

Human Nature at Sea

Stefan Helmreich

There is one knows not what sweet mystery about this sea, whose gently awful stirrings seem to speak of some hidden soul beneath.

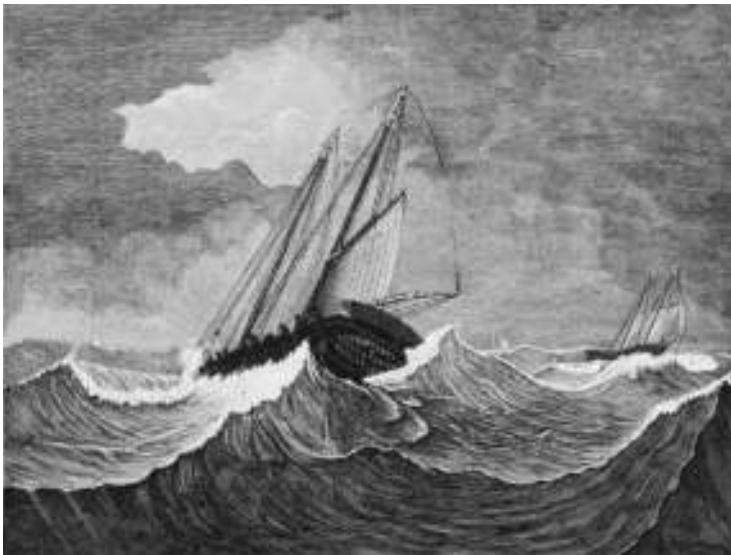
—Herman Melville, *Moby-Dick*

The Sea, a Substance Sublime and Strange

Nineteenth-century Americans and Europeans envisaged the ocean as a sublime space, at once frightening and inviting. Romantic poets such as Byron and Shelley celebrated the sea as a seductive substance

with which we humans might seek to merge, dissolving our bodies into the nourishing matrix of life itself. A kindred vision persists today, underwriting ecologically minded suggestions that we human beings tune more deeply into our environmentally embattled Earth. According to such views, humans might amplify our ecological consciousness by recognizing that an oceanic past swims through our most intimate substances: our blood, sweat, and tears.

Marine biologist and former chief scientist of the United States' National Oceanographic and Atmospheric Administration Sylvia Earle writes of the ocean in her 1995 book, *Sea Change: A Message of the Oceans*, "Our origins are there, reflected in the briny solution coursing through our veins" (15). Conservationist Carl Safina, in his elegiac *Song for a Blue Ocean* (1998), summons his readers to a numinous sense of themselves as nodes in a Neptunian network: "We are, in a sense, soft vessels of sea-



Georges Bank. Courtesy of National Ocean and Atmospheric Administration, National Marine Fisheries Service.

water. ... We are wrapped around an ocean within. You can test this simply enough: Taste your tears" (Safina 1998, 435; and see Calvino 1967). Icelandic singer Björk, singing as "Mother Oceania" in a work she composed for the 2004 Olympics, channels the voice of a maternal sea when she tells her listeners, "Your sweat is salty. I am why."

These pronouncements cast seawater as a shared substance that makes it possible to feel an embodied human kinship with the aqueous Earth. Environmentally concerned scientists hope that such kinship will lead humans to imagine themselves as linked to the planet both personally and evolutionarily. To plug into this one-step model of communion with the oceanic Earth, all that is required is a kind of meditative introspection into one's inner ocean.

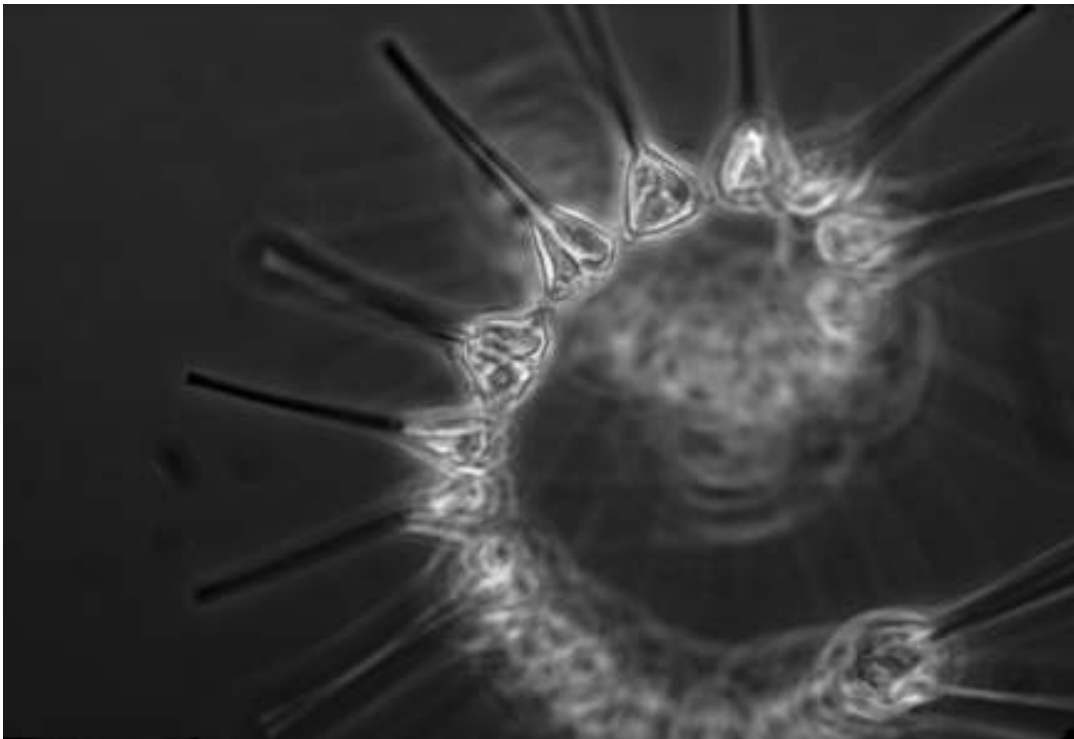
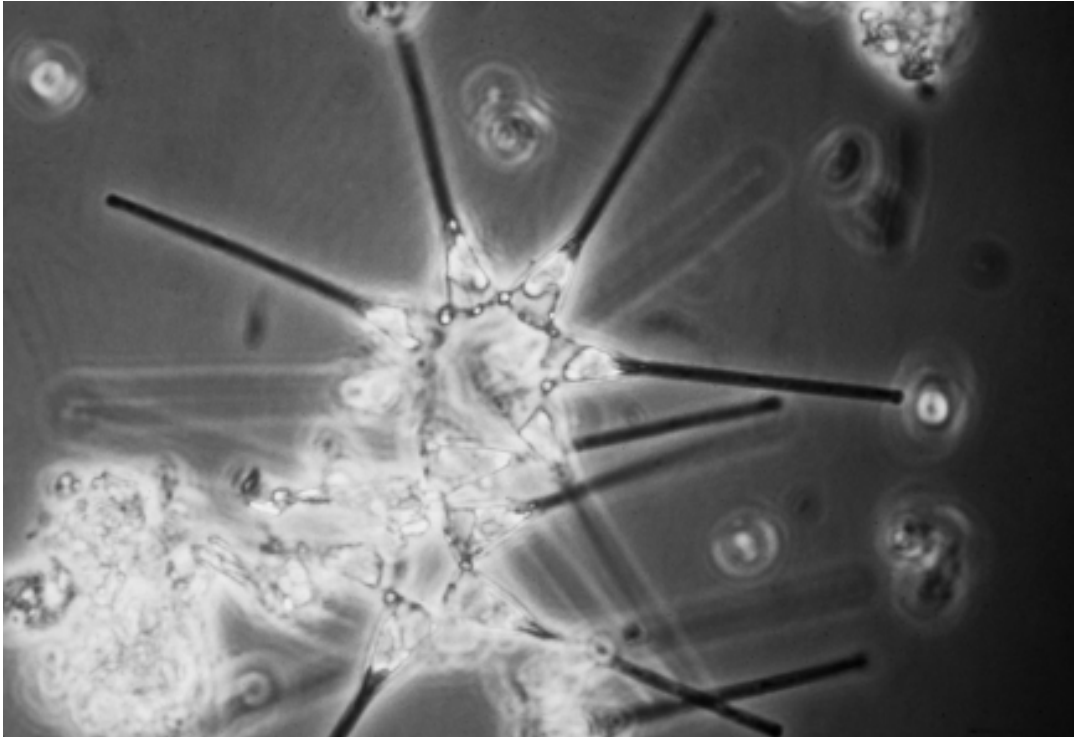
This way of thinking evokes sentiments not only of shared origins, but also of shared destiny, about the conjoined future of human and planetary life. A headline from *The Californian*, a Monterey newspaper, captured this sense of common fate, reporting on the United States' First National Ocean Conference in 1998. Placed above a photo of then Vice President Al Gore, a chief moderator of the Monterey-based discussion, the headline read, "Delegates agree: Sea is life." By "life," participants referred both to the ocean as a vital planetary fluid and as a symbol of life writ large; the sea, they observed, is the medium in which life on Earth originated and today constitutes the bulk of the biosphere. Then First Lady Hillary Clinton, speaking at this meeting, delivered a summary meant to ground a sense of stewardship in human individual experience: "Seventy-one percent of our planet is ocean,

and seventy-one percent of our body is salt water. ... There is this extraordinary connection between who we are as human beings and what happens in this magnificent body of water" (Quoted in United States Department of Commerce 1999:6; this analogy, while evocative, is uneven, since it compares surface area to volume.).

But all is not well in this world of watery touch and feel. These declarations also bespeak a contemporary, anxious humanity, worried about its continued existence in a global ecology under threat from overfishing, global warming, and oil spills—that is, by large-scale anthropogenic processes that may have cascading, fracturing, dissolving effects on our economies and ecologies, and that may endanger the very nature of what we have known as nature.

Marine Microbiology, or Seeing the Sea as a Microbial Soup and Worldwide Web of Genes

Contemporary transformations in oceanic and human natures have been my central anthropological interests in recent years. I have undertaken ethnographic research among marine biologists. In the first decade of the 2000s, I worked among life scientists who access and assess large-scale changes in the ocean by looking at the sea's smallest inhabitants: marine microbes. Such microbes are looped into massive planetary processes. To take just one example, the marine microbe *Prochlorococcus* accounts for 25 to 58 percent of chlorophyll production in the North Atlantic, which makes it hugely important for Earth's climate modulation.



Phytoplankton—the foundation of the oceanic food chain. Courtesy of National Ocean and Atmospheric Administration MESA Project.

The marine microbiologists with whom I have spent time have recently begun DNA sequencing to see their microbial subjects anew. In the process, they have started to see the ocean itself differently. Not only have they become increasingly committed to a view of the ocean as a kind of microbial soup, they have started to see this soup through the lens of the DNA sciences. If, once upon a time, marine microbiologists struggled against seasickness to isolate single cells in unstable Petri dishes on unstable boats, these days they work increasingly in terrestrial laboratories and on computers to characterize assemblages of genetic information in microbes floating about in the sea. They now see microbial communities as networks of genes. They hope to “shed light on the role of marine microbes by sequencing their DNA without first needing to isolate individual organisms” (Rusch, et al. 2007). To put this in today’s scientific language, it has now become possible to think of the genome (the full genetic content of a living thing) of an entire microbial community.

What scientists now think Earth’s ocean *is* has transformed.

The Dissolution of Human Nature

When marine microbiologists speak of the “ocean genome”—the map and sequence of the microbial inhabitants of Earth’s seas—links between humanity and the sea become imaginable in a genomic vein. It becomes possible to imagine elements of the human and the oceanic flowing into one another at a molecular scale. It allows sci-

entists newly to describe human bodies as porous—to ocean-borne viruses and bacteria, for example. It may become appropriate to think about the possibility that human nature, genetically understood, may be dissolving, a dissolution accomplished through the turbulent flowing together of human and oceanic biologies.

This change in seeing the biology of marine microbes correlates with new ways of understanding the biology of human beings, increasingly understood through DNA sequencing and technologies of genetic engineering. The sort of bioengineering that enables our understanding of DNA, however, is simultaneously changing many of the biological facts and processes we take for granted.

Some contemporary thinkers contend that manipulating the substance of human biology via genetic, pharmacological, and reproductive means may lead to “the dissolution of human nature” (Weiss 2005). In Western cultures, where biological nature has long been thought to provide a solid foundation for secular and scientific notions of human nature, such a change would be dramatic. But in the age of cloning, reproductive technology, and genetic engineering, “biology” is in fact morphing, and is no longer considered to be so determinate, so final in its form.

Might the “dissolution of human nature” have a family resemblance with the dissolution of unitary organisms and bounded species in marine microbiology? More, might seeing oceanic nature through the tools of the new genetic sciences offer new ways to think about the growing malleability of the concept of “nature” that has long

been supposed to “ground” human nature? When human and ocean nature are both subject to biotechnological manipulations, can they maintain their separateness?

How the Ocean Got Its Genome

The saltiness of ocean brine and human blood so frequently used to draw attention to a common aqueous heritage has been replaced symbolically by a genetic nature shared by bodies of water and the bodies of humans. MIT marine microbiologist Ed DeLong captured this trend well in a 2003 interview in the *New York Times*: “A milliliter of seawater, in a genetic sense, has more complexity than the human genome” (quoted in Pollack 2003, D1). In the view of DeLong and others in this enterprise, the microbial ocean can profitably be construed as a sea of genes. This is not just a technologically innovative genre of genomics; it represents a novel mode of parsing biology. This is a genomics beyond organisms.

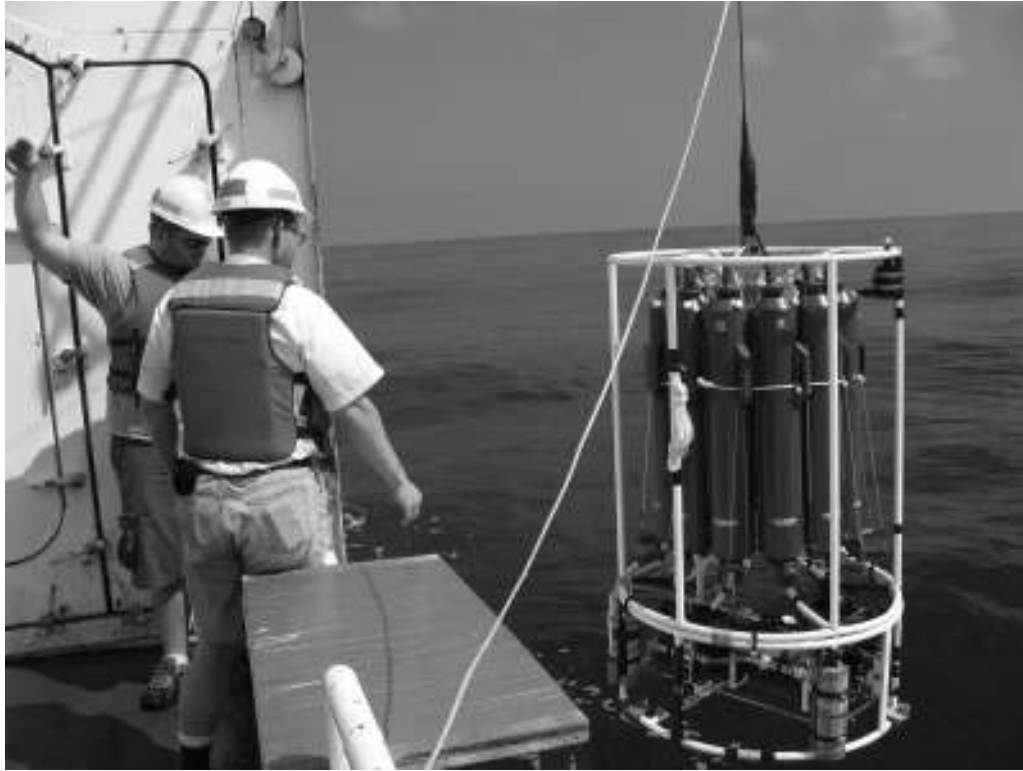
DeLong has introduced the notion of marine metagenomics to both popular audiences and scientific colleagues using an image of the whole Earth, seen from space, upon which he has juxtaposed Leonardo da Vinci’s *Vitruvian Man* (ca. 1485–1490), the perfectly proportioned figure proposed by the ancient Roman architect Vitruvius as a metric for the construction of temples, and resurrected in the 1990s as a symbol of the Human Genome Project (see Figure 1). DeLong employs the image to explicate how the genetic techniques aimed at decoding human biology have been employed to understand the genetic profiles of the microbes



Figure 1. DeLong’s PowerPointing Vitruvian Man. “Earth: The Blue Marble” image courtesy of NASA, created by Reto Stockli with Alan Nelson, under Fritz Hasler, for NASA’s Visible Earth Project. Vitruvian Man photo by Luc Viatour, reproduced under GNU Free Documentation Licence. Composite image, after DeLong, by Michael Rossi.

that fill Earth’s oceans; he argues that the tools of the Human Genome Project can be extended to what he calls “this other beast, our living planet.” Medieval and contemporary symbolisms are connected through the imagery of Renaissance humanism and early modern science.

J. Craig Venter, who is noted (and, in some quarters, reviled) for his biotech company’s sequencing of the human genome in 2000, has recently completed his own environmental marine metagenomic project. Beginning in 2004, he circumnavigated the globe in his private yacht, the *Sorcerer II*, collecting microbes and sending them back to his Institute in Maryland for sequencing. Venter has taken environmental metagenomics to one logical conclusion, conjuring visions of the ocean itself as possessed of its own genome. Venter claimed, when he set



Bringing up water from the Sargasso Sea to sample marine microbes. Photo by author.

out, to be engaged in the “Sequencing of the Sargasso Sea” (Venter et al. 2004), promising to deliver a genome corresponding to this body of water. *WIRED* magazine summarized the aim of his “Ocean Microbial Genome Survey” this way: “to sequence the genome of Mother Earth” (Shreeve 2004, 108).

To paraphrase Rudyard Kipling, How did the ocean get its genome? How did scientists come to think of the ocean in a genetic register? To begin, the ocean was granted a *body*, an image with moorings in the early modern science of Leonardo da Vinci, who wrote, “As man has within him a pool of blood wherein the lungs as he breathes expand and contract, so the body of the earth

has its ocean, which also rises and falls every six hours with the breathing of the world” (Quoted in Ball 2001, 22).

A more recent address for the sea’s body manifests with turn of-the-last-century German oceanographer Victor Hansen, who spoke of phytoplankton as the “blood of the sea” (Mills 1989, 19). Today the ocean’s body is read from what microbiologist Jed Furman (2003) calls “genome sequences from the sea.” Because the sea is a *body of water*, it is now imagined to embody the literal “gene pool.” The ocean’s body becomes identical to the genomic properties of its microbial population. When bits of the sea’s pool of genes are mapped and uploaded into databases, the gene sequence



A freezer full of marine microbial DNA. Photo by author.

stands in for the body of the ocean just as the human genome sometimes stands in for the human body. The sequence becomes the territory. If human nature is now no longer only written in the ink of blood, sweat, and tears, but now also includes genes as a key substance, it may be no surprise that the

ocean now has a genome of its own.

Marine Microbial Molecular Biopolitics

A 2005 study of cyanobacteria collections in Hawaii, Sweden, and Scotland suggested that some marine environments contain neurotoxic bacteria that might be linked (through drinking water and food chains) to incidences of Alzheimer's disease (Cox et al. 2005). Flowing plankton blooms, nourished by noxious effluent from the land, can channel compounds unfamiliar to humans into our nervous systems, accomplishing a sort of science-fiction alien abduction—complete with memory erasure—through everyday drinking, bathing, and swimming. The high volume of sewage that humans put into the ocean and the fact that this waste can be taken up speedily as nutrition by microorganisms—which do not have to spend as much time building their bodies as, say, tuna

or whales—is a likely cause of many microbial population blooms. In the Gulf of Mexico, what we might call the flushing of the American toilet down the Mississippi River has led to whole swaths of sea being named “dead zones” where algal growth blocks out light from reaching regions below and oxygen is sucked out of the seawater, suffocating shrimp, seastars, and other denizens of the

deep (compare Schrader 2010). (As this piece goes to press, the 2010 Gulf oil spill has generated a set of further insults to this ecology. See Broad 2010)). In the Northern Adriatic, supernutritification has produced a massive microorganismic community that depletes phosphorous from the water and creates what is termed in scientific language a “mucilage community”—a formation that Scripps paleontologist Jeremy Jackson (2004) has compared to a “giant piece of snot.”

Human biocultural practices flow into the putatively “natural” zone of the ocean, suggesting that this molecular biopolitics (Rose 2007) is connected to, and sometimes enabled by, macroscale cultural processes (e.g., farming, sewage treatment) (see also Paxson 2008 on “microbiopolitics”). In these marine microbial molecular biopolitics, the ocean is no longer a zone of the past, the place from which our ancestors came. It is part of our bodies’ present, too. Our bodies are no longer merely impressionistically imagined mirrors of a macrocosm, but are just one site among many where micro and macroscales are mixed together, with real corporeal effects.

Oceanic associations with deep origins are still occasionally activated in discussions of these recombinations of nature and culture. Jeremy Jackson warns that such dynamics are making Earth’s oceans *evolve in reverse*. According an article in *The Los Angeles Times*,

In many places—the atolls of the Pacific, the shrimp beds of the Eastern Seaboard, the fiords of Norway—some of the most advanced forms of ocean life are struggling to survive while the most primitive are

thriving and spreading. Fish, corals and marine mammals are dying while algae, bacteria and jellyfish are growing unchecked. Where this pattern is most pronounced, scientists evoke a scenario of *evolution running in reverse*, returning to the primeval seas of hundreds of millions of years ago. Jeremy B.C. Jackson, a marine ecologist and paleontologist at the Scripps Institution of Oceanography in La Jolla, says we are witnessing “the rise of slime” (Weiss 2006, emphasis added).

In this way of putting things, human culture makes the world of nonhuman nature flow backward in time. When oceanic nature begins to mirror the worst aspects of human culture, it also becomes contaminated, inverting the positive valence that such figures as Earle, Safina, Clinton, and Björk attach to human-ocean similarities. This is another kind of return to origins, but to a primal scene unfriendly to humans, a world of sewage, snot, and slime.

Slimy Kinship

We do not imagine sewage, snot, and slime as kinship substances in the way that we do blood. We have traveled far from the briny blood that links us to the sea. But I want to take these icky things seriously as kinship substances—and without assuming that they are in any way “primitive.”

Genomics helps make visible these substances that link humans to the sea. Taking up the idea that gene flow can produce new kinds of connections, I want to think of our kinship with the sea as about our biological,



A ship's laboratory for sampling marine microbes. Photo by author.

often biogenetically mediated, links to its snotty sliminess. Talk of genes, which often emphasizes the *exclusion* of cross-species connections (e.g., we can't interbreed with chimps or dandelions), can also open new paths of relation between divergent creatures. I like this idea of kinship because, by deploying one of the oldest tricks in the kinship book—the revelation of hidden relationships through following biotic substance to unexpected origins—we can think newly across “natures,” human and otherwise.

In the time of algal blooms, mucilage communities, and marine viruses, a sort of abject Other joins the sublime sea: slime. We are related to slime, which flows forward and backward from both our bodies and body politics.

That slime shows up in Venter's samples. His earliest seawater samples from Canada's Halifax Bay, where he began his circumnavigation of the globe, yielded a number of bacterial signatures characteristic of microorganisms that thrive in sewage. Environmental marine metagenomics thus tracks mixes of nature and culture, even of living and dead (compare Sommerlund 2006).

Ecce Homo microbis

If Earth's ocean has a genome, a genome that is equal to the metagenome of its microbial life, it hasn't taken long for scientists to apply this latest micro-macrocosmic thinking back to human bodies. Human

bodies can now be reenvisioned as bacterial ecologies, as themselves hosts of metagenomes. “Our” bodies are not only our own, but also belong to microbes, for whom they are encompassing environments. As microbiologist Jo Handelsman recently told the Public Radio International program, “Living on Earth,” “We have ten times more bacterial cells in our bodies than human cells, so we’re 90 percent bacteria.”

What does such a statement mean? What does it suggest about “human nature”? In some ways, being 90 percent microbial sounds similar to the our-bodies-are-70-percent-seawater factoid (it also recalls the similarly fast-and-loose factoid that has humans as 98% chimpanzee [see Marks 2002]). Our “ocean within” is no longer briny, but bacterial, microbial. And, indeed, some portion of “the” human genome itself is now believed to be full of inheritances from still other microscopic agents—viruses—that infected earlier human populations. There is relic virus DNA in our genes. If one wanted to put it colorfully, the genetic code—what human genome scientist Francis Collins, among others, has called “the book of life”—is written in part by agents of death. Life and death, sublime and slime, self and other, commingle in our bodies (see MacPhail 2004). Think about it this way: *any genomics is already metagenomics*.

But there is also something distinct in the “we are 90 percent microbial” idea, something less amniotically motherly than the 70-percent seawater image. Once upon a time, the “human,” plunged into the sea—as blood, sweat, tears, milk—was baptized into communion with the planet. But plunged into the sea *as a swirl of microbial*

genes, something different happens, something more unsettling. As a recent American public television special has it, microbes are “intimate strangers,” entangled contemporaries rather than echoes of a left-behind origin.

The links between the scale of human bodies and planetary ecologies become much more tangled, spatially and temporally. The bacteria that inhabit our bodies do not simply *mirror* the bacteria that inhabit the sea—as with the brine in our blood. This is not human nature reflecting ocean nature. It is an entanglement of natures, an entanglement that works, perhaps, though an enmeshing of two genres of “culture,” human and microbial.

At the end of *The Order of Things*, Michel Foucault suggested that “man” may someday “be erased, like a face drawn in sand at the edge of the sea” (1966, 387). But that sea—moving now from figurative to material—imagined in a molecular, microbial, genomic idiom, might not usher in the “dissolution of human nature.” Rather, it may make manifest the possibility that human nature is made not by Mother Nature, but, instead, by *other natures*—the natures of ever transforming and recombining biological things that, in saturating our bodies, leave without final foundation the very substances upon which our lives depend.

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Stefan Helmreich on the Alvin, June 1, 2004. Photo taken by one of the other divers on the Woods Hole Oceanographic Institute expedition.

Stefan Helmreich is an associate professor of anthropology at MIT. To learn more about his fieldwork among marine biologists, read *Alien Ocean: Anthropological Voyages in Microbial Seas* (University of California Press, 2009). The book narrates the research that Helmreich conducted alongside scientists in labs and at sea—in sites ranging from Monterey Bay, to Hawaii, to the Woods Hole Oceanographic Institution, to the Bermuda Triangle, to the undersea volcanoes of the Juan de Fuca Ridge, which he was able to visit in the 3-person submersible Alvin.