned” submersible. It has a pilot and carries two scientific observers.

Ari: And it's tiny. The space where you actually sit, there's barely enough room to stretch your arms out to the sides. Tiny portholes let you look out. Not that there's that much to see.

Cavanaugh: Most of the deep sea just looks like sediment or black rock, you know, very, very few organisms.

Ari: But the story's different at places called hydrothermal vents. Basically, they're hot springs on the ocean floor. It's where two plates at the bottom of the ocean are being pushed apart as magma comes up. The magma's hot and acidic and has all kinds of chemicals in it like sulfur. And, says Cavanaugh, it's stunning when you're in Alvin and you approach a hydrothermal vent.

Cavanaugh: And you start way out, you start to see a crab here, and a crab there, and then, you know, maybe a fish goes by. And as you get closer and closer, there is more and more life. When you actually come up to them, it's an oasis. It's biomass that rivals a rainforest.

Ari: When these hydrothermal vents were discovered, they completely blew open the view of the deep ocean as an empty, lifeless desert. There was tons of life down there. Thickets of it. One of the creatures in this deep-sea rainforest is something called *Riftia*.

Cavanaugh: A *Riftia* is... well, they're so called giant tubeworms. They get up to 2 meters in length.

Ari: So imagine a long, white tube as tall as your refrigerator and as wide as a roll of quarters.

Cavanaugh: And the part that you see that's so astonishing is that they have these brilliant red plumes.

Ari: Like a pair of wide, ruby lips at the end of this white tube.

Cavanaugh: And this is effectively their gill, or their lung. It's the equivalent of our lung. The red that you see is actually due to hemoglobin. So just like we have hemoglobin that carries our oxygen, so do these worms. And this hemoglobin is unique in that it binds both oxygen, like us, but it also binds sulfide in a separate spot.

Ari: Strange enough yet? A worm at the bottom of the ocean as tall as your fridge that's got hemoglobin just like we do. And here's the really weird part about *Riftia*.

Cavanaugh: As an adult, it's completely mouthless and gutless.

Ari: That's right. *Riftia* worms have no mouth, no anus, no gut, and they stay put. So how do these things eat? No one knew. Until Cavanaugh had a kind of epiphany almost 30 years ago.

Cavanaugh: It was a moment, but it took a while to prove.

Ari: She was sitting through this talk during graduate school that wasn't what you'd call riveting...

Cavanaugh: So unbelievably, I was still awake, when I jumped up and said, it's perfectly clear. They're effectively like plants but using sulfur instead of sunlight. I mean, they must have sulfur-oxidizing chemosynthetic bacteria.

Ari: Cavanaugh's revolutionary idea was that a special kind of bacteria lives inside the *Riftia* worms and actually feeds them. The bacteria use the energy from all the sulfur billowing about the hydrothermal vents to make food – carbohydrates and proteins – for themselves and for

the worms. But this is a two way street. The *Riftia* use their hemoglobin to bring the sulfur right to the bacteria's doorstep. And the worms also give the bacteria a place to live.

Cavanaugh: Yes, so, they're providing a home, a, in quotes, a warm, cozy environment. Neither the animals nor the bacteria could survive without the other.

Ari: And it turns out that this discovery opened scientists' eyes to the fact that this kind of symbiosis, the kind involving inorganic chemicals like sulfur, is happening everywhere. Not just at the deep sea vents. But also in shallow coastal places, on the tops of mountains, and maybe even on other planets. All these critters, helping each other make a go of it in the universe. And all we had to do was take a lesson from a worm at the bottom of the ocean.

Meet the Scientist

Meet Dr. Colleen Cavanaugh, the scientist featured in the *Riftia* (Vent Worms) podcast:



Where do you work?

Harvard University - Dept. of Organismic and Evolutionary Biology; summers - Woods Hole Oceanographic Institution.

What do you study?

Teaching and research on microbial diversity and symbiosis, lecturing (and preaching) to all about bacteria/archaea as the good guys (the vast majority) from biogeochemical cycles to human microbiome (vs "germs").

What are three titles you would give yourself?

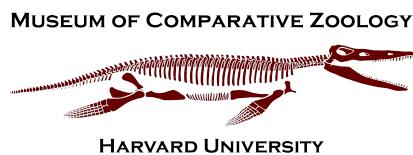
Microbial ecologist, "gleek", lovely wife and mom

What do you like to do when you are not working?

Hmmm....when you love what you do it's not work. In addition- fun with family, aerobics, walks with elder pup, AI enthusiast.

What do you like most about science?

Discovery, intuitive leaps, learning something new (typically many things) every day. Students!!



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