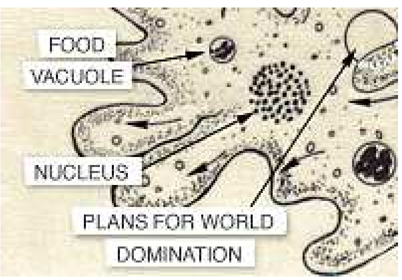

The Artful Amoeba

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The Artful Amoeba Home

Glass Sponges Poriferify — and Beautify — Impoverished Antarctic Neighborhood

By Jennifer Frazer | August 8, 2013 | 2

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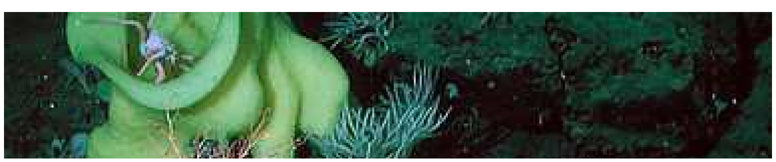

Glass sponges are taking over a newly sunlit strip of Antarctic marine real

Yellow Picasso glass sponges (Staurocalyptus sp.) at 1330 meters water depth on California's Davidson Seamount. Image by NOAA, Public Domain. Click image for source.

estate at a blistering clip, surprising biologists who had no idea they had it in them. And what's in them, it turns out, is also fairly astounding.

The story, as was widely reported last month, is this: Although more than 30% of the Antarctic continental shelf is permanently covered by floating ice shelves, they're eroding. The Larsen A Ice Shelf on the West Antarctic Peninsula collapsed in 1995 and Larsen B in 2002, likely due to climate change.

Before the collapse, creatures living below the icy roof had to obtain their food from whatever drifted in from afar, since the surface waters were never illuminated. During this time, the dominant large species on the seafloor was a stalked sea squirt or tunicate — a close relative of vertebrates (adults sedately filter seawater, but the larvae swim around and sport backbone-like notochords that make them suspiciously resemble tadpoles).

Then, the ice fell apart. A rover visited in 2007, five years after the Larsen B collapse. It visited again in 2011. And this is where the marine biologists' jaws hit the floor.

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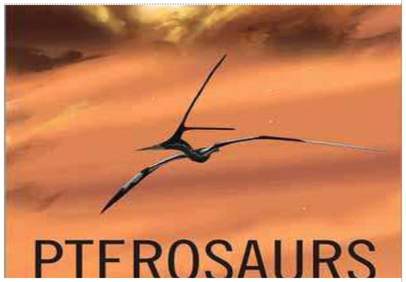

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Within the space of four years, glass sponges doubled in biomass, and in some size classes, tripled in abundance, according to the German-Swedish team of scientists who studied them, who published their findings in *Current Biology* July 22.

These are creatures in which scientists previously observed no visible growth over a decade in Antarctica's McMurdo Sound. Such sponges reach 6 feet in height (and in so doing are some of the largest sponges on Earth). Scientists had thought they represented the end product of a long line of succession that took decades to centuries to form — something like the giant sequoias of the benthic. Instead, they now seem to be growing like scrappy weeds. The team concluded that glass sponges may have a "boom and bust" life strategy in which they can grow quickly or go semi-dormant. They speculate that the joint windfall of food raining from the newly-lit waters above plus food from the seafloor that was somehow resuspended by the ice loss together fueled the boom.

Here are two photographs comparing representative 2007 and 2011 seabeds. The stalked, vaguely-suggestive tunicates are obvious in the first image. The red arrows indicate glass sponges.

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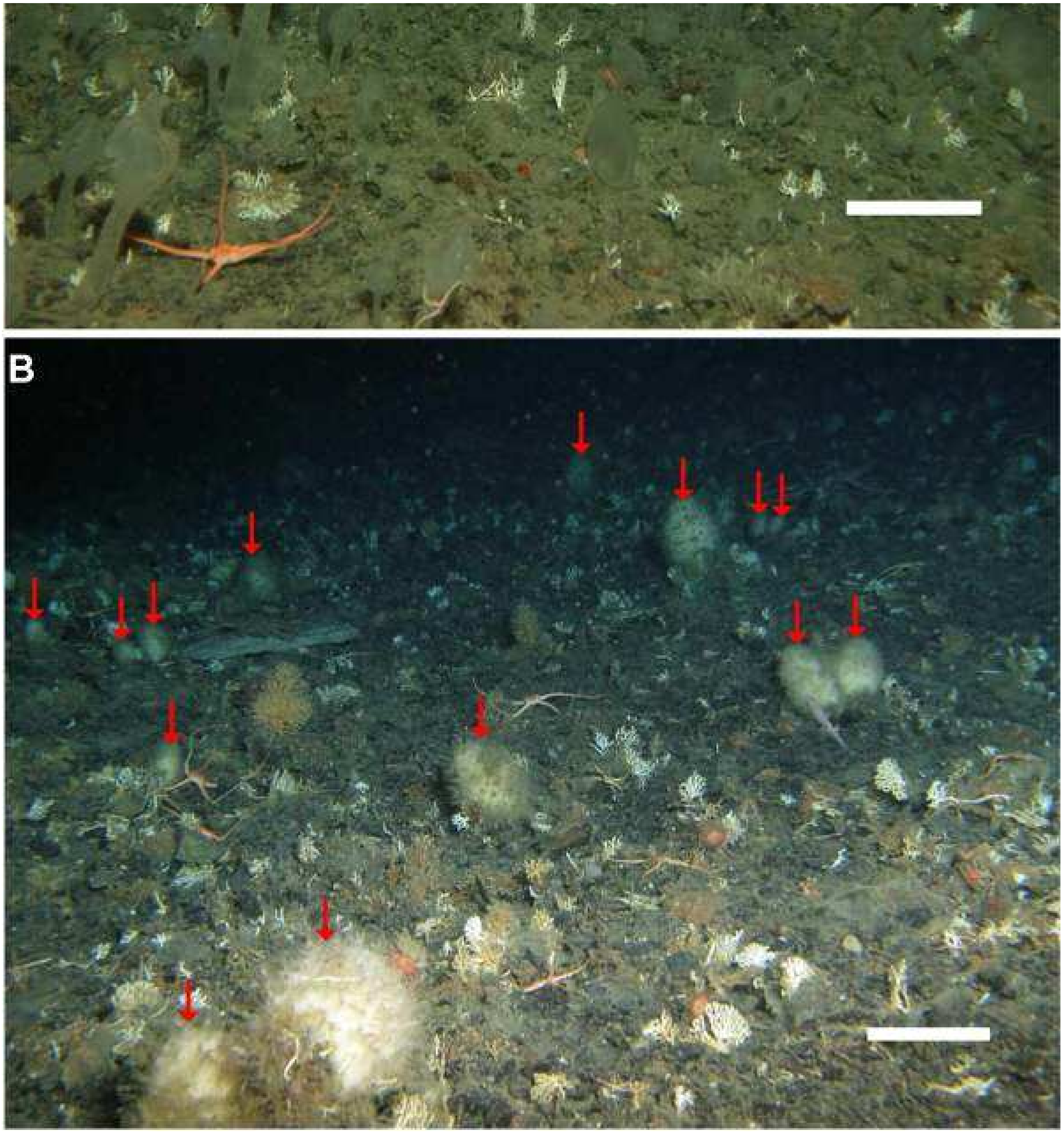

Fillenger et al, 2013. Click image for source.

Cue "The Jeffersons".

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The Sponge Life

What was omitted from most reports about this discovery is how deeply weird glass sponges are — even for sponges, which are already pretty weird in animal terms. Regular sponges — most members of the phylum Porifera — exist in a grey zone somewhere between a colony and an individual. They were likely among the first animals to evolve, and certainly among the first to split off the main Animal evolutionary trunk. As such, possess some bizarre behaviors by the rest of animals' standards.

For example, the most famous biology student sponge experiment is the one that involves mercilessly squeezing a sponge through a sieve. After you let your sponge extract sit for a while, the individual cells will begin busily assembling themselves back into a single organism. Trying this with most any other animal will yield profoundly different results.

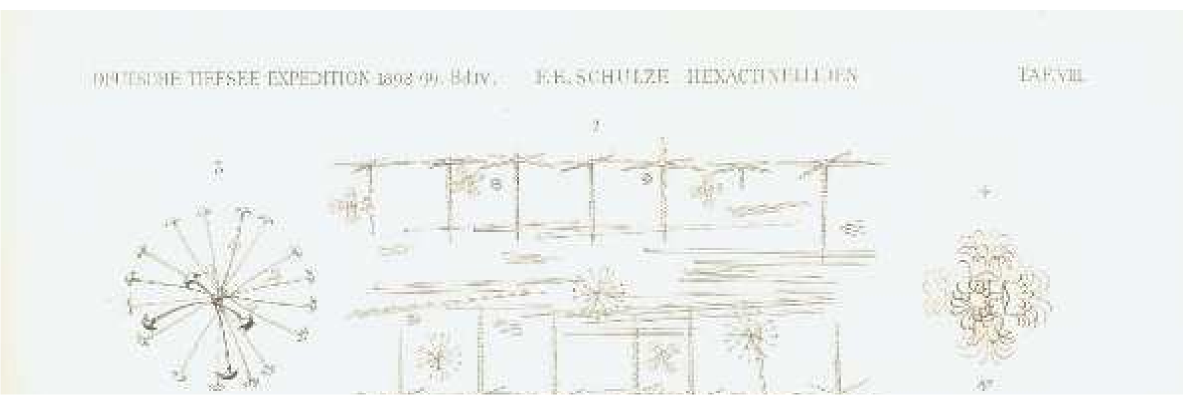
The cells inside "regular" sponges are not joined into true tissues (like muscle or nerve tissue), but they do specialize. There are cells that focus on transporting food, or defending against invaders, or beating flagella to move water and catch prey (mostly bacteria). Many sponges build pointy microscopic spicules made of protein, silica, or calcium carbonate that help support their bodies and defend against predators. Few organisms can tolerate a needle-spiked meal.

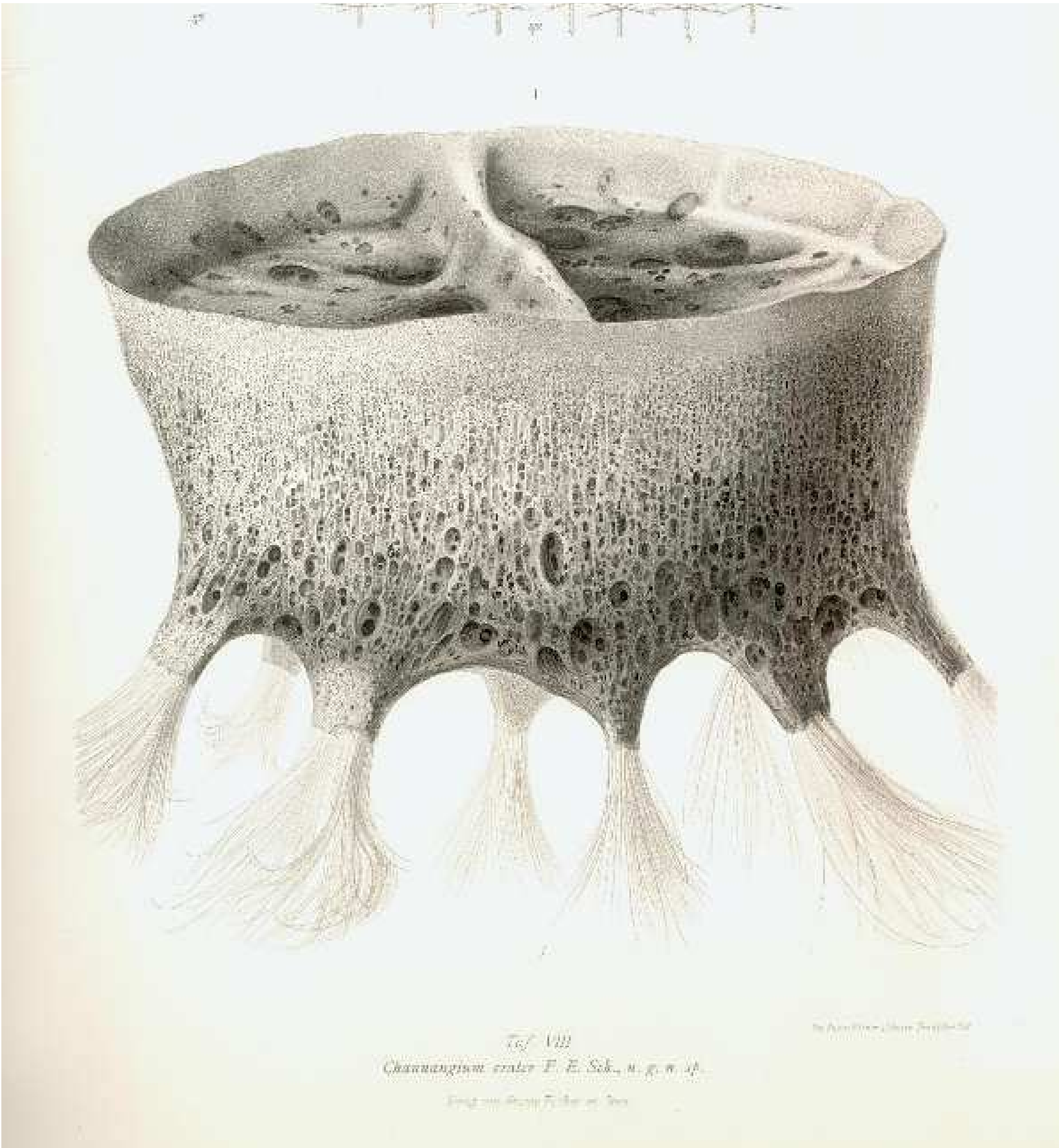
The Exotic Glass House and Its Peculiar Occupant

Glass sponges get their name because they too make spicules of silica which they join into lacy, elaborate, semi-geometrical glass skeletons. The spicules are often six-pointed (like a set of Cartesian XYZ axes) but can take on a variety of surprising shapes, as you'll see in a minute. The very first sponges may have been glass sponges, and even in their earliest pre-Cambrian and Paleozoic fossils we can see their amazing geometric beauty. For example, *Hydnoceras* fossils appear to be wearing plaid, but are actually composed of a fractal-like cross matrix. This particular architecture seems to have since been abandoned.

In modern glass sponges, many species also secrete anchoring spiculate "roots" resembling bundles of fiber-optic cable, or fasces of fiber glass. As you might guess from this setup, glass sponges seem to favor deep, quiet, seafloors made of soft sediment into which they plunge their anchoring roots. They are incredibly abundant in Antarctic waters and frequently seem to be the dominant form of life there.

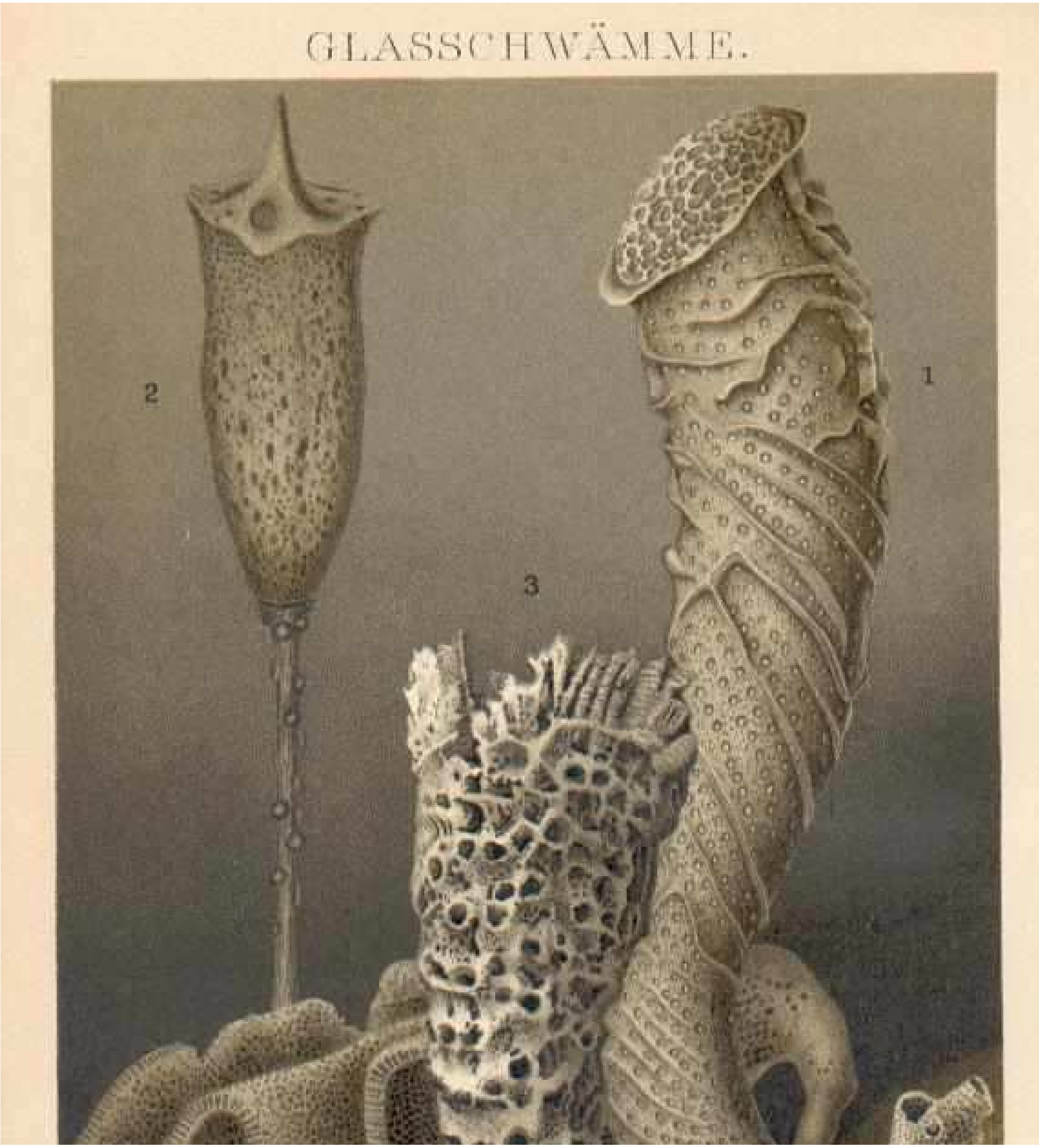
Let's take a look at a few of these features. Below you see a 1904 German engraving of the glass sponge *Chaunangium*. At the top are drawings of its six-pointed spicules. Sandwiched between them are many horizontal rod-shaped spicules, along with spicules of another type resembling fireworks enlarged at right and left. It's worth clicking on the image to view and magnify the original so you can see the spicules better. At the bottom is the organism itself, supported by those rooting bundles of silica.





"The glass sponge Chaunangium crater, captured on the Valdivia expedition in the years 1898-1899", By Franz Eilhard Schulze, 1904. In Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898/1899. Public Domain. Click image for source.

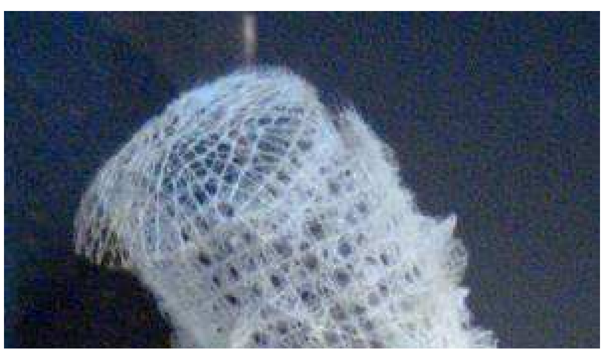
Here's another engraving by the same artist showing an assortment of species. The one labeled #1 is probably the most famous glass sponge, the Venus's Flower Basket, *Euplectella aspergillum*.

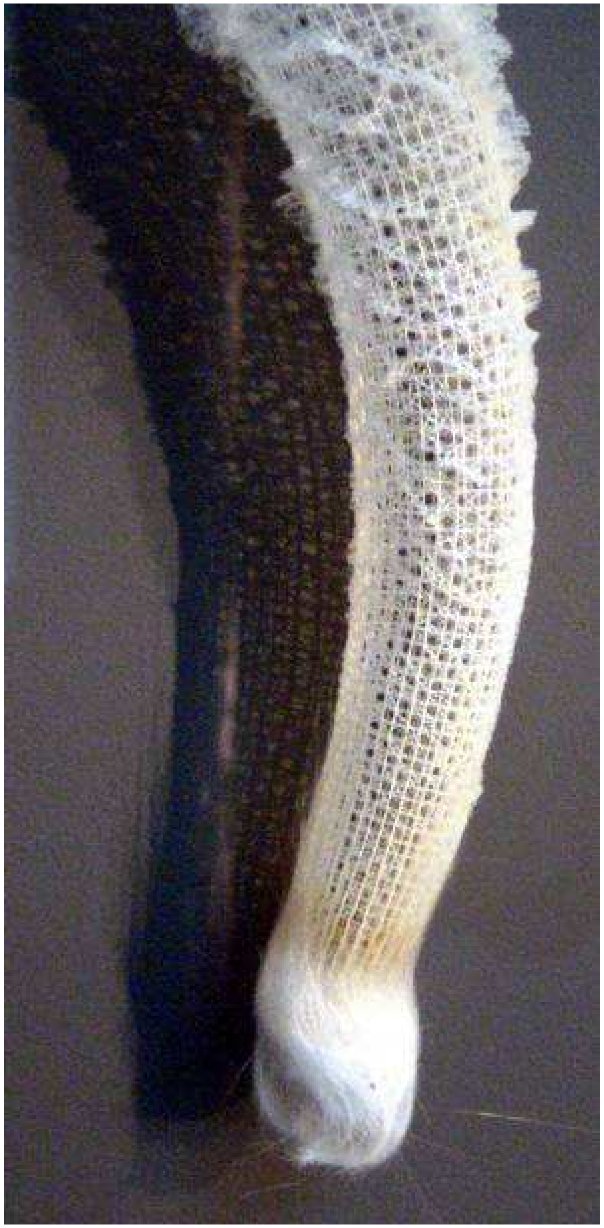


"Glass Sponges". Franz Eilhard Schulze, Public Domain. Click image for source.

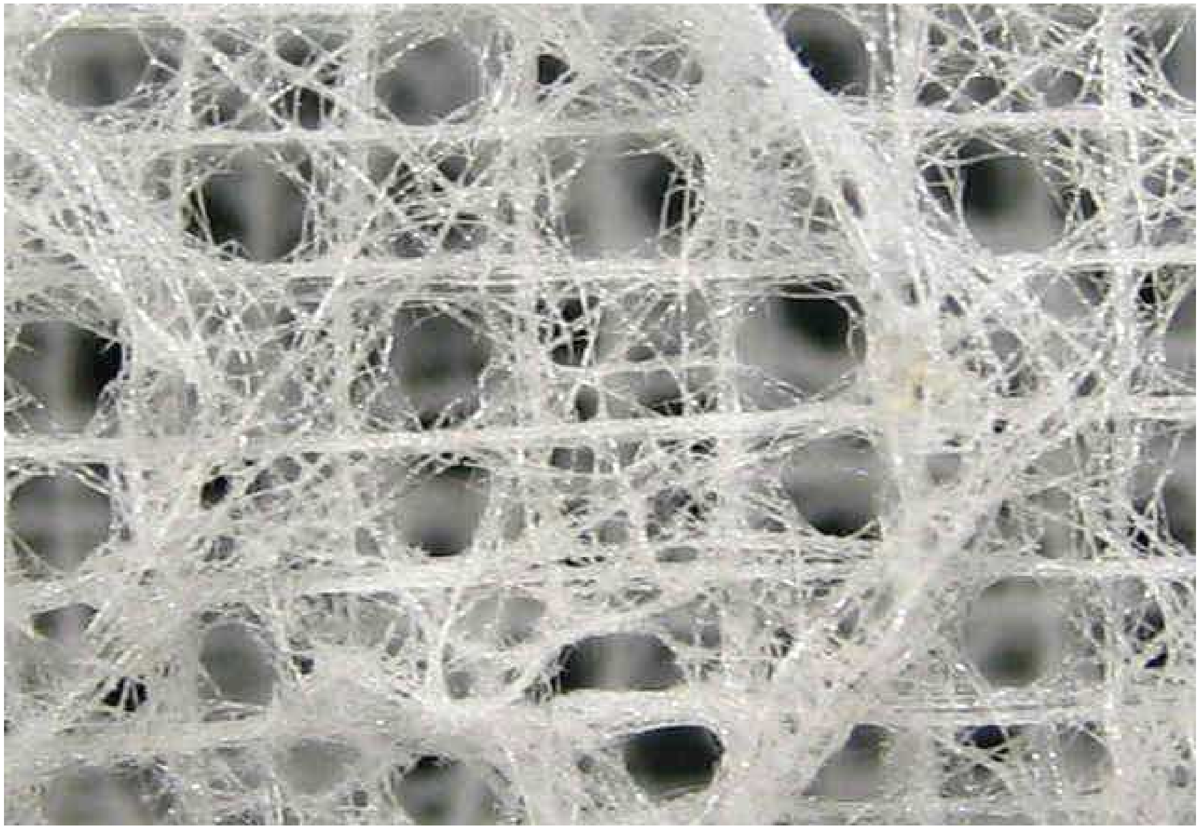
Here's a real-life preserved skeleton of #2 above, *Hyalonema* sp., taken by me during my first visit to the Natural History Museum in London this June. You can see how extensive the "root" system is.

Here's a closeup of a real skeleton of *Euplectella*, #1. Notice the spiculate root.



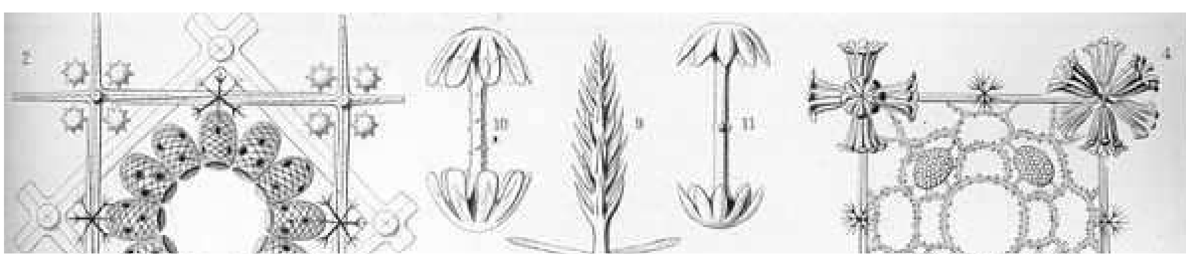


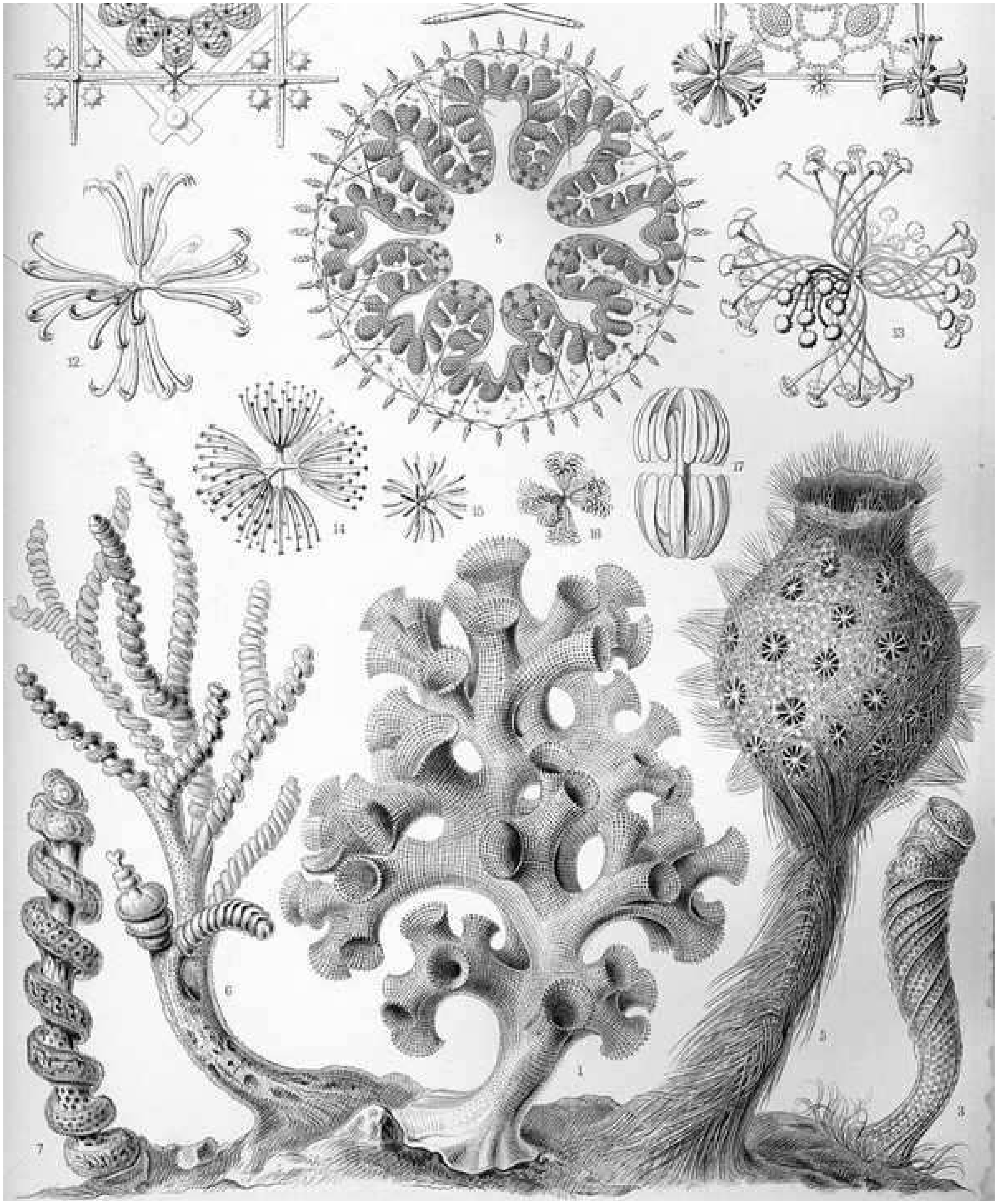
And here is its spiculate skeleton close up.



Creative Commons NEON_ja. Click image for license and source.

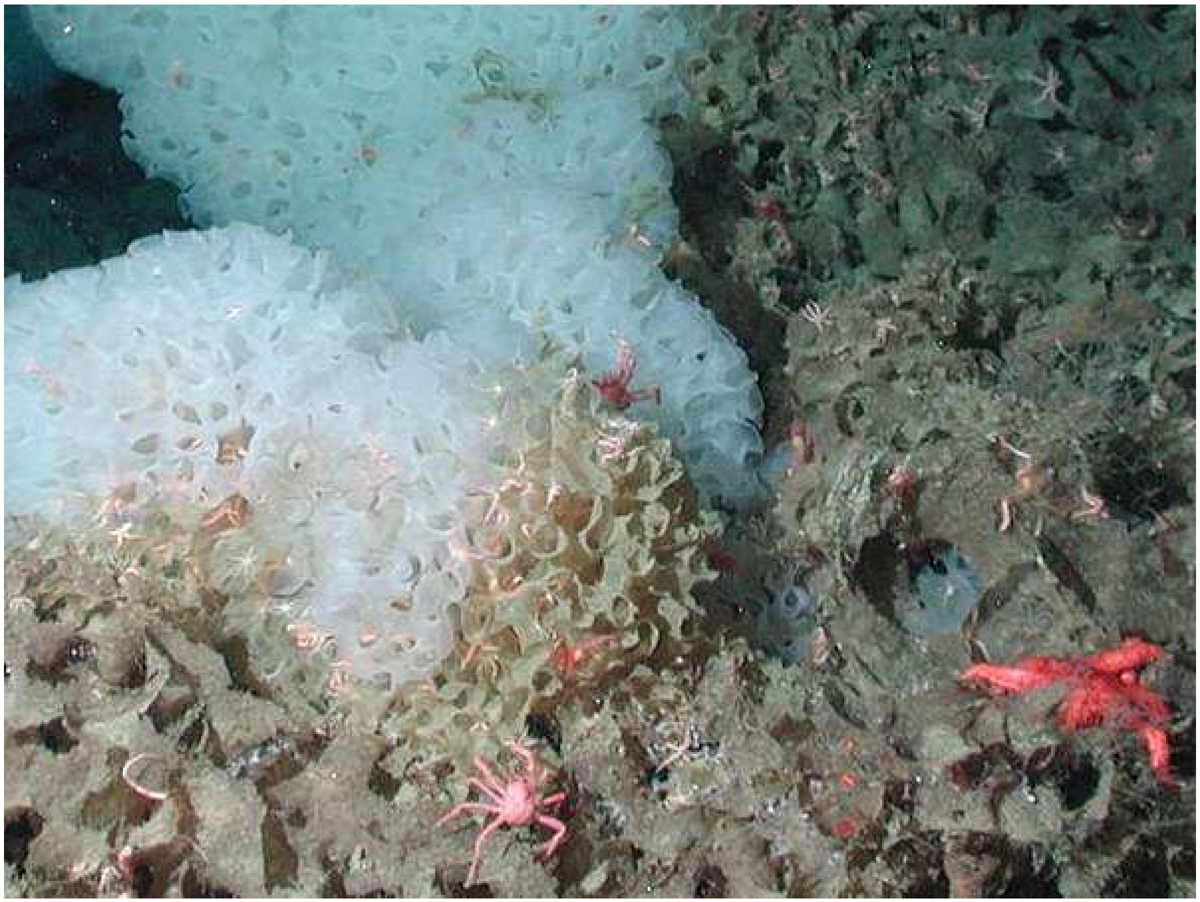
Here is German biologist Ernst Haeckel's take on the glass sponges. As with all Haeckel art, it's been slightly idealized and artificially posed, but the essence reflects reality. The circular image in the center depicts a glass sponge cross section. The rest of the top half shows various spicules. This one's probably also worth viewing up close.



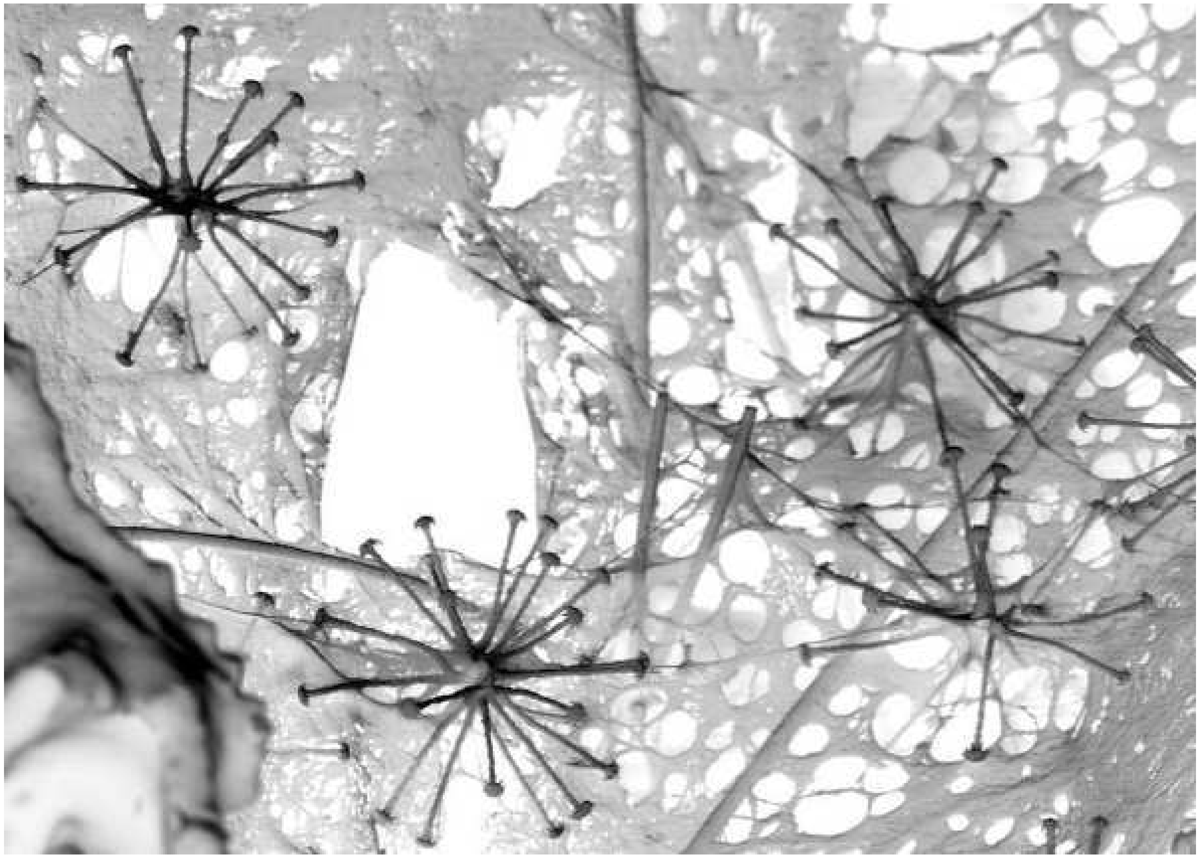


Heactinellidae, by Ernst Haeckel. Public Domain. Click image for source.

In the center bottom of Haeckel's image is #1, a species of *Farrea*. These sponges were only in the last few decades discovered to be reef-formers — a habit that scientists had thought glass sponges gave up back in the Cretaceous. Now we know that glass sponge reefs still exist in deep waters off the Pacific Northwest in Canada and the U.S. And here is one built of *Farrea*, captured by NOAA.



Finally, a here's photomicrograph of those crazy pyrotechnic glass sponge spicules. This one could be hung in an art gallery or the cover of one of those blank greeting cards that you never know how to use, I think.



Spicules in the tissue of a glass sponge, by Lamouroux. Public Domain. Click image for source.

Yet the glass houses and their strange building blocks are just the start of glass sponge weirdness. Their real twist on sponge biology is in their living arrangements. Instead of a federated colony-like organism of individual sibling cells, glass sponges are composed of a giant, filamentous bag of nuclei with a scattering of affiliated individual cells.

They begin life as swimming multicellular larvae made of individual cells as other sponges do. But at some point, those cells begin to fuse. If this is giving you flashbacks to the giant protists called Rhizarians or xenophyophores that were found living on the bottom of the Mariana Trench, that's for a good reason. It's a similar lifestyle that functions in a similar dark, still, nutrient-poor deep sea niche.

In glass sponges, one mass of nuclei seems to make up the inner lining of the sponge, while the other forms the exterior. Spanning these two layers are filaments of cytoplasm that connect the layers, in which food-harvesting chambers are suspended, according to Palaeos. This is what I have read, but the only image showing a glass sponge in cross section that I have been able to find is the one at the center of Haeckel's illustration above. It's hard for me to integrate that image with what I know.

This form of growth, in which many individual cells fuse to form a giant nucleus-filled bag has a name in biology: a syncitium (sin-city-um). Oddly enough, viruses like HIV and respiratory syncitial virus(RSV) provoke unsuspecting immune cells called T-cells to do the same thing in order to inactivate and kill them.

What advantage this lifestyle brings to glass sponges is harder to fathom. Whatever it is, it's a way of life that's been serving them well for over 500 million years, and seems to be conferring some new advantage in our planet's latest climate spasm. Indeed, the authors of the *Current Biology* study conclude by noting, "If the alarming rate of ice shelf disintegration continues, with increased primary production and reduced asteroid [sea star] predation in response to ocean acidification, glass sponges may find themselves on the winners' side of climate change …"

Whether they will continue to be winners as the Antarctic warms further and passes into a climate regime outside human experience — but not outside glass sponges' – is anyone's guess.

Reference

Fillinger L., Janussen D., Lundälv T. & Richter C. (2013). Rapid Glass Sponge Expansion after Climate-Induced Antarctic Ice Shelf Collapse, Current Biology, 23 (14) 1330-1334. DOI: 10.1016/j.cub.2013.05.051

About the Author: Jennifer Frazer is a AAAS Science Journalism Award-winning science writer. She has degrees in biology, plant pathology/mycology, and science writing, and has spent many happy hours studying life *in situ*.

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