The Marvelous Clouds

Toward a Philosophy of Elemental Media

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In memory of

John M. Peters, MD (1935–2010),

and

Gudrun "Goodie" J. Paulsen (1915–2010),

lord and lady of infrastructure

"By small and simple means are great things brought to pass."
—Alma 37:6

"The mid-world is best."
—Ralph Waldo Emerson

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Of Cetaceans and Ships; or, The Moorings of Our Being

> "L'imagination . . . se lassera plutôt de concevoir que la nature de fournir." (The imagination runs dry sooner than nature does.)
> —Pascal, *Pensées*

Is the Sea a Medium?

To understand media, we should start not on land but at sea. The sea has long seemed the place par excellence where history ends and the wild begins: the abyss, a vast deep and dark mystery, unrecorded, unknown, unmapped. Melville called the sea "Inviolate Nature primeval." It has long been a profoundly unnatural environment for humans in both life and in thought. Seventy-one percent of the earth's surface has been a sublime, uncanny place without limits and beyond understanding, the ultimate wasteland. The ocean was once roiling with dragons, Leviathans, and pirates—a merciless mix of fate, wind, and weather that imperiled anyone brave or foolish enough to risk their life on ship. It is still a very dangerous place, a kind of planetary waste dump and graveyard for many forms of life, including hapless immigrants. Only recently have humans dipped much below its surface, with depth exploration historically having been limited to the shoreline. Both Babylonian and Hebrew origin myths describe creation as the conquest of chaotic uncreated waters (*tiamat*, *tehom*). The Book of Revelation, at the opposite end of the Bible from Genesis, seals this conquest by announcing a new heaven and earth

in which the sea is no more, abolished as if in a final act of spite (Revelations 21:1). The sea is a particularly apt place for mythmaking. Humans at sea are out of place, and transgress the bounds of their natural needs and habitat. Only a god could walk on water—that is, treat it as a natural habitat for bipedal beings.[1]

In one sense, then, the ocean is the primordial medium-free zone, immune to all human attempts at fabrication. In another, however, the ocean is the medium of all media, the fountain from which all life on earth emerged. Life in all its varieties pays homage to the sea in its structure and function. In an ancient analogy, the blood and lymph of terrestrial animals are internal oceans and rivers that we carry beneath our skins. The idea that blood preserves the chemistry of ancient oceans seems to have started with the the early twentieth-century French biologist René Quinton, and even made it into a speech by John F. Kennedy.[2] As Vilém Flusser and Louis Bec quip, "Life can be regarded as drops of specialized seawater."[3] Our brains float in cerebrospinal fluid, nourished and sustained against gravity, and mammal embryos grow in the oceanic environment of the amniotic sac. Many organisms, of course, have never left the ocean, which continues to bubble with viruses and plant life, plankton, crustaceans, mollusks, fish, and mammals, though a vast amount of the earth's biomass, the bulk of it plants, is now terrestrial thanks to the success of the life-forms that ventured from sea onto land. (It is a widely noted fact of ecology that populations flourish in adopted habitats.) From terrestrial animal life-forms emerged reptiles, birds, and

1. See Wolf Kittler, "Thallata Thallata: Stéphane Mallarmé: *Brise marine*, Übersetzung und Kommentar," *FAKtisch: Festschrift für Friedrich Kittler zum 60. Geburtstag*, ed. Peter Berz, Annette Bitsch, and Bernhard Siegert (Munich: Fink, 2003), 245–52; Hans Blumenberg, *Shipwreck with Spectator*, trans. Steven Rendall (Cambridge, MA: MIT Press, 1997), 28–29; and Bernhard Siegert, "Kapitel 55: Of the Monstrous Pictures of Whales," *Neue Rundschau* 124 (2014): 223–33.

2. "All of us have in our veins the exact same percentage of salt in our blood that exists in the ocean, and therefore, we have salt in our blood, in our sweat, in our tears. We are tied to the ocean. And when we go back to the sea—whether it is to sail or to watch it—we are going back whence we came." John F. Kennedy, 14 September 1962, Newport, Rhode Island. The history of salinity, alas, is much more full of gaps than this. The sea today is about 3 percent salt, our blood about 1 percent. Perhaps our ancestors emerged in estuaries, where fresh and salt water blend.

3. Vilém Flusser and Louis Bec, *Vampyroteuthis Infernalis*, trans. Valentine A. Pakis (1987; Minneapolis: University of Minnesota Press, 2012), 32.

eventually mammals, the last being an enormous variety of (mostly) gregarious, warm-blooded, hairy animals that suckle their young. All three of them remain water-based. If this all-pervasive oceanic environment—this universal *Lebenswelt* outside and inside so many life-forms—is not a medium, then what is?

In a more ordinary sense, the ocean has long been thought of as a medium invisible to its users. Plato compared a human soul getting a glimpse of heavenly truth to a fish lifting its head above water.[4] Aristotle observed that "animals that live in water would not notice that things which touch one another in water have wet surfaces."[5] The British physicist Oliver Lodge, a key figure in both early radio physics and spiritualism, gave a boost to the term *media* in the sense that goes back at least to Newton: "A deep sea fish has probably no means of apprehending the existence of water; it is too uniformly immersed in it: and that is our condition with regard to the ether."[6] McLuhan, who in his youth loved to sail, made piscine obliviousness famous, but was not original when he claimed: "One thing about which fish know exactly nothing is water, since they have no anti-environment which would enable them to perceive the element they live in."[7] In fact, fish probably know a lot about water's temperature, clarity, currents, weather, prey, and so on, but the point was that they did not recognize it as water. It was just background, the stuff that slides into infrastructural obliviousness. As McLuhan said elsewhere: "Environments are invisible."[8] (His mission was always to provide an anti-environment.)

So is the ocean the greatest medium or the limit point of any possible media? Answering this apparently simple question will show that media are species- and habitat-specific and are defined by the beings they are

4. Plato, *Phaedo*, 109e.

5. Aristotle, *De anima*, 423a–b.

6. Lodge, *Ether and Reality* (London: Hodder and Stoughton, 1930), 28. See also "Lodge Pays Tribute to Einstein Theory," *New York Times*, 9 February 1920: "Imagine a deep sea fish at the bottom of the ocean. It is surrounded by water; it lives in water; it breathes water. Now, what is the last thing that fish would discover? I am inclined to believe the last thing that fish would be aware of would be water."

7. Marshall McLuhan and Quentin Fiore, *War and Peace in the Global Village* (NY: McGraw-Hill, 1968), 175. See also David Foster Wallace's 2005 commencement address, "This Is Water."

8. Marshall McLuhan and Quentin Fiore, *The Medium is the Massage* (New York: Bantam, 1967), 84.

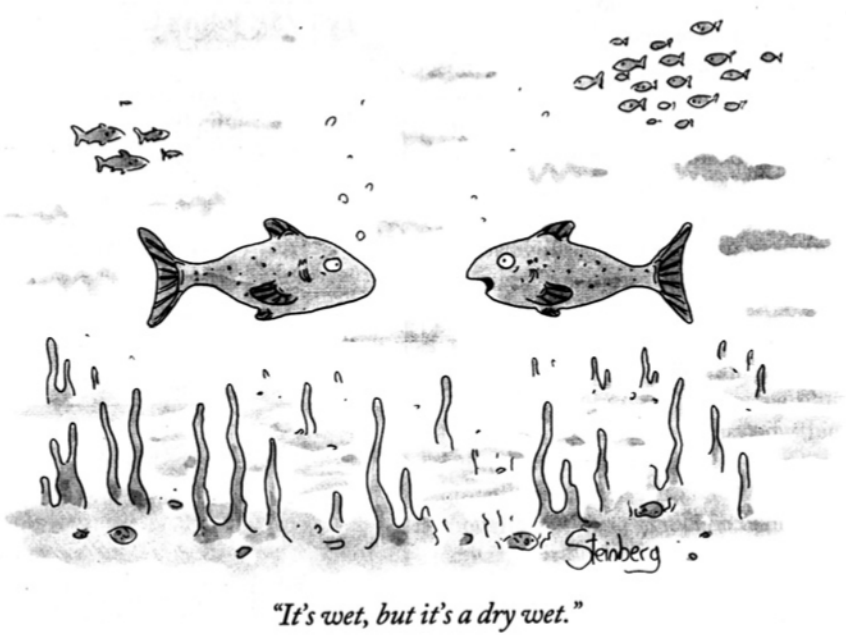

Figure 1. Connoisseurs of water. Cartoon by Avi Steinberg.

for. This chapter conducts a thought experiment using two families of apparently highly intelligent mammals, cetaceans and humans, which have mastered the sea in very different ways. Cetaceans, which include whales, dolphins, and porpoises, descend from terrestrial animals that returned to sea and adapted by evolution; those few humans who have gone to sea have done so by invention and engineering.[9] Cetaceans acquired blowholes, sonar, and exquisite powers of hearing; humans built ships and all manner of nautical gear. Cetaceans live at sea by nature; humans do so by art. The sea is a hospitable environment for one animal, and is profoundly hostile for the other. Cetaceans are born in the ocean medium, but humans cannot live there without craft. The two live in worlds with very different kinds of materiality. I take intelligent marine mammals as medieval theologians did angels: as entities helpful for thought experiments about intelligence in different media.

9. Porpoises are generally smaller than dolphins, live in less complex social groupings, and have less pointy beaks, fins, and teeth.

The very different destinies of the two mammalian orders with the biggest brains in the key habitat for the history of earth life tell us much about what role technology plays in our worlds, and how we might think about media, body, and being. What might animals that are parallel to us in intelligence and sociability be like in a marine rather than terrestrial environment? Unlike humans, with our ability to sit, stand, and sleep for long periods and to dwell for years at a single address, cetaceans seem incapable of a purely stationary existence. They have no feet or hands, nests or lairs, closets or graves. Fire, stars, and books would never shape their worlds. What would it mean to live in an environment immune to shaping and permanence? What would aqueous mind look and sound like? How would we feel if our bodies had adapted to live in water? Would we be anything close to human as we know it? Dolphins and whales are stranger than anything we could have conjectured. They live in an environment closed to material fashioning and their bodies show it, just as ours show our habitats: the biomechanical shape of creatures bears witness of the worlds they have evolved to dwell in. Our bodies reveal and enable our respective arts.

Cetaceans in the Sea Habitat

We should briefly get acquainted with our partners in this thought experiment. Cetaceans descend from hoofed animals that returned to the sea somewhere around fifty million years ago. They are thus related to deer and cattle, though their closest land relative is the hippopotamus. Cetaceans are thus ten times older than humans, who only started to emerge about five million years ago. Abandoning dry land, early cetaceans adapted to the sea habitat, developing some organs, especially their ears, nose, and throat, and reducing or losing other ones, such as hair, the sense of smell, and the hind limbs, which disappeared altogether.[10] The bodies of cetaceans bear traces of the double history of aquatic-terrestrial-aquatic adaptation. Some marine mammals—the pinnipeds

10. On the evolution of hearing, see Bernd Fritzsch et al., "Evolution and Development of the Tetrapod Auditory System: An Organ of Corti-centric Perspective," *Evolution and Development* 15, no. 1 (2013): 63–79.

(fin-foots), such as seals, sea lions, and walruses—continue to do their most important business on land. But cetaceans are not amphibious and will die if beached, as breathing becomes difficult, the weight of their unsupported bodies can crush their internal organs, they cannot hydrate or regulate their temperature, and they have no protection against sunburn. Cetaceans are fully maritime animals, their bodies as radically dependent on the ocean habitat as ours are on the atmosphere and earth. The water medium is their natural environment (although they cannot directly drink salty seawater; they hydrate through the organisms they consume). The sea is the taken-for-granted element shaping all they do, like oxygen, gravity, ground—or fire, language, or celestial bodies—for us.

Cetaceans divide into two living suborders (in addition to one extinct line), the smaller group of mysticetes or baleen whales (eleven species), which includes blue whales and humpbacks, and the larger group of odontocetes or toothed whales (seventy-two species), which comprises sperm whales, narwhals, killer whales, and the smaller toothed whales, including dolphins in their varieties. Mysticetes eat small prey, scooping up massive quantities of microscopic plankton with their giant mouths; they live more solitary lives or in smaller groups, and operate in a low-frequency soundscape, with infrasonic sounds as low as ten cycles per second. Odontocetes eat organisms higher on the food chain, such as fish, squid, and ocean mammals; they tend to have more complex social structures whose potential membership seems to have no upper limits; and they engage in echolocation, using supersonic frequencies in ranges that can reach as high as those of bats. The feeding patterns of the two suborders present different kinds of search strategies: toothed whales target and pursue, but baleen whales scoop and filter. Echolocation and filter feeding are different adaptations to their habitat; targeting singletons and filtering pluralities remain key modes of searching. (A Google search request starts with a target, but ends like a filtration system. Google is both toothed and baleen whale.) Cetacean bodies, like ours, have evolved in concert with their technical practices and environs.[11]

At the center of my narrative will be dolphins, particularly the bottle-

11. Most Google users employ toothed-whale strategies, searching for a single target in a huge array, but Google itself operates like a baleen whale, one that wants to swallow the whole universe. See chapter 7.

nose dolphin (*Tursiops truncatus*), which Marine Studios, *Flipper*, SeaWorld, the Cold War, and naval bioscience have made the royal road to cetacean knowledge.[12] Dolphins are a rather straightforward choice, and have been thought of as intelligent marine counterparts to humans for at least fifty years. They have the advantage of having been thoroughly studied, and thus can provide our thought experiment with some empirical grist. (As a Chinese saying has it, it is harder to draw pictures of horses and dogs than of devils and demons.)

The nervous system mediates between an organism and its environment, including its internal environments. Brains and bodies bear record of the stresses of habitat and history, and the cetacean brain has evolved to comparative extremes. The cerebral hemispheres of modern cetaceans are much larger and more convoluted than those of their ancestors in the fossil record. Whales have the biggest brains of any animal on earth in terms of sheer size, with sperm whale brains weighing in at more than eight kilograms, but absolute brain size is a poor indicator of intelligence. A better measure is the encephalization quotient (EQ), a statistical measure comparing total brain size to expected total body volume, and dolphins rank second of all creatures on earth in EQ, above the great apes but below human beings.[13] Delphinids also have a higher cerebellum-to-total-brain-volume ratio than humans: fifteen percent of their total brain weight is the cerebellum, in contrast to about ten percent for us.[14] Perhaps their large cerebellum, which fine-tunes motor control, ties to their gymnastic skill in both water and air: kinesthesia may be a main way they exist in the world, and their spectacular stunts may even be mimetically rich in what is inadequately called "nonverbal" meaning. Aquatic conditions might encourage body art as a main mode of expression.

Measures of relative brain power are unreliable due to other factors such as neuronal packing density, but there is abundant evidence of social intelligence among cetaceans, and their complex social systems are often compared to those of primates. Sonar seems to be used for both environ-

12. Gregg Mitman, *Reel Nature: America's Romance with Wildlife on Film* (Cambridge, MA: Harvard University Press, 1999), chap. 7.

13. Lori Marino, "Cetacean Brain Evolution: Multiplication Generates Complexity," *International Journal of Comparative Psychology* 17 (2004): 1–16.

14. Helmut H. A. Oelschläger, "The Dolphin Brain: A Challenge for Synthetic Neurobiology," *Brain Research Bulletin* 75, nos. 2–4 (18 March 2008): 450–59.

mental scanning and communication. There is evidence that individual "voices" can be identified among dolphins, and that they have something like proper names for each other: distinctive "whistle" sounds unique to each individual.[15] Dolphins can also recognize themselves in mirrors, a sign of intelligence found in only a few species. They form lifelong bonds. Whether they are capable of what some call *metacognition*—knowing about knowing, so as to infer the mental states of others, and thus engage in such acts as politeness or deception—is disputed.[16] Dolphins are talented vocal and motor mimics. The athletic claps and splashes their bodies make after diving into the air may also serve signaling purposes. Cetaceans also exhibit high levels of altruism, including group hunting and mutual aid to injured conspecifics—a tendency that can be bad for sperm whales, which bunch around an injured comrade, making them more even susceptible to harpoons; for centuries, whalers have exploited their mutual aid to call forth more targets. Knowledge of cetaceans' society and intelligence first came from their main predators.[17]

What other pressures would aquatic conditions exert? The sea is a habitat as varied as earth, air, and sky. It has subfreezing polar waters and boiling temperatures near heat vents, oxygen-rich zones and dead spots, translucent surface waters and lightless depths. It has sustained vast epochs of evolutionary experimentation. If media theory concerns the different sense ratios through which mind interacts with world and the various worlds that come into being in distinct historical and ecological climates, the ocean should be of primary interest as an environment that invites us landlubbing bipedals to abandon most everything we take for granted. The marine world invites fundamental anthropological questions.[18]

15. Michael Marshall, "Dolphins Call Each Other by Name," *New Scientist* 211, no. 2829 (10 September 2011): 15. Sperm whales respond to each other by mimicking previous vocalizations in duets of "coda-matching," perhaps with the point of marking group belonging; see Tyler M. Schulz, Hal Whitehead, Shane Gero, and Luke Rendell, "Overlapping and Matching of Codas in Sperm Whales: Insights into Communication Function," *Animal Behaviour* 76 (2008): 1977–88.

16. Derek Browne, "Do Dolphins Know Their Own Minds?" *Biology and Philosophy* 19 (2004): 633–53.

17. Frans de Waal, *The Age of Empathy* (New York: Three Rivers Press, 2009), 125–30.

18. See Stefan Helmreich, *Alien Ocean: Anthropological Voyages in Microbial Seas* (Berkeley: University of California Press, 2009).

Compared to dry land, the enveloping water would have several curious effects on its inhabitants. Up and down, day and night, the pull of gravity, and the circadian rhythm of wake and sleep would be much less dictatorial for aquatic creatures than they are for us. Feet, the drivers of human evolution and anchors of land-based humans, have been lost altogether. Body heat is harder to retain underwater; a built-in thermal blanket of blubber is an evolutionary adaptation for warm-blooded animals. Cetaceans thus wear their clothes *under* their skin, and, as some enthusiasts have observed, they live in nudist colonies. Since the 1960s, an erotic frisson has boosted the animals' profile in human fantasy, as we will see—but they also have built-in loincloths, their genitals being hidden inside the body.[19]

Probably the most important feature of the marine habitat is that it filters out light and enhances sound conductivity. Underwater, light is scattered and absorbed but sound speeds at a quicksilver pace; optics are discouraged and acoustics encouraged. Despite the brightly lit underwater seascapes featured in color film and television documentaries since the 1950s—themselves advertisements for the idea that the ocean can and should be colonized by human technologies—the ocean is a murky place, and light effectively vanishes once you reach a certain depth. Sound behaves differently in water than in air, traveling more than four times faster (with variations for temperature, depth, salinity, and temperature layers or "thermoclines" that can create deaf spots for sonar). The architecture of the sea—the water's depth, the roughness of its surface, and the composition of the bottom—affects sound propagation, and sound can bounce off the surface or off the arctic ice as it would off the ceiling of a concert hall. In the atmosphere sound vanishes quickly, extending a maximum of about ten kilometers, but ocean sounds can travel for thousands. Humpback whale "songs" off the coast of Mexico can be heard off the coast of Alaska, and a natural "deep sound channel" of varying depths in the ocean can carry sound around the earth.[20] In one experiment, sounds transmitted at a depth of 175 meters from (aptly named) Heard

19. Mette Bryld and Nina Lykke, *Cosmodolphins: Feminist Cultural Studies of Technology, Animals, and the Sacred* (London: Zed Books, 2000).

20. For the canonical study, see Roger S. Payne and Scott McVay, "Songs of Humpback Whales," *Science* 173, no. 3997 (13 August 1971): 585–97.

Island in the South Indian Ocean were detected as far away as the East Coast of the United States (traveling around Africa through the Atlantic Ocean) as well as the West Coast (traveling through the Pacific).[21] Fifty million years of living in such conditions would be enough to reshape senses, mind, and body. The sea is a natural laboratory for altered sense ratios. The natural history of sense organs shows the incorporation of the environment in the body, the core topic of media ecology.

Breath, Face, and Voice

In an aqueous environment, the evolutionary incentive for loading communicative intelligence on the acoustic channel would be tremendous. Not all marine organisms, however, are hearing specialists. In the countermovement from land back to sea, not all mammals developed the hearing capacities of cetaceans. Manatees, for instance, are fully aquatic mammals, but they have not developed anything close to the supersonic hearing of some cetaceans. In evolution we should talk sooner about path-dependence than necessity, given the incalculable diversity of life-forms.

This diversity of animal shapes invites a phenomenology of alien sensory ratios. Much of the stretching of the cetacean brain seems due to its enormous investment in producing and receiving sound. The hypertrophy of the acoustico-motor system may account for much of cetaceans' large brain size. Their other sensory systems seem to have shrunk, especially smell, which is functionally absent, as their cranial design gives no transit routes for olfactory nerves. Smell has been replaced with a sonar nose-face structure: the nasal part of the dolphin respiratory tract doesn't sample scents, but has undergone a drastic remodeling to emit sound.[22] It is unclear what role vestibular input has. Dolphin brains have a very small hippocampus, which suggests that dolphins may have limited powers of memory—though this, like much else about dolphins' cogni-

21. Whitlow W. L. Au and Mardi C. Hastings, *Principles of Marine Bioacoustics* (New York: Springer, 2008), 109. This book is a treatise on aquatic media *sans le savoir*.

22. There is no necessary environmental reason for the withering of scent unless it is the abandonment of a contested niche to the competition; sharks have chemical receptors fabled for their sensitivity to small amounts of blood. The relevant unit for evaluating evolutionary pressures is not just the environment, but competition for niches in it.

tion, is poorly known, and perhaps they have conjured other structures for recording the past.[23]

Cetaceans, like bats, live in a dark habitat and solve the problem of darkness with an investment in hearing. This is not to say that all sea creatures are blind (bats are not completely blind, for that matter). Dolphin retinas have adapted to the dim and overwhelmingly blue light below. (Giant squid, which live at great depths, have basketball-sized eyeballs, perhaps to help them detect the shadowy movements of their main enemy, sperm whales, and the bioluminescent signals from conspecifics.) It seems highly unlikely that cetacean eyes are good enough for stargazing: the number of axons in the bottlenose dolphin optic nerve is only one-eighth that of humans, and no cetaceans seem able to perceive color. Although their eyes operate independently, some dolphins may be the only cetaceans capable of binocular vision; in most whales, for instance, the eyes are mounted on the sides of the head like those of fish. Melville speculates that experiencing a whale's visual field would be like looking sideways through our ears with blind spots directly in front of and behind us; it would seem as if we had two backs and two fronts. Because of the bilateral placement of the eyes, he thought, whales could entertain two visual fields at once, and thus transcend the linear one-thing-at-a-time mode of human consciousness. This was not the last time cetaceans were thought to live differently in time.[24] Face-to-face communication would mean something very different among whales. Intimate concourse might mean swimming abreast. There would be no looking into one's eyes; just looking into one eye at a time.[25] Cetaceans show the primacy of habitat and embodiment to communication; they reveal the existential, even anatomical, force of habitat.

According to Heidegger and Kittler, humans access Being through sound, because sound embodies being's key aspect, temporality. This would hold a fortiori for the cetacean "world," if we can even call it that. (It also might hold for some plants, whose acoustic sensitivity can be a constitutive part of their organism.)[26] Ability to send and receive

23. See Oelschläger, "The Dolphin Brain."

24. Herman Melville, *Moby-Dick* (New York: Norton, 1967), 279–80.

25. Technically, this is also the case for humans in face-to-face interaction.

26. Monica Gagliano, Stefano Mancuso, and Daniel Robert, "Towards Understanding Plant Bioacoustics," *Trends in Plant Science* 17, no. 6 (June 2012): 323–25.

sounds in the water is biologically critical for sensitive-eared cetaceans. For humans as well, knowledge of the sea comes through sound. As one marine biologist put it: "Acoustics is a great way to see what's going on where you can't see."[27] The marine environment is a superb place for sound studies.

The ears, noses, and throats of dolphins are radically different from ours. Dolphins produce sound ("phonate") in their nose, blowing air through their nasal sacs, using so-called "monkey lips" common to toothed whales. Like our vocal folds, these lips are a double-reed instrument: a pair of vibrating cords that produce sound when they strike each other. They can be observed by inserting an endoscope into the dolphin blowhole, which seems to be part of an organ of acoustic production as subtle as our own vocal tract, with its ability to articulate a near infinity of tones, colors, and accents.[28] The "melon" on the dolphin forehead seems to be a transducer that receives and directs sound; indeed, the huge spermaceti organ on sperm whales, which made them a target for so long, seems to be a giant resonator.[29] Our noses make incidental sniffs, squeaks, and squawks when we have a cold—imagine that those meager sonic resources had grown over millions of years into a complex sounding system. Further, imagine singing that was only indirectly tied to breath control. Humpbacks can "sing" for ten to twenty minutes without blowing bubbles, suggesting the recycling of air.[30] Song and voice severed from the vital intake of air would be very different than ours, which is always rooted in the pulse of breath and the body. Human song always short-circuits the need to take in oxygen, making art in the time and space in which natural need is suspended.

Breath control is much more at the heart of cetaceans' existence than it is for ours. The founding father of the postwar fascination with dolphins, the neurologist John Cunningham Lilly, discovered that they die

27. Kelly Benoit-Bird quoted in Eric Wagner, "Call of the Leviathan," *Smithsonian* (Dec. 2011), 68–74, 76.

28. Ingo R. Titze, *Fascinations with the Human Voice* (Salt Lake City: National Center for Voice and Speech, 2010).

29. *Principles of Marine Bioacoustics*, 405–8, 502, passim.

30. Peter L. Tyack, "Functional Aspects of Cetacean Communication," *Cetacean Societies: Field Studies of Dolphins and Whales*, ed. Janet Mann et al. (Chicago: University of Chicago Press, 2000), 270–307, at 277–78.

if put under anaesthesia: they essentially stop breathing. He and his team studying dolphin neuroanatomy in the 1950s killed five in quick succession, not having questioned the humanoid assumption of autonomic respiration.[31] The drugged animals essentially suffocated to death. Breathing seems to be always under conscious control for whales large and small. Though we do it many times a minute, breathing is hardly ever conscious to any humans but asthmatics, swimmers, singers, brass and woodwind musicians, and yogis. Cetaceans breathe in cataclysmic bursts and intakes instead of in our uniformitarian pulses; sperm whales at rest can breathe only three to five pulses per minute. The odontocete blowhole, a cyclopean marriage of the two nostrils that have taken an evolutionary journey to the top of the head, is a valve closable by a complex system of muscles; we cannot, in contrast, seal our nostrils against the intake of water. Cetaceans cannot breathe through the mouth; their only source of air is the blowhole (mysticetes have two of them). Hence, they cannot choke on food: the mouth connects to the stomach via the esophagus, the blowhole connects to the lungs, and they are spared the anatomical double-tasking of the human throat. Our lungs have evolved for an environment that can take access to oxygen for granted, but all cetaceans must surface to breathe. Under the water, whales and dolphins are always holding their breath.

What we outsource to habit, cetaceans perhaps steer as an art. There may be a lore of breathcraft among cetaceans. Sperm whales can dive two miles (three kilometers) deep in plunges to hunt squid, eating up as much as one ton of them per day, and they store up oxygen in their blood by hyperventilating before their descents into the freezing waters of the hostile deep. Their jointed ribs allow the thoracic cavity to compress under the colossal pressure. Sperm whales also get "the bends" (nitrogen narcosis): tissue damage from surfacing too quickly and accumulating too much nitrogen in the blood. (Human beings are not the only animals that expose their bodies to environmental hazards to earn a living.) Cetacean sleep is very different from ours, since breathing cannot be ignored. Dolphins have been observed to remain vigilant for at least five days straight without exhibiting symptoms of sleep deprivation; their brains seem to

31. John C. Lilly, MD, *Man and Dolphin: Adventures on a New Scientific Frontier* (Garden City, NJ: Doubleday, 1961), chapter 3.

sleep one half at a time, which can include shutting the corresponding eye, in a phenomenon known as "unihemispheric sleep."[32]

If the dolphin's voice is in the nose, its ears seem to be in the jaws. Cetacean hearing is a fascinating example of natural selection's combined conservatism and creativity. In moving onto land, the ears of terrestrial animals had to adapt from an aqueous to an airy environment. The mammalian inner ear remains water-based and takes advantage of water's superior sound conductance. The ears of terrestrial creatures had to learn to convert—more specifically, to amplify—the tiny amounts of airborne sound energy hitting the tympanum with oto-acoustic emissions and other methods.[33] Cetacean ears, however, are once again immersed in water. When humans go under, their air-based hearing ceases to function and the bones of the skull are the main conductors of sound to the inner ear—which has the effect of disabling the locative function of binaural hearing, as does the faster speed of sound, which compresses the difference between the times at which sounds hit both ears. Cetaceans' hearing has adapted, and their outer ear canal seems not even to be used for carrying sound, as it is typically plugged with cell debris and wax; it thus provides clues as to the age of the animal, which is coveted information in whaling, since the age of the catch can indicate how badly depleted a population is. Instead of the vestigial outer ear, it seems likely that in bottlenose dolphins the lower jaw forms a complex alternative hearing apparatus that picks up sound, bypassing the eardrum and connecting via the ossicular chain, the train of hearing bones in the middle ear, to the cochlea. (In this the dolphins are a bit like snakes, whose jawbones conduct vibrations carried by the ground directly to a cochlea-like system; snakes lack both outer ears and eardrums.) In fact, the dolphin tympanum has no connection to the three hearing bones at all. The fat bodies in the dolphin jaws, whose rich oil has been prized by human hunters, seem to amplify sound (just as the human ear does, via a different mechanism), though much about cetacean hearing is not well understood.[34]

Both phonation and hearing in toothed whales can operate at ex-

32. Sam Ridgway et al., "Dolphin continuous auditory vigilance for five days," *Journal of Experimental Biology* 209 (2006): 3621–28.

33. Thanks to Shawn Goodman for explaining this.

34. See Au and Herzing, *Marine Bioacoustics*, 244–52, 337, for discussion.

tremely high frequencies. (That dolphins are sensitive to high-frequency sounds like submarine signals, and largely ignore low-frequency ones like the thud of artillery, was first noticed during World War I.)[35] Like bats, the aerial masters of echolocation, dolphins use ultrasonic frequencies to locate prey and each other and to survey their environment. Killer whales (*Orcinus orca*) use hunting clicks in the same ultrasonic frequency ranges as do bats. The clicks of a sperm whale traverse its entire nasal complex, and this "interpulse interval" can supply the knowing listener with an index of the whale's size (and is thus an "honest signal").[36] Heard through hydrophones, the vocalizations of sperm whales sound like popcorn popping, bacon sizzling, or nails being struck by a hammer—the reason why submarine operators once hypothesized "carpenter fish." Baleen whales, in contrast, are low-frequency specialists not equipped for echolocation. Rather than serving the purpose of local finesse, infrasonic frequencies serve distance communication, pass around obstacles, and thus form the largest communication network for any animals save humans (unless we count interstellar spores or pheromones). Hardly anything is known—by us, at least—about what baleen whales might be saying.[37]

Strange creatures, that hear with their jaws and vocalize with their noses! For humans, the face is both an organ of emotion and an ethical claim to personality, but whales cannot even look at each other face-to-face. Even binocular dolphins do not have faces as we do. For one thing, they might not see well enough in the water, though they can recognize themselves in mirrors. More importantly, their faces cannot produce visual displays of emotion. The anthropomorphic smile people see on dolphins owes to the shape of their mouths: in fact, their lips are immobile and their heads lack the musculature for facial expression (our comparatively expressive faces are puppet-mastered by forty-two distinct muscles), although the skin around the dolphin "face" is as sensitive as that in the human face and fin-

35. D. Graham Burnett, *The Sounding of the Whale: Science and Cetaceans in the Twentieth Century* (Chicago: University of Chicago Press, 2012), 225.

36. Judith Donath, "Signals, Truth, and Design," (11 January 2007), www.youtube.com/watch?v=xE_P7pe2ilo, accessed 25 May 2013. As with the astronomical red shift, frequency discloses size and distance.

37. Vincent M. Janik, "Vocal Communication and Cognition in Cetaceans," in *The Oxford Handbook of Language Evolution*, ed. Maggie Tallerman and Kathleen R. Gibson (New York: Oxford University Press, 2012), 102–8, at 107–8.

gers.[38] Instead, dolphin faces may exist in sound as "acoustic facial expressions." What would an ethics be like that did not take the face as a claim to individual dignity and the voice as a representation of will and choice? Perhaps cetacean empathy is performed corporeally and gymnastically rather than facially, or perhaps cetaceans are exquisitely sensitive readers of the microtones in each other's sound productions.

Or perhaps they see directly into each other's guts with sonar. That dolphins were mobile ultrasound machines, able to peer not only through the waters but into each other's flesh, was one of Lilly's weirder proposals (of which he had plenty). He fantasized that dolphins would not greet each other with "How are you?" since they would know the answer already. "We might imagine one dolphin saying to another, 'Darling, you do have the cutest way of twitching your sinuses when you say you love me. I love the shape of your vestibular sacs.'" If dolphins lack the musculature for facial expression, maybe they can contort their bowels expressively, grimacing or grinning with their guts.[39] You couldn't make up this stuff as amply as Lilly supplies it: dolphin sociability as applied radiology. He didn't tell us about the well-established gusto with which dolphins taste each other's feces. In many large social mammals, such as dogs and elephants, urine and feces sampling is a form of socializing and sizing one another up; fecal analysis also seems to be one of the ways in which dolphins best assay one another's well-being. If so, they draw the line between purity and danger in a very different place than we do.

If dolphins can "see" (hear) into their surroundings with three-dimensional sonar, this would not even mean seeing for us, since our vision distantly touches the opaque surface of things.[40] To see inside an object we have to dissect, hack, and chop or use imaging techniques; we need additional operations before or after the point of seeing. Dolphins are equipped, writes philosopher Thomas I. White, with "a personal ultrasound device . . . a biological version of the technology used by submarines."[41] (This curious language of nature as a "version" of tech-

38. Tyack, "Functional Aspects of Cetacean Communication," 275.
39. Lilly, *The Mind of the Dolphin*, 133.
40. James J. Gibson, *The Ecological Approach to Visual Perception* (Boston: Houghton Mifflin, 1979), chapter 5.
41. Thomas I. White, *In Defense of Dolphins: The New Moral Frontier* (Malden, MA: Blackwell, 2007), 21.

nology is widely echoed in cetacean discourse.) What would a social world of see-through bodies be like? How would interaction change if we could see sympathetically into each other? With our X-ray vision we could detect illness, pregnancy, hunger, and injury, or perhaps even moods and emotions. Transparent flesh would open a new realm of loveliness, the coils and symmetries of the insides of the body. Beauty would no longer be skin-deep. We'd be like the visible men and women of anatomical museums. Seeing with sound would not be equivalent to seeing with light: the topology of inside and outside would be different, and colors would matter less. Bodies without opacity: an oxymoron for us, but perhaps mundane for dolphins.

A History of Fantasy

I have already started to speculate, rather mildly in comparison to the norm, about cetacean and especially dolphin capacities. There is a long and not innocent heritage of imagining sea creatures as radically "other" to humans. Cetaceans are preeminent fantasy animals (along with parrots and squid). One of the greatest services they have provided is to our imagination—a service as great as the oil, bone, meat, chicken feed, lubricants, fertilizer, and ambergris they have provided over the centuries. They conjure wish-images of alternative ways of being and being together. Rather like native peoples, who often get suffused in a romantic glow of nostalgia once they have been wiped out, whales and dolphins went from harpoon fodder to spiritual objects rather quickly. Within the course of a decade, from about 1965 to 1975, the dominant conceptions of whales and dolphins changed from long animate barrels of animal feed and lubricants to sea gurus soulfully singing of cosmic peace and harmony, showing humans the higher path of intelligence and coexistence like age-old Yodas. Like bats, aliens, and teleportation, they provide things to think with. They have been swimming alongside communication theory since that project was invented around 1950. They show up on television and film, in aquaria and resorts, in feminist and socialist utopias, in the philosophy of mind and the musings of media theorists. Rarely has any creature so haunted an age as whales and dolphins have in the past half-century. They and the sea have often appeared as anti-

dotes to human politics, when in fact they often mirror it intensely. [42] The vision of human otherness in the sea is preconditioned by naval and commercial exploitation.[43]

There is a longer history. Whales have long fascinated and mystified humans. They are singled out in the creation story of Genesis. The Book of Job dwells on the "Leviathan" as marking the outer limits of human knowledge of meteorological and zoological phenomena, and as proving our puny epistemological capacities in the face of God's ballistic questioning. Some scholars think the scaly Leviathan may have been a crocodile, the lord of the Nile, already invested with extra meaning in Egyptian lore, but the Leviathan's multiple heads, fire-breathing flashing eye, stony heart, ability to make the sea boil, and other biological improbables suggest that it is a mythological creature reprising the old battle of creation between sea and dry land.

The ancient Greeks were fascinated by dolphins, the most important sea animal in the eastern Mediterranean. The term *delphis* stood for the animal, for a constellation, for a weapon, and, by association, for Apollo (of Delphi); the similar term *delphys*, womb, rounds out the circle. The late nineteenth-century classicist Otto Keller, sounding rather like his contemporary Friedrich Nietzsche, thought the Greeks loved dolphins as an idealized image of themselves—vivacious and joyful, lovers of the sea and of music, athletics, and dance.[44] (Melville wrote, in a similar spirit: "If you yourself can withstand three cheers at beholding these vivacious fish, then heaven help ye; the spirit of godly gamesomeness is not in ye.") [45] Dolphins served as a symbol of Poseidon's dominion over the sea, and were linked to the Orpheus myth and music, voyages to the dead, and impossible love. The Greeks and Romans understood them to be deeply erotic creatures, in love with humans and music, who rescued Aphrodite and her son Eros, who in turn rides the sea on dolphins'

42. See Nicole Starosielski, "Beyond Fluidity: A History of Cinema under Water," in *Ecocinema Theory and Practice*, ed. Stephen Rust, Salma Monani, and Sean Cubitt (New York: Routledge, 2013), 149–68.
43. See John Shiga, "Sonar: Empire, Media, and the Politics of Underwater Sound," *Canadian Journal of Communication* 38 (2013): 357–77.
44. Otto Keller, *Thiere des classischen Alterthums* (Innsbruck: Verlag der Wagner'schen Universitäts-Buchhandlung, 1887), 211–35.
45. Melville, *Moby-Dick*, 126.

backs, playing a lyre or a flute.[46] (The idea that the sirens of the *Odyssey* were mermaids, half woman and half fish, is a later development in the European imagination; the sirens were birds, and not particularly seductive to look at—only to listen to.)[47] Herodotus tells the story of the poet and harpist Arion, who, during a sea voyage from Sicily to Corinth, found himself among thieves who sought his great riches. He begged for his life and offered them his money, but the sailors still required him to kill himself. Stalling for time, he offered to play the harp and sing, and then hurled himself into the sea, where, unbeknownst to the sailors, he was rescued by a dolphin that carried him to safety, where he was able to testify against and convict the brigands. The implication is that Arion knew that the music would call the dolphin to his aid. Here we have a primal meeting of *physis* and *technē*: Arion's art of poetry—and poetry was the highest kind of *technē* for the Greeks—summoned the dolphins, whose nature was both to love song and to ferry creatures that did not possess the gift of living at sea.[48]

Dolphins have long been liminal creatures between nature and artifice, sea and sky, the living and the dead. Much of the sublimity of whales and dolphins comes from their inhabiting a zone parallel to the stars: like angels, dolphins haunt us as beings that dwell in sublime ethereal or maritime climes, in contrast to sublunary humans. John Milton saw dolphins as singularly poetic beings, the nightingale's sole rivals as muses and lovers of music, who listened to the music of the spheres and had a special connection with the constellation Delphinus.[49] "Angels are gliding underneath the keel," wrote a more recent poet of a boat trip to see dolphins.[50] The sea and the stars are two environments humans traverse only by craft, sight, or sound and never dwell in for good. The sea-sky equation runs deep. Dolphins were also thought to ferry souls, both in the sky and in the deep, between the living and the dead. The early Chris-

46. See Pliny, *Naturalis historia*, book 9, chapters 7–10.

47. Adriana Cavarero, *For More Than One Voice: Toward a Philosophy of Vocal Expression*, trans. Paul A. Kottman (Stanford, CA: Stanford University Press, 2005), 95–116.

48. Herodotus, *The History* 1:23–24. Keller, *Thiere*, 229–30, thinks the biblical Jonah story a variant of this theme. Thanks to Mary Depew for help.

49. Karen Edwards, "Dolphin," *Milton Quarterly* 40, no. 2 (2006): 110–13.

50. Derek Walcott, *The Prodigal* (New York: Farrar, Straus, Giroux, 2004), 102. Thanks to George Handley.

tians took dolphins as symbols of the resurrection, special envoys that assured safe passage between this world and the next: dolphins rescued survivors from shipwrecks and dwelled in the borderland. Such imagery of godly gamesomeness still abounds, as in the lovely film *Whale Rider* (2002, New Zealand, dir. Niki Caro).

Interaction between humans and whales and dolphins was not always poetic. In the Renaissance a new attitude is detectable, though whales had been hunted to some degree for millennia. Whales started to be seen in the dire light that Heidegger calls "*Bestand*,"—as stockpiled assets or "standing reserve," mobile vats of natural resources to be liquidated into oil and money—an attitude that would decimate their population. Northern Europeans became the leading whalers. Martin Luther used a whale vertebra as a footstool while translating the New Testament, and it is still to be seen in Wartburg Castle in Eisenach, Germany. The pioneering microscopist Antoni van Leeuwenhoek dissected the eye of a whale that had been pickled in brandy by an obliging ship's captain. The coast of Holland saw many strandings of male sperm whales in the sixteenth and seventeenth centuries, from which the enterprising Dutch pulled a rich harvest not only of oil and bone but also signs and oracles. "The great leviathans, their sonar scrambled by the North Sea sand, were migrating not only from Atlantic to Arctic, but from the realm of myth and morality to that of matter and commodity," writes Simon Schama.[51] Between these two realms is precisely where they have continued to migrate since.

Herman Melville, partly of Dutch descent, sat squarely in the tradition of thinking about whales noted by Schama. As a young sailor on a whaler, Melville's job was to make whales not into allegories but into oil for lamps and bone for corsets. The history of whale science is a bloody one. As D. Graham Burnett shows in a noteworthy, whale-sized book, one tradition of cetology in the twentieth century comes from biologists working side-by-side with butchers (flensers, as they are known) on the blood-dimmed tide of whaling stations. Scientists were left free to ransack the cadavers for parts not immediately useful as commodities—ear bones and ovaries were particularly valued, the first as historical evidence of the

51. Simon Schama, *The Embarrassment of Riches* (Berkeley: University of California Press, 1988), 130–45, at 140.

evolutionary journey from land back to sea, and the second as a means of measuring the age of whales, so important to population management. This "life science at work in the maw of death" was always mixed up, comically or tragically, with the interests of the whaling industry.[52]

A new boon to fantasy, and an ontological shift in the being of cetaceans, came with the rise of underwater warfare, starting in World War I but fully emerging in World War II. Another kind of cetology arose, as Burnett shows, that was more interested in living behavior than in postmortem anatomy and closer to military bioacoustics and communications engineering than to comparative zoology and natural history. Whales and dolphins were suddenly sign-emitting animals, avid senders of signals. Tape recorders and hydrophones replaced hip boots and flensing knives, readying cetaceans for their role as beings that lived in music and meanings. In the postwar wake of Shannon's mathematical theory of communication and Wiener's cybernetics, their natures were transformed by diverse militarized audiovisual and signaling devices. The history of both the popular fascination with and the scientific investigation of cetaceans is also the history of media technologies. New media not only gave epistemic access to the beasts, but redefined what they were.

Before we turn to sound, by far the more important medium, consider the visual domain, especially via scuba diving and underwater color movie cameras. Here the key figure is Jacques-Yves Cousteau, inventor of the Aqua-Lung, popularizer of skin diving, documentary filmmaker, and prominent advocate of submarine exploration. His book *The Silent World* (1953) was an international bestseller. As the title suggests, the ocean had long been thought of as soundless, and much of the gear of underwater exploration had previously been tactile—dredges, trawls, sounding ropes. (The contents of whale stomachs, for instance, served as biopsies from the depths.) Cousteau's films and television shows unfurled a brightly colored world, peaceful, floaty, and full of wonder, narrated in the language of postwar existentialism. (Ship captains, air pilots, astronauts, and deep sea divers often serve as male existentialist heroes, from Charles Lindbergh to Cousteau, from Joseph Conrad's Marlow to Antoine Saint-Éxupery.) Consider Cousteau's lines about the sea: "From birth, man carries the weight of gravity on his shoulders. He is bolted

52. Burnett, *The Sounding of the Whale*, quotation from 4; passim.

to earth. But man has only to drop beneath the surface and he is free. Buoyed by water, he can fly in any direction—up, down, sideways—by merely flipping his hand. Underwater, man becomes an archangel."[53] "I sink, therefore I am" was to provide much of the dream material in postwar cetacean research and, in a different direction, space exploration. Returning to the watery womb and primeval flood would be a kind of adult baptism cleansing us from our terrestrial attachments. Gravitation would give way to levitation. (John Lilly, who read and annotated Cousteau's book carefully, claimed to have experienced an LSD-enhanced liberation while floating in the sensory isolation tank at his Virgin Islands "Communication Research Institute."[54]) Cousteau's sea world also sounds like the online world as dreamed up in the 1990s: freedom from the constraints of terrestrial life, with universal navigation by merely flipping your hand.

Another visual boost of the dolphin's profile came from theme parks, television shows, and nature films. Starting in the 1930s, Florida's Marine Studios made dolphins into spectacle, mixing together bits of the circus, science, and showmanship. Like later television shows such as *Flipper*, Marine Studios kept the dolphin's sexually voracious escapades under wraps.[55] Other visually lush depictions of the world underwater have been made in beautiful coffee-table books by Leni Riefenstahl, once Hitler's in-house filmmaker, with all the contradictory exultation in sheer beauty and political blindness that one would expect, and in the ongoing Census of Marine Life, with its jewel-like images of odd aqueous animals of the deep set against velvet black backgrounds.[56] The sea continues to be a visually fascinating place, thanks to our media.

But sound technologies were most crucial in revising the world of cetaceans. Contrary to Cousteau's title, the ocean got very noisy indeed in World War II thanks to sonar, radar, echo sounding, and other sensing technologies. Efforts to listen in on enemy craft during the war intercepted the newly (to human ears) vociferous "whistles, squeals, chirps,

53. "Poet of the Depths," *Time*, 28 March 1960, 66–77 (intermittent pagination).
54. Burnett, *The Sounding of the Whale*, 579.
55. Mitman, *Reel Nature*, 157–79.
56. See Eva Hayward, "Diving into the Wreck: Leni Riefenstahl, Coral Preservation, and Surface Tension" (work in progress), and Stacy Alaimo, "Violet-Black," in *Prismatic Ecology: Ecotheory Beyond Green*, ed. Jeffrey Jerome Cohen (Minneapolis: University of Minnesota Press, 2013), 233–51.

clicks, and rasping noises" of small whales and porpoises.[57] Like UFOs, weather fronts, or enemy craft, whales and dolphins were mysterious entities looming on the horizon. (They fit perfectly in cybernetics' "ontology of the enemy.")[58] As transmitters of ultrasonic code, cetaceans shared the same overall apparatus as cryptography; Lilly explicitly saw dolphin vocalizations as a problem in cryptanalysis. Like other fringe beings in the 1950s—extraterrestrials, computers, bees, otters, apes, and schizophrenics—whales and dolphins became subjects of *communication*.

Both the US and Soviet navies were deeply involved in cetacean research in the 1950s and 1960s and notoriously considered using dolphins as armed combatants and intelligence gatherers. Both nations also funded vigorous research on communication with extraterrestrials, often with considerable overlap; Apollo, rider of dolphins, was a namesake of US space exploration. Lilly had close ties with SETI researchers and some of them even created the whimsical Order of the Dolphin, complete with lapel pins to mark membership in the global freemasonry of extraterrestrial communicators. [59] (Sometimes whales and dolphins were figured as extraterrestrials that happened to take up residence in the ocean as in *Star Trek IV*, *Hitchhiker's Guide to the Galaxy*, etc.) One military strategist fantasized the dolphin as "a self-propelled marine vehicle, or platform; with a built-in sonar sensor system suitable for detecting and classifying targets; and carrying an on-board computer . . . capable of being programmed for complex performance." Dolphin research was, as Burnett concludes, "inextricable from (and dependent on) Cold War military bioscience."[60] After the war, eavesdropping devices for detecting submarines and mines were repurposed for marine mammals; Lilly's laboratory for dolphin experiments was a state-of-the-art recording studio. Like tape recorders, aluminum foil, LSD, rock 'n' roll, reggae, and radio astronomy, cetacean research was a spinoff from postwar technology—

57. Donald R. Griffin, *Listening in the Dark: The Acoustic Orientation of Bats and Men* (1958; New York: Dover, 1974), 269–73, 323–46, quote from 273.

58. Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21, no. 1 (autumn 1994): 228–66.

59. Bryld and Lykke, *Cosmodolphins*, 179, passim.

60. Burnett, *Sounding the Whale*, 530. His chapter 6 is an essential treatment of Lilly and his context. See also Bryld and Lykke, *Cosmodolphins*, 48–49, 189–206, passim, who treat the Soviet side missed by Burnett.

in Kittler's famous words, an "abuse of military equipment."[61] Like the Internet, another kind of extrahuman intelligence spreading through an oceanic medium, dolphins were brewed in the Cold War cauldron.

The notion that dolphins live in a ubiquitous, organic network of minds is widespread, but the link is more than metaphorical. John Lilly, Ted Nelson (inventor of hypertext), Douglas Engelbart (inventor of the computer mouse), and J. C. R. Licklider (who foresaw computer-based social media) were all funded in the 1960s by the Information Sciences division of the US Air Force under Harold Wooster, a nexus that deserves more research. The young Nelson also did a 1962–63 internship at Lilly's Communication Research Institute as an aspiring filmmaker. He worked on an unfinished documentary, edited a short film that he called "the dolphin sex movie," and says he loved the animals.[62] He draws no link between the year he spent with informationally aqueous brains and his ideas of collaborative computing, but there is a suggestive similarity that further research might be able to establish. Today marine biologists like to say, as we will see below, that dolphins possess "distributed cognition" with networked beehive- or cyborg-like knowledge and perception.[63]

Military technoscience gave birth to dolphins as peaceful beings. Starting in the 1960s, some came to see dolphins as counterspecies to our brutal ways. In contrast to the almost entirely masculine history of whale hunting and military exploitation, cetaceans became for some feminist thinkers watery pacifist shape shifters, perhaps in the tradition of sirens, mermaids, and selkies. Mette Bryld and Nina Lykke's wonderful but unfairly neglected *Cosmodolphins*—even Burnett's compendious book misses it—is an indispensable analysis of postwar fantasies around cetaceans. Surveying both science and science fiction on both sides of the Cold War, including wonderful Soviet material, Bryld and Lykke show that the glorification of dolphins in countercultural and utopian discourse was inseparable from the military and scientific con-

61. Friedrich A. Kittler, *Gramophon Film Typewriter* (Berlin: Brinkmann und Bose, 1986), 149.
62. Ted Nelson, *Possiplex: Movies, Intellect, Creative Control, My Computer Life and the Fight for Civilization* (Hackettstown, NJ: Mindful Press, 2010–11), 133–39.
63. Denise L. Herzing, "SETI Meets a Social Intelligence: Dolphins as a Model for Real-Time Interaction and Communication with a Sentient Species," *Acta Astronautica* 67 (2010): 1451–54.

texts eager to exploit their sonar and navigational powers. Dolphins have been an inkblot for the past five decades, and have been seen variously as high-tech communicators, noble savages, androgynously postgendered beings, beach bums and surfer dudes, free lovers, angels free of the supposed curse of technology, and the epitome of a good society.[64]

Lilly led the way in such speculations, seeing dolphins, in Burnett's terms, as "sexually liberated, stereophonic, non-manipulative superintelligences."[65] "Dolphins have large brains," said Lilly's co-conspirator Ashley Montagu in 1962, adding with a touch of pathos: "Possibly they will someday be able to teach us what brains are really for."[66] In his effort to imagine a radical other to humans, as Bryld and Lykke show, Lilly only reproduced some obvious inequalities. He hoped that his research, for instance, would "be useful for interspecies communication with species other than dolphins, say with elephants or with the large whales, or between man and woman!"[67] Women were not Lilly's only others; he also compared dolphins to "the Negro races in Africa who are attempting to become westernized." Bryld and Lykke show how both weird and conventional Lilly's ideas about cetacean gender and race were. He started out as a Cold War neurologist and ended up a new age advocate of drugs and dolphins, and amid all his changes the idea that nature was the other, including racial minorities and women, remained unmoved. (This is obviously not the concept of nature endorsed in this book.)

Whales, with "their majestic bulk and mystic ways," played a somewhat different role. Rumbling basses to the dolphins' splashy tenors, their deep, mysterious voices were much more influential on the soundscape and musical imagination of the 1970s and beyond.[68] The call to save the whales echoed the extinction threat to the human species by nuclear annihilation and the Holocaust. The profile of dolphins also benefits from their living in paradise-like climes that loom large in tour-

64. Bryld and Lykke, *Cosmodolphins*.
65. Burnett, *Sounding of the Whale*, 619.
66. *The Dolphin in History: Papers Delivered by Ashley Montagu and John C. Lilly at a Symposium at the Clark Library, 13 October 1962* (Los Angeles: Clark Memorial Library, UCLA, 1963), 21.
67. Lilly, *The Mind of the Dolphin*, 98.
68. Melville, *Moby-Dick*, 106.

ism and imagination. (One Greenpeace activist called whales "a nation of armless Buddhas.")[69] And it was not only in the industrial West that dolphins served as an image of a radical alternative. Soviets found them good things to think with. Opined the official newspaper *Izvestia* in 1966: "Characteristic of the dolphins is a feeling of comradeship; they are unselfish in their relations to each other and always rush to help at the first call, even at the risk of their own lives."[70] Dolphins, the original communists, were at the heart of the two non-earthly spaces explored by and battled over by the United States and Soviet Union during the Cold War, outer space and the sea. Cetaceans again have always straddled brutal material interests and fantastic spiritual whimsies.

Inevitably dolphins have more recently been gaining a darker reputation. For two decades we've known that they apparently hunt for sport and take part in what looks like gang rapes. (And they do not seem to respect the incest taboo.) It is always hard to know where to draw the line between their behavior and our projection when it comes to the tabloid potentials of animal sexuality and predation. Dolphins, long a screen for projecting wish images of our angel nature, now reveal its devilish side as well. They swing between the "twin spectres of sacralizing and cannibalizing."[71]

Political Animals without Infrastructure

Whatever evils dolphins are capable of, however, pale in comparison to the scale of wickedness that a few humans, armed with civilization's leverage, have achieved. For my part, I take dolphins as very smart sea hippos, not the oceanic counterpart to human intelligence or aliens in our midst. Because mind is radically embodied, as Andy Clark argues, the minds of dolphins cannot be like ours. Clark shows how knowing is like swimming, playing the piano, bicycling, or doing equations with a pencil—an orchestration of technical skill and technological medium. Mind and matter are married, and mind is exterior to brain. Human

69. Bryld and Lykke, *Cosmodolphins*, 207.
70. Bryld and Lykke, *Cosmodolphins*, 203, 207, passim.
71. Bryld and Lykke, *Cosmodolphins*, 225.

cognition is a "fecund interface between a variety of action-oriented internal resources and a larger web of linguistic competence and cultural tools and practices." Mind is a compound with the environment: "larger structures (of agent and artifacts) both scaffold and transform the shape of individual reason." [72] Without the material supports we so richly use and ignore, our minds would be different, and cetaceans give a hint about what we would miss. Dolphins have no feet, hands, fire, houses, graves, astronomy, clocks, or writing—all infrastructures of the human condition as we know it, as I will argue, with qualifications, in what follows. They can create with their bodies, but not with their hands. They show us by contrast how intertwined our being is with our material environment.

What kind of worlds would appear to such beings? Millions of years went into making the living things known as humans and dolphins, and billions of years to provide a sea, earth, and heaven to dwell in. Dolphins invite us to consider the taken-for-granted stakes that pin down our world. What would up and down be? Dolphins certainly have front and back—kinesthetically if not visually—and probably right and left, but would they have north and south? Would lateralization of brain and world be used for navigation? What would it be like to sleep only in short snatches or only half a brain at a time? To see with the ears and speak with the nose? To have a predominantly acoustic relation to the cosmos? To have no knowledge of heavenly bodies, save perhaps sun and moon? To live in a medium in which soundproof isolation, one of the modern human criteria of privacy, was impossible?[73] To live in societies completely without material infrastructure or records?

Whatever material changes cetaceans could achieve would have to come in the shape of the only matter they can mold: their bodies. Marcel Mauss, in his concept of body techniques (*techniques du corps*) warned against "the fundamental mistake of thinking that there is a technique only when there is an instrument." The body, he said, was our first instru-

72. Andy Clark, "Embodiment and the Philosophy of Mind," in *Current Issues in Philosophy of Mind*, ed. Anthony O'Hear (Cambridge: Cambridge University Press, 1998), 35–52.
73. Erving Goffman, *Behavior in Public Places: Notes on the Social Organization of Gatherings* (New York: Free Press, 1963), 8ff; and John M. Picker, *Victorian Soundscapes* (New York: Oxford University Press, 2003), chapter 2.

ment.[74] (Chief among body techniques for Mauss was childbirth.) For cetaceans, the body would be the only instrument and wetware the only programming material. The boundary between dolphins and humans lies not in lofty matters of mind, reason, or communication, but in humble ones of physical shape, fire, feet, hands, and text. Our distinctness lies in our land habitat, our adopted body and environment, and the gift of durability. Reification properly understood is not an evil but rather the material basis of our continuity in time.

The key contrast between the aquatic and terrestrial worlds is the ability to fabricate objects. Dolphins could have arts but not apparatus because their relation to the world, in Leroi-Gourhan's terms, is purely "facial"—indeed, like that of their closest relatives, the hoofed animals. For Leroi-Gourhan, the facial and manual poles of the anterior field (*le champ antérieur de relation*) are the two great modes by which all animals relate to their environment. Tuna, gazelles, horses, cattle, and non-grasping birds have only a facial field.[75] Vertebrates often have both a facial and a manual field, and he believes it to be our special gift that feet, via upright posture, have liberated our hands from the duty of locomotion, save for contributing to walking and running. Human speech, Leroi-Gourhan thinks, could never have appeared had not the hands (and possibly cooking) rescued the mouth from the duties of gathering and consuming food, a release that in turn released the cranium from the need to support a vigorous dental armature, allowing for much expanded brain volume. Moreover, hand and mouth are coevolutionary organs of symbolization: the hand through what Leroi-Gourhan calls "graphism" (drawing and writing) and the mouth through the sounds of vocal language. But in a wetscape, a large brain can be supported without wilting the neck; speech, if it exists among cetaceans, must have appeared without the hand.[76]

For cetaceans the inorganic world is as beyond manipulation, as the stars or the weather are to us: a closely watched background out of our hands. Cetaceans can use the medium of the water for sound—their leaps

74. Mauss, "Techniques of the Body," 75.

75. *Gesture and Speech*, 31ff; *Le geste et la parole*, vol. 1, 49 ff.

76. The degree of "liberation" of head from neck varies among cetaceans, from the massive fixity of the head in whales to the highly flexible spines of Amazon River dolphins, whose unfused vertebrae provide an unusual range of motion for their long, thin, beaklike snouts.

and splashes could be a percussive semiotics, but they never take the form of choreo*graphy*. (Some dolphins are avid surfers.) Dolphins could have techniques of navigation by seamarks, tides, or currents, but no tools or writing, and only the briefest engineering of matter. For them, technics consists only of activities and not instruments.[77] Their world would lack registries, right angles, cardinal orientation, or the possibility of standard time—all rarely fathomed infrastructures that keep us afloat. (Complicating the usual story, the sole organ besides snout and flippers that seems capable of environmental manipulation is the penis, which is under voluntary control among cetaceans and has been seen, for instance, to be able to drag nets away. Kind of like that of a monkey's prehensile tail, such dexterity is an adaptation for coupling in a watery environment in which lovers cannot hold each other in their arms.)

Cetacean history fatally lacks the inorganic accomplices of stone, glass, silicon, metals, and electricity—and the organic accomplices of flowers, grains, cattle, yeast, dogs, papyrus, and wood—that have so shaped our history. Whatever culture these animals possess would have to be *hands-free*. They would have intelligence without infrastructure. They lack the sky media that are so crucial for orienting us and giving shape to our built environments. They do not have feet to hold them in place. There could be no such attitude as what Heidegger called *Zuhandenheit*, or being ready to hand. Without fingers, could they have digits or the arithmetic that follows from them? Could they have a geometry of points, lines, and planes without our basic phenomenological conditions of walking, looking, hearing, scanning, and taking one's bearings from the sky and the horizon? Geometry makes implicit reference to the shape of earth and sky and to the bodily shape and habitat of those who practice this art (one reason why the phenomenological tradition is so fascinated with geometry as an index of human being in the world). Whatever mathematics dolphins could possess would have to exist without the diagrammatic techniques that have governed ours. Perhaps, given their vortices and three-dimensional maneuvers, they excel in topology, with loops and inside-out surfaces that would strain our torus-embodied minds. (Flusser, for his part, thinks that squids would

77. To update a distinction from Martin Heidegger: "Die Frage nach der Technik," *Vorträge und Aufsätze* (Pfulligen: Neske, 1954), 71.

have dynamics instead of geometry.) In any case, cetaceans show us by contrast that *technē* is our lot, written into our terrestrial environment and thus inseparable from human nature. The rest of this book surveys crafts that dolphins lack: sea media, fire media, sky media, writing media, and database media. Enormous blessings, all of them, and each one with a stinger on its tail.

Dolphins show us communication without artifacts. To dolphins is forever closed the possibility of the inorganic media of mind. They cannot make instruments or monuments, and cannot externalize or automate. Their quicksilver intelligence would vanish with the event. Data would always be streaming, never downloading, a library of instantly disappearing books like radio and TV shows in the days before home taping, or like speech before writing. We take stationary objects for granted, except on spacecraft and seacraft where they must be battened down. Cetaceans would lack both fixity of objects and what philosopher Paul Ricoeur called "the fixation of meaning," the preservation of symbolic (legal, religious, poetic, musical, philosophical) achievements.[78] For good and ill, they do not possess "the devastating power to wreak thought upon the body of the world."[79] Dolphins would be naturally schooled in the Buddhist practice of detachment—except that they wouldn't know it. They could have "things" in the sense of an assembly of citizens, but no "things" in the sense of artifacts or architecture. In sum, dolphins could have parliaments but no pyramids; memory but no history; poetry but no literature; religion but no scripture; education but no textbooks; law but no constitution; counting but no chalk, paper, or equations, and thus no mathematics; music but no scores; weather reports but no almanacs; navigation but no ephemerides; culture but no civilization.

In the sea, said Melville, "to traditions no rocks furnish tablets."[80] Dolphins exemplify "oral" culture. Immortal fame among dolphins would lie in memory, limiting its life span to a few centuries, although the greater longevity of some cetacean species—up to two centuries in some whales—may extend memory's duration. Indeed, if whales have a col-

78. Paul Ricoeur, *Hermeneutics and the Human Sciences*, ed. John Thompson (Cambridge: Cambridge University Press, 1981), chapter 8.
79. Loren Eiseley, "The Long Loneliness," in *The Star Thrower* (New York: Times Books, 1978), 37–44, at 43.
80. Melville, *Moby-Dick*, 409.

lective memory, one of their central narratives would have to be the near genocide of Boschian butchery their kind underwent over the twentieth century. Their material media, sound in the water and the memories of their brains and bodies, are less mixed than ours. Writing and its associated means of recording do not exactly make us human, but they do help make civilization as we know it, for better or worse. One mark of civilization is that the store of records outstrips any single individual's knowledge. In an oral culture, a single individual can know all there is to know; indeed, what there is to know is defined by the storage capacity of an individual. Dolphins invite us to recognize the degree to which our worlds are made of nonhuman stuff. Under the sea, the two scholarly "sins" of technological determinism and talk of essential human qualities no longer seem so bad.

Cetaceans cannot—and this is a key point—bury their dead or make lasting gravesites, though they do seem to mourn those that have died.[81] One of the most decisive markers of "behavioral modernity," the package of symbol-using traits associated with the appearance of modern humans many tens of millennia ago, is the burial of the dead; symbolization is tied historically to the marking and overcoming of death, and any system of symbolic storage such as writing or photography will have had a crypt-like reputation. Dolphin culture would have to manage without the grave, one of humanity's great semiotic resources, perhaps the first fixed human address, and the prototype of all recording media since the pharaohs. Modern Europe is haunted by the thought that all our gear amounts to one big tomb, civilization being nothing more than the project of fending off death by devices.[82] Dolphin know-how would consist exclusively in the political and performative arts. They could have no tombs for their Lincolns, Lenins, or Maos—if indeed their social order would ever even permit such leverage over life and death.

Despite such lacks, there is no reason to think that such intelligent and sociable creatures do not have highly developed forms of communication and culture. And if they do not have complex forms of culture or

81. Rowan Hooper, "Do Dolphins Have a Concept of Death?" *New Scientist* 211, no. 2828 (3 September 2011): 10.

82. Peter Sloterdijk, *Derrida ein Ägypter: Über das Problem der jüdischen Pyramide* (Frankfurt: Suhrkamp, 2007).

intelligence, our conjecturing does them no harm and may even help protect them from further anthropogenic damage. Consider possible aquatic techniques, starting with swimming and hunting. Tuna take advantage of vortices to propel themselves through the water at speeds much greater than would be predicted from their body size and strength, benefitting from hydraulic phenomena their swimming creates: their techniques shape the environment to enhance their techniques.[83] Pilot whales hunt in packs numbering up to one hundred, dolphins swim in superpods, and narwhals manage to avoid jabbing each other with their unicorn-like twirled teeth—all feats that must involve rapid coordination (perhaps by echolocation and feedback). Killer whales in the North Atlantic and humpbacks in the North Pacific stun herring with their sonar beams, which resonate incapacitatingly through their well-developed hearing apparatus, sound louder than a lightning crash, and feel, say divers, like being kicked in the head by a horse. The whales whack the herring with their tails or drive them to the surface, and feast lazily on the dazed fish like a king eating grapes. Orcas seem able to pick out Chinook salmon from among other less tasty fish by sonar. Bottlenose dolphins have been cooperating to mutual advantage with fishermen on the Brazilian coast since the middle of the nineteenth century: they drive mullet toward the fishermen standing in shallow, murky water, signal by rolling over when it is time for the men to cast their nets, and then devour the fish that flee from the nets. The fishing is initiated by the dolphins, not by the fishermen, who know many of the dolphins by name.[84]

Other techniques are harder to access empirically. Why couldn't a water-only habitat afford a great deal of cultural development? Dolphins have complex forms of social life and signals that maintain mother-calf contact, group order, pair bonds, rivalry, and other forms of social life.[85] Lifelong matrilineal bonds also exist among whales, so kinship could

83. M. S. Triantafyllou and G. S. Triantafyllou, "An Efficient Swimming Machine," *Scientific American* 272 (1995), 64–71.

84. See Karen Pryor, Jon Lindbergh, Scott Lindbergh, and Raquel Milano, "A Dolphin-Human Fishing Cooperative in Brazil," *Marine Mammal Science* 6 (1990): 77–82. This collective is dramatized in *Ocean Giants: The Fascinating Lives of Whales and Dolphins* (BBC Earth, 2012), part 3. Pliny the Elder mentioned similar cooperation in the Mediterranean in *Naturalis historia*, book 9, chapter 9.

85. Tyack, "Functional Aspects of Cetacean Communication."

be a source of social organization. Male dolphins bond and team up for life, their signature whistles often merging into new conjoined calls. Intelligent marine mammals could conceivably have traditions of music, dance, gymnastics, child rearing, and language—there do seem to be dolphin dialects, suggesting in and out groups (so much for the utopia of a community without marked outsiders). There could be teachers and students. They could have the art of memory, though without the fixed "places" (*topoi*) that architecture and, to a lesser degree, astronomy have provided to mnemotechnics since the ancient Greeks.[86]

Cetaceans could certainly be capable of what Hannah Arendt calls "action," the bringing of new political orders into being, as opposed to "work," the fabrication of things that last in a durable world. They are also capable of what she calls "labor," tasks that reproduce life itself. Work and action for Arendt are the two ways in which human beings can leave a stamp on time: by changing relations among objects (work) or among subjects (action)—that is, by creation and procreation. The paradigm of action for Arendt is giving birth, "natality," bringing something radically new into the world. For humans, work and action blur, but for dolphins, there could be no work. They could deliberate about laws and penalties, including excommunication from the group, and could be political animals since they have interests—their being is mutual, *interest* suggesting being among or between (*inter esse*). (Arendt followed Aristotle in defining political animals by role differentiation in the pursuit of a common project.)[87] Some even think dolphins have an aquatic public sphere: "Democracy takes time," speculated one marine biologist, "and they spend hours every day making decisions."[88] The apparent intensity of dolphin sociability led Gregory Bateson, another luminary who spent time at Lilly's Communication Research Institute, to imagine them as ideal psychotherapists who had evolved uniquely for emotional intelligence.[89] Others thought them something like new communalists expert

86. See the classic study by Frances A. Yates, *The Art of Memory* (1966; London: Pimlico, 1994).

87. See David J. Depew, "Humans and Other Political Animals in Aristotle's *History of Animals*," *Phronesis* 40, no. 2 (1995): 156–81.

88. Natalie Angier, "Dolphin Courtship: Brutal, Cunning, and Complex," *New York Times*, 18 February 1992.

89. Burnett, *Sounding of the Whale*, 613 n164.

at building a creative commons.[90] Dolphins could even possess rhetoric, one of the first of many "techniques" to be denounced as not up to epistemic snuff, and one with an intimate association with the art of memory.

Dolphins teach us the blessing of infrastructure. Cetaceans lack the tools to shape artificial and natural environments. Dolphins may be able to nuzzle mud with beak, fin, or fluke, building short-lived dams to channel fish, and dive into the sandy bottom headfirst after fish with sponges clasped in their mouth to soften the blow, but they cannot leave a lasting mark on time, space, or matter. Like melancholy romantic poets, their art is mutability, "a book of myths / in which / our names do not appear."[91] Many cetaceans seem to be bubble artists, exhaling blasts of air into the water. Bubble clouds serve as nets for encircling fish, as masculine displays of aggression, and perhaps as play, but such oceanography (taken in its literal sense) vanishes quickly. (Bubble streams are also signals of size in male display—the more bubbles, the bigger the lungs, and the bigger the body.)[92] Some whales seem to intentionally spray rainbows in the air from their blowholes, though they can't see colors—perhaps to delight human spectators in a "clever Hans" phenomenon, named after the horse that seemed to count but was actually only pleasing the humans whose nonverbal cues he was reading. Natural media are the only media available to our briny cousins, and only a restricted repertoire at that, ones uniquely resistant to any graphic staying power.[93]

Perhaps cetaceans have simply outsourced their crafts of memory and history—to us![94] We must be as confusing to them as the gods were to the ancient Greeks: we rescue cetaceans when they are beached, kill them intentionally for their acoustic fat or unintentionally as "bycatch" in tuna nets, write their chronicles, and spoil their habitats with noise and chemicals. Perhaps they, too, store their data in a strange sphere

90. Fred Turner, *From Counterculture to Cyberculture* (Chicago: University of Chicago Press, 2006), and Bryld and Lykke, *Cosmodolphins*, 202–6, passim.

91. Adrienne Rich, "Diving into the Wreck."

92. In 1809 the German physician Sömmering invented a prototypical telegraph system using hydrogen bubbles.

93. "And though they breathe air, cetaceans basically like being in the water, while books are mostly written on paper, a substance that fares poorly when submerged. In this sense books and whales are, in an important way, immiscible." Burnett, *Sounding*, 1–2.

94. Thanks to Tore Slaatta for this point.

over their heads, kept above in "the cloud" by beings they sense but little understand.

Techniques without Technologies

Dolphins, in other words, could have techniques but no technologies. Techniques and technologies are distinguished by the durable materiality of the latter. Concepts of technology have long hovered between these two poles of practices or skills on the one hand and tools or gadgets on the other. The ancient Greek term *technē* is often translated as *art* or *craft*, and in modern Greek, which is often a good indication of meanings implicit in ancient Greek, the term can mean "mastery," "artistry," or "dexterity," all pointing to the activity of the artisan, not only to the material instrument or the final product. In nineteenth-century English, *technology* referred to the study of the mechanical arts rather than to technical devices or systems, carrying on the ancient cognitive sense of the term. *Technologie* was coined only in 1770s Germany, and it meant a field of learning, a sense reflected in the name of the Massachusetts Institute of Technology, founded in 1861. (This sense persists in French and German today, which use *technique* and *Technik* to mean "technology.") Terms such as "craft," "device," and even "machine" once had more tactical or rhetorical senses, but they started to solidify into material objects under pressure from modern science and industry.

Thorstein Veblen, probably the last century's most important shaper of the concept of technology, saw technology as ambiguous between handcraft and skill on the one hand and machine and scientific system on the other. For Veblen, writing in the 1910s and 1920s, modern "technology" depended on theoretical knowledge in a way that older arts and techniques did not. Medieval handicraft or ancient metalsmithing had little need for the sciences of the time, unlike modern technologies of all kinds. Making and knowing had become conjoined in a way unprecedented in history, Veblen thought, and *technology* stood for that conjunction. By the mid-twentieth century, technology took on a sinister air in the light of the atomic bomb, television, hydroelectric dams and mass production, and other big beastly machines that seemed impervious to human input or democratic steering; Karl Jaspers, for instance, wrote

of the concept's "demonism." Much philosophy of technology since has tried to sort out the ways in which the concept carries with it a sense of overpowering social direction or "determinism."[95]

The notion that technology is inhumane has a long lineage. There is a narrative since the ancient Greeks and Hebrews that technics marks expulsion from the presence of gods: when paradise was lost, people had to live by their wits, tools, and tactics. As the philosopher of technology Bernard Stiegler says, tracing ideas about technics from Plato to Rousseau, "The fall is exteriorization."[96] To live utterly without media suggests a supposedly heavenly state in which the need for means has been lifted. Like angels, dolphins represent the dream of meanings without matter. Since they lack devices, some assume they also lack the vices. But this is obviously not the story I am telling: our virtues, such as they are, depend radically on the footings we have devised to stand between heaven and earth.

The macro-focus of philosophers of technology like me can grate on the sensibilities of scholars more interested in the exclusively human world, where workers, women, and ordinary people fight over the definitions and uses of new objects.[97] Given its "hazardous" intellectual DNA, perhaps any use of the term *technology* risks effacing the part played by people. The denunciation of "technological determinism" in the name of popular agency, however, not only underestimates the power of devices but also overestimates the power of people. It provides metaphysical comfort by keeping subjects and objects in separate boxes, something

95. Leo Marx, "The 'Idea' of Technology and Postmodern Pessimism," in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith and Leo Marx (Cambridge, MA: MIT Press, 1994), 238–57; Leo Marx, "*Technology*: The Emergence of a Hazardous Concept," *Social Research* 64, no. 3 (fall 1997), 965–88; Eric Schatzberg, "*Technik* Comes to America: Changing Meanings of Technology before 1930," *Technology and Culture* 47, no. 3 (July 2006): 486–512; George Parkin Grant, *Technology and Justice* (Notre Dame, IN: University of Notre Dame Press, 1986), 11–14.

96. Bernard Stiegler, *Technics and Time: The Fault of Epimetheus*, trans. Richard Beardsworth and George Collins (Stanford, CA: Stanford University Press, 1998), 116, 96; Bert de Vries and Johan Goudsblom, eds., *Mappae Mundi: Humans and Their Habitats in a Long-Term Socio-Ecological Perspective* (Amsterdam: Amsterdam University Press, 2003), 271 ff.

97. Thomas J. Misa, "How Machines Make History, and How Historians (and Others) Help Them to Do So," *Science, Technology, and Human Values* 13 (1988): 308–31, notes that philosophers of technology are most friendly to ideas of technological determinism, and women's and labor historians least so.

I don't think can be done without trouble. The claim that technologies should be subject to humans portrays our wills as immaterial and disembedded, as if we were not already networked creatures, and as if matter were blank nothingness—an insult to this pluralistic universe. As if our intentions and actions were transparent to ourselves. As if our bodies were not technical systems as strange and mysterious as any devices we use. As if the history of life on this planet were not already the great showcase for the inventive messiness of intelligence free to act in its sphere. The agency of human beings is a question we should answer, not a fact we should assume. A theory of human technicity should humble us by showing our radical groundedness, not encourage us to vaunt our distinctive powers; the question concerning technology should radically examine what we humans are. [98]

The fear of "technological determinism" serves to uphold a barrier between mind and matter, human and thing, animal and machine, art and nature—precisely the continuities across which the most interesting cultural histories of media are written. By isolating acute parts of our world as technology that we should control, it effaces the existential fact that we live environmentally, dependently, in apparatuses not of our own making, starting with the womb itself. The fear that technology could impose itself externally on humans is a form of denial that humans are already beings made by art, although I would be the last to deny that some forms of technology need vigorous criticism. Things can be alive and people can be machines—these inalienable truths are obscured by the charge of technological determinism. We might add to Bruno Latour's saying "Things are people too" the corollary: "People are things too." Saint Augustine said it well: "We, however, who enjoy and use other things, are things ourselves."[99]

The recent proliferation of small, smart, digital devices which blackbox the technology but require much manual and mental interaction is one condition for the rethinking of these terms. From bombs and dams to laptops, genetically modified crops, and geo-engineering, the ground

98. For a broad discussion, see *Die technologische Bedingung: Beiträge zur Beschreibung der technischen Welt*, ed. Erich Hörl (Berlin: Suhrkamp, 2011).

99. Augustine, *De doctrina christiana*, 1:22. "Nos itaquae qui fruimur et utimur aliis rebus, res aliquae sumus."

of the philosophy of technology has shifted radically in recent decades. The task is to rethink technology as constitutive of the human being without thereby providing Silicon Valley with one more marketing argument. (In Bogost's version of object-oriented ontology, for instance, *thing* could often be replaced with *Apple product*.) After decades in which humane voices opposed—and with good reason—the technophilia of the technicians and engineers, changes in our meteorological and technical climate invite a reorientation toward a philosophy of media that appreciates the embedment of techniques without forfeiting critical judgment.

Certainly, digital devices are a chief backdrop for the new intellectual interest in handicraft at the heart of all technical work in thinkers such as Latour. Similar is the recent concept in German media theory of *Kulturtechniken*, a term that is hard to translate because each half of the term has double partners in English (*culture* or *civilization*, *technique* or *technology*)—terms the dolphins help us sort out. A recent definition states that *Kulturtechniken* may include "inconspicuous techniques of knowledge such as filing cabinets, writing implements, and typewriters, discourse operators such as quotation marks, pedagogical media such as the slate, singular media that defy classification such as the phonograph, or disciplinary practices such as literacy training."[100] Such cultural techniques, however inconspicuous, can turn the world. In the discovery of the anthropomorphic business at the heart of technics, the repressed has returned in German media studies since Kittler.[101]

For me, *techniques* is the right translation of *Techniken* if we are thinking about practices of know-how, handicraft, and corporeal knowledge that interact with bodies or instruments. In cars, detailing and diagnostics are techniques, but camshafts and crankcases are technologies. Techniques can be purely cognitive or bodily if you are a dolphin, though it is hard to find such purity in the object-ridden human being. Naked-eye stargazing, breathing, and swimming might at first seem like relatively object-free techniques, but they depend both on *Umwelten* (the sky, oxygen, water) and training. Many of Mauss's body techniques, such as marching, jumping, climbing, squatting, and sleeping, stemmed

100. Lorenz Engell and Bernhard Siegert, "Editorial," *Zeitschrift für Medien- und Kulturforschung* 2 (2010): 5–9.

101. See the special issue on cultural techniques of *Theory, Culture and Society*, 30, no. 6 (2013).

from military drill and were the result of some kind of software.[102] Leroi-Gourhan, Mauss's student, put it well: "Techniques involve both gestures and tools."[103] Techniques have both biological and artifactual histories; they consist both of suites of actions and of materials, even if those materials are the body of the user. For Leroi-Gourhan, techniques orchestrate the intersection of tool and a "chain of operations" (*chaîne opératoire*).

Everything durable is material, but not everything material is durable. Techniques are material but are not necessarily durable, while technologies always are. Speech is a technique, but writing is a technology. Speech is a muscular exercise that modifies pressure gradients, moving matter around, both in the vocal and hearing organs of the speakers—their bodies—and in the conducting medium of air or water. It does not need ink, a planar surface, or anything whose trace outlasts its utterance. The line between technique and technology is externalization into durable form, and thus the ability to profit from distance and absence. (Alfred Korzybski defined "time-binding" as the essential human marker.) We make signs that speak in our absence, and we are immersed in the leavings of those who've gone before. (Autonomous technology is not unique to the industrial era; it is part of the history of human technics in general.) These traces include our bodies, whose structure and DNA testify to a long history of the departed and absent.

Nonsimultaneity

The great foe of durability, of course, is time, and time presents one last axis of difference for our thought experiment. What would it be like to live in a world without standard time? In a world in which there could be no agreed-upon chronology marking the serial order of historical events? What if effects preceded causes and answers preceded questions? What

102. Marcel Mauss, "Techniques of the Body," trans. Ben Brewster, *Economy and Society* 2, no. 1 (1973): 70–88, and Erhard Schüttpelz, "Körpertechniken," *Zeitschrift für Medien- und Kulturforschung* 2 (2010): 101–20.

103. *Gesture and Speech*, trans. Anna Bostock Berger (1964–65; Cambridge, MA: MIT, 1993), 114; *Le geste et la parole*, vol. 1 (Paris: Albin Michel, 1964), 164: "La technique est à la fois geste et outil . . ."

would cetacean communication techniques look like, especially over space and time?

Dolphins are irresistible metaphors for the sea as what Tim Berners-Lee, inventor of the World Wide Web, called "a single global information space."[104] Perhaps they've spent millions of years building an Internet of open communication, a metaphor that regularly appears in the cetology literature.[105] Their great auditory range could open up possibilities of signal processing we barely fathom. From information theory we know that frequency is a measure of channel capacity. One reason, for instance, why FM radio is better than AM for transmitting music, which requires a more complex signal than speech, is that FM deals in megahertz instead of kilohertz, the lowest FM frequency operating at about fifty times more cycles per second than the highest AM frequency. Due to their high frequencies of phonation and audition, odontocetes could perhaps, like computers, encode and decode immense amounts of data in subsecond slices of time. Well-developed neural auditory processing centers may allow them to send and receive highly complex data through the waters. Perhaps they can even trade auditory "images." For us to understand a dolphin's unaltered "speech" might be like trying to understand the squeaks and grunts that dial-up modems or fax machines make. We could hear the noises but have no idea what texts, numbers, pictures, or music they stood for; our "baud rate" is too slow (human hearing ranges, at best, from twenty to twenty thousand cycles per second, or hertz; dolphin from about four hundred to two hundred thousand hertz).[106]

What kind of auditory storage and transmission could the ocean afford for smart animals that had millions of years to experiment with it? As we know from early radio history, jamming (interference) is a prob-

104. Jan Müggenburg and Sebastian Vehlken, "Rechnende Tiere. Zootechnologien aus dem Ozean," *Zeitschrift für Medienwissenschaft* 4, no. 1 (2011): 58–70, and John Shiga, "Of Other Networks: Closed-World and Green-World Networks in the Work of John C. Lilly," *Amodern* (2013), http://amodern.net/article/of-other-networks/.

105. E.g. Tyack, "Functional Aspects of Cetacean Communication," 272.

106. Recently marine biologists have gone into the water with computer-assisted vocal pitch shifters in hopes of generating higher-frequency sounds of greater interest to dolphins. See MacGregor Campbell, "Learning to Speak Dolphin," *New Scientist* 210, no. 2811 (7 May 2011): 23–24.

lem when many senders use the same channel at the same time. (Two years before the *Titanic* sank in 1912, the US Navy Department referred poetically to the "etheric bedlam" of the unregulated airwaves.) Living in a single medium, cetaceans would be under significant evolutionary pressure to filter messages out of the constant din. Group glossolalia may have its uses and pleasures, but the question of how to get a message across the static and how to pick a signal out of its midst were key questions in radio's history, and perhaps similar concerns have pushed the hearing of cetaceans, with its higher baud rates, toward auditory multitasking. Humans learned to build ships, track stars, and write programs; and perhaps dolphins, having nothing better to do with their large brains, learned to pluck single voices out of the pitchy tangle of high-frequency noise. If they built an oceanwide web, it would have no archive but their collective brains and no search engines but their sonar.[107]

Though sound travels much faster in water than in air, it is still much slower than light. Most human communication is marked by imperceptible nonsimultaneity. Even though there is a microscopically small lag time between the speech of one person and its hearing by another (and an even longer lag in its cognitive processing), we rarely perceive the gap or note its effects on the structure of interaction. Speech and hearing are not simultaneous, but our senses are too dull to notice. Even at electrical speeds, a small lag passes for contemporaneity in worldwide telecommunications on our smallish globe. At cosmic distances, when these gaps become apparent, all kinds of havoc occurs. Einstein made great theoretical profit thinking about the lags between remote clocks and the difficulties of coordinating standard time at great distances, and concluded that a single "now" would be impossible on the scale of the universe (see chapter 7). To achieve distant simultaneity, two clocks would have to compensate for the time that the signal burned to arrive at the second clock. The circumference of the "now" is defined by signal speed.

Einstein discovered relativity while pondering the finite speed of light, and our briny friends may have noted something similar with the finite speed of sound: they have no universal acoustic standpoint that could set all clocks simultaneously to the same time. Einstein spoke of the relativity of the observer, and perhaps some ocean collective has dis-

107. On the ocean as a (contrary) communication system, see Stanisław Lem, *Solaris*.

covered the relativity of the listener. To acoustically intelligent marine mammals, the difficulties of distant simultaneity would be apparent on much smaller scales of distance than to us. How might they manage the problem of multiple temporal origins? Cetaceans do seem to have differentiated strategies of distant and proximate communication. Offshore bottlenose dolphins engage in rapid-fire sound production when swimming in groups. Their whistling can be marked by over 50 percent overlap in phonation among two to six animals simultaneously. This chorusing, as it is known, is less frequent among shoreline dolphins, perhaps because the pressures of living offshore, in a greater range of territory, require more tightly knit communication.[108] Mother-calf pair vocalizations among baleen whales tend to be rare and low in volume, perhaps to avoid attracting the attention of predators and males, so some phonations are clearly designed for proximity. Other baleens, such as humpbacks, are legendary for their ocean-spanning "songs." There is much speculation: are these phonations symphonies, lonely mating calls, or simple joyous noise? Why are males the exclusive singers? (Almost all birdsong is produced by males as well.) We do know that there are fads and fashions in humpback songs that spread virally across the Pacific Ocean, so whale song is at least intensely social.

Would distant ocean intelligences have the same troubles engaging in dialogue as mutually distant extraterrestrials? Just as observers at different cosmic lookouts see different constellations, so listeners in different spots of the ocean hear distinct sonic constellations, receiving distant messages in an order determined not only by the time of sending, but by the receiver's position relative to the senders. Closer analysis shows that utterances underwater would arrive in slightly different serial order to listeners in different locations (see appendix). The turn-taking sequence, which we use as an interpretive resource in conversation, could be slightly off in distant ocean discourse. Never, however, in underwater diffusion would the temporal sequence be reversed, except in the very unlikely case of sound waves from the same source circumnavigating the globe in opposite directions. Even underwater, the flow of time does not run backwards. (It takes terrestrial recording media to do real time axis manipulation.)

108. V. M. Janik et al., "Chorussing in Delphinids," *JASA* 130, no. 4 pt. 2 (October 2011): 2322.

As distant cetacean correspondents would not share the same exact sequence of messages, they cannot presuppose ordinal logic. For distant underwater communications with many senders, no single "now" can serve as the fulcrum of turn-taking. What would communication be like without strict time order? What happens when distant voices take minutes or even hours to arrive? How would humpbacks avoid losing the thread? Could a savvy speaker use the differences of arrival times to reconstruct the serial order of messages as delivered in real time? (Some cetaceans, like bats, engage in Doppler compensation, adjusting for their own motion, perhaps as astronomers use red shifts to estimate the age and distance of stars.)[109] What would "conversational implicature"—Paul Grice's term for the supposition that utterances are somehow relevant to what they follow—mean in a medium where distances made precise coupling between speech turns impossible? In an environment with an extended "now," humpbacks and other long-distance senders might develop modes of talk and song that downplayed the relevance of the hic et nunc. Since phonations would arrive at different ears at different times, perhaps humpbacks identify the voices and retroactively reconstruct who must have been responding to whom in the same way that one can read an Internet discussion and piece together the various threads of the conversation. Or perhaps they don't care, and play their vocals for cloudy musics. Perhaps cetaceans live in what medieval mystics called the time of the now—a plural now in which many different times cross.[110]

A world in which one utterance does not follow another sounds odd at first. and beyond the norms of conversation. But the time of the elongated now is found everywhere in natural and human worlds. The nocturnal stars are a field of nonsimultaneity, appearing together to our eyes though they mingle huge differences in temporal origin. Some may have even ceased to exist, but their light, launched eons ago, still touches our retinas. If it did not cost light time to travel the ever-expanding cosmos and the universe had existed forever, the night sky would be white with light, a star shining at every possible point (assuming a more or less even distribution). Known as Olbers's paradox, the blackness of the night sky

109. Tyack, "Functional Aspects of Cetacean Communication," 306.
110. See discussion of "Jetztzeit" in Walter Benjamin, "Über den Begriff der Geschichte," *Erzählen*, ed. Alexander Honold (1940; Frankfurt: Suhrkamp, 2007), 129–40.

is a tribute to the finite velocity of light and the finite age of the universe, a message that is also a comment on its medium.

There are many other examples of storehouses of the fullness of times. The lithosphere, our DNA, and our language preserve bits of the past scrambled that allow random access. Our DNA in particular is a record of our species's epidemiological history, our prehistoric battles against viruses, many of which have been taken on board our host genome in exchange for immunity.[111] Libraries, museums, memories, and history itself are all collections of multiple nows, and accessing them is a fundamental problem in database organization. (How to access DNA, or epigenesis, is a similar problem.) Human hearing makes inferences from small timing differentials, and perhaps cetaceans do something similar on a larger scale for underwater sounds. Maybe the whole ocean is their auditory apparatus and archive; by joining their water-based inner ear with the outer ear of the ocean, perhaps they have a medium for being in time that resembles our recording media but contrasts with the apparent instantaneity of our oral communication. What is perhaps natural for them—nonlinear data access—is a matter of cultural techniques for us, and is only made possible by recording media (see chapter 6).

Of Vampire Squids and House Cats

Consider the squid: by far a more grotesque marine fantasy than dolphins, at least if we go by Vilém Flusser, the polyglot, polymath media philosopher who made *Vampyroteuthis infernalis*, the vampire squid from hell, famous. His foray in alien phenomenology, written with biologist Louis Bec and recently translated into English, is an extraordinary short text whose genre is somewhere between fable, black comedy, horror, spoof, parable, science fiction, and animal porn. Flusser and Bec treat the squid as an antipode to human *Dasein*. We look forward and defecate backwards, and our gastrointestinal tract is below our head. Squids, in contrast, have their sense organs, their tentacles, below their heads, and

111. Luis P. Villareal, "Can Viruses Make Us Human?" *Proceedings of the American Philosophical Society* 148, no. 3 (2004): 296–323.

their guts above. Lacking an endoskeleton, squids enjoy a polymorphous perversity so total as to be self-destructive: their month-long orgasmic clenches can end up with the squids eating themselves and each other. Squids use death to rise above their default setting of eros; we humans transcend our default setting of death by eros. Flusser and Bec lavish particular attention on the squid's triple penis, alerting us that their fantasia is a kind of masculinist counterpart to feminist dolphins. "If only we could grasp the world with a penis," they effuse, stating a core fantasy in much of the philosophy of technology with refreshing frankness.[112]

Flusser and Bec were also fascinated by the inkfish's ability to squirt and shape clouds of ink—that is, its artistic equipment. Squids ejaculate a mix of melanin and mucus through their head-mounted anus to dazzle and distract predators, and perhaps also to impress conspecifics. Once ejected, these inky fluids can be sculpted by their many limbs into phantom doubles—"pseudomorphs"—which the predator is supposed to attack instead. Flusser thought such submarine sculpture went beyond self-defense: "The vampyroteuthis broadcasts information in sepia clouds." Here was an organism that could lie—one, like the human, gifted with art. Its signature was forgery.[113] And of course the squid's ability to exude vast clouds of ink provides a ready point of identification for any theorist.

More recently, the digital designer and virtual reality pioneer Jaron Lanier has fallen for cephalopods, and especially for their skill at colorful morphing. In the old link of sea and outer space, he says that squids provide us "a dress rehearsal for the far-off day when we might encounter intelligent aliens." By morphing their bodies three-dimensionally, cephalopods practice a "postsymbolic" mode of communication that works not by emitting signals but by altering bodily form. With cephalopods, Sign is *Sein*: there is no gap between appearance and reality. Thanks to an enormously malleable body and a skin loaded with chromatophores, cephalopods, according to Lanier, are endowed with three-dimensional displays that essentially sweat colors. He enthuses that squids use bodily performance art in their existence, their colorful shape-shifting bodies

112. Flusser and Bec, *Vampyroteuthis Infernalis*, 20.
113. Flusser and Bec, *Vampyroteuthis Infernalis*, 50.

and shadow painting revealing a technicity built into every cell. (Lanier's musical band is called Chromatophoria.)[114]

This excursus on squids raises the ethics of animal otherness. What is at stake in reaching for the most exotic species possible? Why don't philosophers of the animal exalt house cats, for instance? Jody Berland asks this question, noting the tendency among some male philosophers to prize maximal exoticism in their animals, a critique certainly relevant for the squid theorists. As Lanier says, in praise: "Cephalopods are perhaps the most 'other' that we know." No one ever says this kind of thing about cats. Cats, Berland argues, are all too familiar. As feminine companion species, pussycats call forth (male) worries about suppressed wildness and female sexuality, and arouse general jitters about domestication. Cats are the most maligned and tortured of animals (outside the slaughterhouse) and are also the animal with the most profuse online existence (outside pornography). Berland criticizes thinkers such as Gilles Deleuze and Félix Guattari for thinking that house cats are enslaved, abject beings in need of liberation, as if living at home were a kind of bondage. Cats evoke the uncanny, *unheimlich* quality of the domestic world, the place where the most difficult and deepest of all labors are performed.[115] Perhaps the most uncanny thing of all, says Freud, is the womb—the home we came from but do not recognize. Freud, like Berland, links the uncanny to male anxieties about the female body, and castration anxiety is of course another source of *das Unheimliche*, a hard-to-translate term which the English *unnerving* captures quite nicely.

Squids or cats? The consideration of animals as objects for the philosophy of technology has somehow landed us in gender politics at the most basic level possible. Heidegger said that to ask about *technē* is to ask about *physis*; he knew, but unlike Kittler did not point out, that *physis* can mean genitals in ancient Greek (as indeed *Natur* can in German).[116] In revealing nature, technology also necessarily reveals sexual differ-

114. Jaron Lanier, "Why Not Morph: What Cephalopods Can Teach Us about Language," *Discovery* 27, no. 4 (2006): 26–27. In a response to an e-mail query on 14 February 2013, Lanier reported that he hadn't heard of Flusser before.

115. Jody Berland, "Cat and Mouse: Iconographies of Nature and Desire," *Cultural Studies* 22, nos. 3–4 (May–July 2008): 431–54.

116. Kittler, *Musik und Mathematik* 1.1. (Munich: Fink, 2006), 30n8; and *Liddell-Scott-Jones Greek-English Lexicon*, physis, VII.

ence. Technology can never be thought apart from gender, and remains a highly masculine category. How did this bias, as Innis would call it, come about?

As elsewhere in this book, a few paragraphs will have to serve where a treatise is needed, but let me venture two thoughts. First, agriculturally supported civilization, in contrast to hunter-gatherer societies (which of course are just as subject to egalitarian fantasies as are dolphins), is, for widely debated reasons, male-dominated.[117] Only a relative few have operated the technologies I study here—ships, calendars, writing, computers, or philosophy itself—and they have been men, with a few notable exceptions. "Yali's question," asked by Jared Diamond's Papuan friend—Why did white people get all the "cargo?"—could easily be asked by other groups.[118] For example: Why did men end up with all the cargo? Or, more pointedly: Why did only a few men end up with all the cargo? Most humans, male and female, have labored with their bodies to sustain the circle of life without any access to the media of durability. Perhaps dolphins have been so interesting to feminist theorists because dolphin arts resemble traditional women's arts, such as birthing, child care, cultivating, cooking, and community making.[119] In emphasizing the critical role played by sailing, navigation, burning, timekeeping, and documenting, my aim is not to endorse the historical dominance of paterial over material media. Not everyone reads the sky, makes records, or sets the clock, but those who do arrange the infrastructural settings for the rest of us. Understanding leverage helps us learn how to democratize it. Artificiality is our lot, yes, but that does not mean there is not a lot of fight left about how to design it. Any reader of Innis understands that to look for infrastructural elements is not to succumb to a delusion that all is well in history, but to ready oneself for battle.

Second, technology in patriarchal societies (i.e., civilization) has been conceived in a masculinist fashion, as tools of governing and organizing matter rather than as techniques of producing and caring for people and their bodies. McLuhan provided a perfect version of the patriar-

117. For a nice short overview of explanations, see Johan Goudsblom, "Het raadsel van de mannenmacht," *Het regime van de tijd* (Amsterdam: Athanaeum Boekhandel Canon, 2006), 97–107.

118. Jared Diamond, *Guns, Germs, and Steel* (New York: Norton, 1999), 13–28.

119. Zoe Sofia, "Container Technologies," *Hypatia* 15 (2000): 181–201.

chal status quo in arguing, in essence, that men give birth to technologies and women give birth to men. "Man" was "the sex organs of the machine world" and "woman" was "a technological extension of man's being." McLuhan also added, without critical qualification, that "man's oldest beast of burden was woman." [120] The problems here are obvious but McLuhan at least saw—or rather showed—why technology has almost always been defined as being hostile to women. Women have long been figured *as* technologies, as ablative beings by means of which men beget children with their tools. Eve was a help given to Adam, and, in one of Genesis's two accounts, was taken from his rib. (In the other account, male and female were equiprimordial.)[121] In the Western tradition, not without wrinkles and gaps of course, men's dominion over nature implied dominion over women as part of a set of inanimate and animate tools enabling mastery. The gender coding of the concept "technology" continues to this day.

Although gender is a blind spot for many scholars of technology, that is not the best way to describe its role for thinkers such as McLuhan and Kittler. It was not that they neglected gender; there was no topic of greater interest to the authors of *The Mechanical Bride* or *Musik und Mathematik* than gender (and sex). For both McLuhan and Kittler, the erotic was ultimately the most sensitive of all domains for registering tectonic shifts in media, and it forms an absolutely crucial category in their thought. McLuhan was a gender conservative, and it shows.[122] Kittler was something else, though also primarily heterosexual in imagination, and it is hard to sort out whether his late fascination for Aphrodite, the sirens, and the idea that Being itself is feminine was female-friendly or a form of phallophilic ravishment.[123] (Of course, not all friendliness is always welcome.) Gender was not a blind spot for McLuhan and Kittler; no, "spot" is too small a term. Rather, the question of gender was what Gestalt psy-

120. *Understanding Media*, 46, 25, 93.

121. See Arendt, *Human Condition*, 8.

122. See Ulrike Bergermann, "1.5 Sex Model. Die *Masculinity Studies* von Marshall McLuhan," in *McLuhan neu lesen*, ed. Martina Leeker and Kerstin Schmidt (Bielefeld: Transcript, 2008), 76–94.

123. See for instance, Claudia Breger, "Gods, German Scholars, and the Gift of Greece: Kittler's Philhellenic Fantasies," *Theory, Culture and Society* 23 (2006): 111–31.

chologists call a "ganzfeld effect," a sensory white-out so omnipresent that it was hard to perceive.

This book takes McLuhan's and Kittler's implicit lesson that a philosophy of technology must also be a philosophy of gender. For my part I would never claim to be free of blind spots, especially on this most difficult and important topic, and I simply hope that critical self-awareness provides some immunity to the toxins lacing the intellectual tradition I work in. An account of technology that pairs it with techniques and one of media that takes nature seriously should, I hope, be more friendly to humans of every kind.

Shipshape and Seacraft

In contrast to dolphins, humans can live and flourish at sea only by ship, and the same is true a fortiori for the sky. The ship is thus an enduring metaphor of the ways in which we we stake our survival on artificial habitats amid hostile elements—that is, of our radical dependence on technics. Here *technē* is best translated as *craft*, especially in the sense of seacraft, aircraft, and spacecraft, all total environments that enable our passage through climes unnatural for us. The ship metaphor will arise whenever we think about the ontology of our environments. Humans, Hans Blumenberg argues, live pragmatically on dry land but existentially at sea. Our language is saturated with seafaring: helms and anchors, harbors and reefs, lighthouses and storms, embarking and arriving, currents and doldrums, compass and navigation, winds and sails, mutiny and shipwreck provide a rich palette for describing our deepest concerns. Even for people who've never been at sea for an extended period, the ship remains a master metaphor—a *Grundmetapher*, as Blumenberg calls it.[124] This apparently mixed metaphor for the ship—*Grund* means *ground*, among other things—is actually very apt, as the ship is a mobile terra firma for bipedal creatures whose physical form attests to their evolutionary history on land. The ship is literally a metaphor, if you can say that—a vessel or vehicle that transports passengers and cargo from one place to another, which of course is the original meaning of *metaphor*.

124. Blumenberg, *Shipwreck with Spectator*, 7–9.

The ship reminds us of the ancient association of communication and transportation and the many ways in which conveyances bear our deepest meanings.

The ship is not only a metaphor; it is an arch-medium that reveals the ontological indiscernibility of medium and world. [125] On a ship, existence and technology are one. Your being depends radically on the craft. If the journey goes well you disembark onto terra firma and leave the craft behind, but if it starts to malfunction during the journey, catastrophe looms: the ship's fate is your fate too. The vessel stands in for being. Craft builds a surrogate for ontology, an artificial ground. The ship and the sea are as closely connected as Heidegger's "world" and "earth." "Welt und Erde sind wesenhaft von einander verschieden." he says, "und doch niemals getrennt." World and earth are essentially distinct from each other and yet never divided.[126] For mortals the world and the earth are one, but not for gods. For sailors the ship and the sea are one, but not for cetaceans. What the sea is to a cetacean, the ship is to the sailor: the sine qua non of existence.

The ship is the archetype of artifice become nature, craft become environment. Wherever thinking gets most existential, ships irresistibly appear. The classic statement is from the choral ode on human beings in Sophocles' *Antigone*:

> There are many strange and wonderful things,
> but nothing more strangely wonderful than man.
> He moves across the white-capped ocean seas
> blasted by winter storms, carving his way
> under the surging waves engulfing him.
> (lines 334–37; Ian Johnston, trans.)

125. Bernhard Siegert, "'Ort ohne Ort': Das Schiff. Kultur-und mediengeschichtliche Überlegungen zum Nomos des Meeres," lecture, Internationales Forschungszentrum Kulturwissenschaften, Vienna, 15 November 2004, 4–5. Siegert's forthcoming book will be the standard work on the ship in media studies.

126. Martin Heidegger, *Der Ursprung des Kunstwerkes* (Stuttgart: Reclam, 1960), 45–46, echoing Schelling's line that Nature is "ein von [Gott] zwar unabtrennliches, aber doch verschiedenes Wesen," *Über das Wesen der menschlichen Freiheit* (1809; Frankfurt: Suhrkamp, 1975), 53.

Homer's *Odyssey* established the literary genre of survival at sea amid myriad perils, and the Bible is full of boat narratives as lessons in renewal and salvation: Noah saving the creatures of the earth in his ark, Jonah learning that even on the high seas you can't hide from God, Jesus making fishermen his inner circle and the catching of fish one of his central metaphors, and the picaresque tales of Paul's journeys and shipwrecks in the Book of Acts. Ephesians 4:14 exhorts the early Christians to no longer be tossed by waves and driven around by every wind of doctrine. [127] Horace provided ever-relevant advice in Ode 1.14: "Beware lest you become the plaything of the winds."[128] Pascal described humans as sailing on a rudderless ship.[129] The mental states of seafaring describe those on land: *nausea*, which Jean-Paul Sartre made an existential mood par excellence (*ναῦς* [*naus*] is Greek for ship), and *nostalgia*, which was originally a condition of sailors, pining for home like Odysseus, even though the disease was not named until the late eighteenth century. (*Nostalgia* unites *νόστος* [*nostos*], homecoming, and *ἄλγος* [*algos*], pain, on the basis of the German *Heimweh*.) The phenomenological term *horizon*, as an existential limit point, hints at a maritime origin. *The doldrums* has come to describe affective desolation, not only windlessness. Boredom is the ever-present companion of the sailor, whose time, like that of a pilot or anesthesiologist, consists of long spells of boredom interrupted by moments of terror. And Melville's Captain Ahab is only one in a long line of mariners chased by madness; life at sea, in its sheer alienation from familiar haunts, seems to tempt sanity.[130] (In this, it is like life on land.)

Here again we see species specificity. The medium combines phenomenologically with the natural element for the relevant species. For humans the ship is existentially the same as the sea, but not for other

127. King James's translators, trying to give emphasis to Paul's *adokimos* ("unapproved"), rendered it as *castaway* in 1 Cor. 9:27. In 1611 shipwreck provided a moral vocabulary.

128. ". . . tu, nisi ventis / debes ludibrium, cave" (lines 15–16). See also Ernst Robert Curtius, *Europäische Literatur und lateinisches Mittelalter* (Bern: Francke, 1948), 136–38.

129. "Nous voguons sur un milieu vaste, toujours incertains et flottants, poussés d'un bout vers l'autre." *Pensées*, 72.

130. This quick survey of Western thought suggests an amendment to Blumenberg: Perhaps it is not humans but Europeans who live existentially at sea, whose culture emerged on the shores of the Mediterranean and to a lesser extent the North and Baltic Seas. The Chinese, who have a civilization of rivers, do not live by ship metaphors to the same degree.

kinds of beings. Disaster reveals the existential plight of infrastructure. In an emergency, ship, passengers, and cargo are all one. Naught but an inch of *technē*—wood, steel, or glass—separates the passenger on the ocean liner or airliner from the deep sea or from a seven-mile drop into the Labrador ice fields. This is not to say that the craft is your existence, but that in times of danger your existence is eclipsed by the vessel. The very notion of cargo implies that you can separate the vessel from what it carries, but in crisis this contrast cannot be sustained. In an extreme situation everything on a ship is cargo, including the ship itself. Emergency converts necessity into superfluity. The imperative of survival overvalues the vehicle: my kingdom for a horse. In dire straits, content is the first thing to go. This is one reason why at the dawn of the Anthropocene we need an elemental philosophy of media.

An infrastructural focus turns our attention toward the ways in which media steer and stay afloat, instead of toward the cargo they bear. The ship exists for the sake of the cargo, but the ship is ontologically prior to the cargo. As the cargo is tossed first, the medium has a higher standing than the message. In a forerunner text to *Understanding Media*, McLuhan wrote: "Depending on the type of the vehicle-medium the nature of the road-medium alters greatly."[131] As often is the case with McLuhan, you feel at first that things are upside down: shouldn't the road alter the vehicle? But understood phenomenologically, the vehicle alters the road. It is not the same road to a truck as it is to a car, a bicycle, a hiker, or a driver stranded in a broken-down car. The vehicle-medium alters the road-medium: the ship alters the sea, or rather makes the sea navigable at all. One medium reveals another, and without the ship there would be no sea. "All media are active metaphors in their power to translate experience into new forms."[132]

As the first completely artificial environment for human dwelling, the ship is an allegory for civilization. For Buckminster Fuller, the sea was where human invention—and piracy—most decisively emerged, since

131. McLuhan, 1960 NAEB report, quoted by Jana Mangold, "Traffic of Metaphor: Transport and Media in the Beginning of Media Theory," in *Traffic: Media as Infrastructures and Cultural Practices*, eds. Marion Näser-Lather and Christoph Neubert (Amsterdam: Rodopi, forthcoming).

132. Marshall McLuhan, *Understanding Media* (New York: New American Library, 1964), 64.

the sea forced people to live by their wits and carried them around the globe; thus people became generalists.[133] The ship not only makes the sea available; it makes features about social order visible. On a ship, *physis* and *technē* are one. A ship stands in for nature, replicating what the terrestrial environment provides—footing, water, food, shelter, sleep, waste disposal—for an extended period on the open seas. As John Law notes, early modern long-distance sea vessels incorporated elements of the environment into their design and architecture.[134] (Boats, in contrast, are not designed for long trips but hug the shore; they are not outfitted as miniature worlds. Compare the phrase "the boat of state" with "the ship of state" and the contrast will be obvious.) Nothing can be left implicit in ship design: all functions have to be converted to explicit systems of steering, navigation, and social order. On board, infrastructure comes out of hiding. The mix of a natural element (the sea), a craft (the ship), and skills (navigating, steering, prognosticating, disciplining) make this ensemble a cultural technique of the first rank. Each ship creates its own world afresh, a firmament to withstand the chaos of the waters.

The ship is a veritable seedbed for innumerable arts such as navigation, steering, leverage, reading the sky and stars, mapping, timekeeping, documentation, carpentry, waterproofing, provisioning and preservation, containerization, division of labor, twenty-four hour surveillance, defense, fire control, ballast, alarm calls, and political hierarchy. Even nutrition: the British "limeys" famously discovered that citrus fruits prevent scurvy. Shipping launched the notion of risk and the practice of insurance. Life at sea is a logistical art. Stars must be read, storms predicted, fickle winds caught and controlled. "The seaman encounters and must deal with more facets of nature than do people in any other occupation."[135] The winds that fill the sails and the sea that keeps the ship afloat also threaten to destroy it. "The storm is my best galley hand / And

133. Buckminster Fuller, *Operating Manual for Spaceship Earth* (1968), http://www.therealityfiles.com/wp-content/uploads/edd/2012/12/3-fuller_operating-manual.pdf.

134. John Law, "On the Methods of Long-Distance Control: Vessels, Navigation, and the Portuguese Route to India," in *Power, Action, and Belief: A New Sociology of Knowledge?* ed. John Law (Henley, UK: Routledge, 1986), 234–63.

135. Austin M. Knight, rev. Captain John V. Noel, Jr., *Seamanship*, 15th edition. (New York: Van Nostrand, 1971), 493.

drives me where I go."[136] Navigation required calendars and, later, clocks, which blossomed in accuracy during the great age of European seafaring. Nautical almanacs and ephemerides (charts predicting tides, the location of the moon, and stellar positions) were important tools. Seafaring requires lifelines, knots, tackle, pulleys, commands. Water control is essential; it included rain gear and other weather preparations, and gateways for fluid control such as pumps and valves have a nautical history though they are also widely used in irrigation. The sounding of depths is a maritime technique full of metaphysical suggestion. The ship, in short, is a chip: both ships and computer hardware require a compact and recursive architecture. Like DNA or any other robust system, a ship must be redundant enough to handle many different environments.

The edge space between ship and shore has been remarkably fertile for inventions of various kinds such as piracy, border control, customs houses, and the long mix of taxation and smuggling. Like life, technology seems to benefit from evolutionary leaps between sea and land. The world-spanning sea voyages of Portugal and Spain in the fifteenth and sixteenth centuries went together with the invention of paper machines for inventories and populations—the trial, manifest, lading and management of cargo, identity papers, and related forms of visual, numerical, and verbal data management.[137] Other communications media have benefited from the nautical context. Long before wireless telegraphy, the ship-to-shore borderland was a hot zone for semio-technical invention including buoys, flags, fires, beacons, foghorns, bells, sightlines, and signals of all kinds. [138] The coast is much more dangerous than the open sea: in any infrastructure, the last mile is always the most difficult (and expensive) to traverse. Though a lighthouse can transmit news about weather and events, its most important communication is not subject to updates: "I am here."[139] (This makes it a classic logistical medium.)

136. Ralph Waldo Emerson, "Northman," in *Selected Writings of Emerson* (New York: Modern Library, 1981), 905.

137. Bernhard Siegert, *Passagiere und Papiere: Schreibakte auf der Schwelle zwischen Spanien und Amerika* (Munich: Wilhelm Fink, 2006).

138. John Naish, *Seamarks: Their History and Development* (London: Stanford Maritime, 1985).

139. Björn Ægir Norðfjörð, "The Yellow Eye: The Lighthouse and the Paradox of Modernity," seminar paper, fall 2002, University of Iowa.

Alexander Graham Bell proposed "ahoy" for answering the telephone, as if it were a kind of ship-to-ship hailing. (Edison's counter-suggestion of "hello" won out in English-speaking countries.) Wireless telegraphy was at first a maritime medium, making the sea a founding context for modern radio. Cybernetics, the metascience of communication and control in organisms and machines, takes its name from the art of steering a ship.

Sea metaphors, of course, are pervasive in cyberspace.[140] The sea is the preferred imaginary habitat for new media, from radio amateurs "fishing the waves" a century ago to people "surfing" the Internet and its "floods" of information today. Some media are "immersive." We "log on" as if taking up a watch. Sony first marketed the Walkman in Britain as the "stowaway." The term "Internet" names the chief tool of fishing. Computers connect in "docks" and "ports." Google, once known as a "web portal," at first called its plan to scan books and put them online "Project Ocean." As Tim Koogle, the first CEO of Yahoo, said: "The Net is all about connection, but you can't connect people without good navigation."[141] The Google "campus" in Mountain View, California, is adorned with large white statues of maritime explorers, including one of actor Lloyd Bridges, the star of the old television show *Sea Hunt*. Here Google portrays the digital realm as the sea as much as the cloud—and itself as the captain of the ship (in an aesthetic that has uneasy fascist or socialist-realist resonances). Indeed, Google has actively been investing in sea vessels and all kinds of vehicles, especially self-driving cars.[142]

The sea has also inspired a fertile clutch of techniques of social organization. Seacraft models statecraft. Plato, who invented the metaphor of the ship of state and hated the disorder of the sea, used the expertise of a ship's captain against its rowdy sailors to parallel the wisdom of philosophers over the people, though he was never happy to cede control over the ship to a technical expert. In the captain's work at homeostatic

140. Hörisch, *Ende der Vorstellung*, 148 ff.

141. John Battelle, *The Search: How Google and Its Rivals Rewrote the Rules of Business and Transformed our Culture* (New York: Portfolio, 2005), 62; cf. Bruno Latour, "Networks, Societies, Spheres," *International Journal of Communication* 5 (2011): 796–810, at 805.

142. Hiawatha Bray, "Google Goes to Sea, and the World Wonders Why," *Boston Globe*, 2 November 2013, http://www.bostonglobe.com/business/2013/11/01/google-goes-sea-but-why/EbxjX9rEvfWcoRIDPGPa1N/story.html

control, he had to pay attention to "the year, seasons, heaven, stars, and winds."[143] (A good κυβερνήτης [*kybernētēs*] has the duty of cosmic orientation.) International law was first worked out by Hugo Grotius in 1609 with respect to the sea. During the Christian Middle Ages, the cathedral was symbolically outfitted as a ship, with its main hall being the *nave* (from the Latin *navis*, ship); the church was the vessel of salvation. Vehicles of public transport, from the medieval ship of fools to Tolstoy's "Kreutzer Sonata," from John Ford's *Stagecoach* (1939) to elevator scenes in situation comedies, are, as quick microcosms of social order, irresistible narrative devices. And what Melville said of oral genres of communication is true of much else: "And as the sea surpasses the land in this matter, so the whale fishery surpasses every other sort of maritime life, in the wonderfulness and fearsomeness of the rumors which sometimes circulate there."[144]

The ship reminds us what it is to move vehicularly and shows our dependence on craft and the technical fertility of harsh inhuman habitats. In this it is the archetype both of our essential technicity and of all infrastructures since. The sea surpasses the land in this matter.

I conclude this section with a brief etymological trawl. It is suggestive that *ship* seems linked to terms relating to creation, constitution, and condition, such as the Dutch *schepping* (creation) or German *Schöpfung* (creation), whose English cognate is the word *shaping*. The ubiquitous Germanic suffix *-ship* (English), *-schap* (Dutch), *-schaft* (German), or *-skab* (Danish) means the art or fact of quality. Friend*ship* (*vriendschap*, *Freundschaft*, *venskab*) is the condition of being a friend; a land*scape* is the vision of the land created by a painter; and *shaft* in archaic English meant creation, origin, make, nature, or constitution.[145] All of these meanings are very close to the ancient Greek *physis*. Even in the Genesis narrative the earth is a kind of ship created to weather the primeval waters. If media studies has as its domain the study of ways of world making, then ships should be front and center. In the ship, ontology is

143. Plato, *Republic*, 488a–489d, at 488d; ὥρα [*hōra*] is the word translated as season, and πνεῦμα [*pneuma*] as wind.
144. Melville, *Moby-Dick*, 156.
145. *Oxford English Dictionary*, "shaft," definition 1.

created by craft and nature is made by art. The ship shows us how being can be artificial.

Mutual Mimicry of Nature and Technology

Cetacean natural history makes the sea cultural (a medium for immaterial arts) and human technical ingenuity makes the sea natural (a place for shipping). Dolphins are endowed with gifts by nature that we must mimic by invention. What dolphins do by nature, we do by craft or not at all. Dolphins might be impressed with our ships, scuba gear, and sonar, but they more likely might note our feeble and ill-fitting attempts to do what they do without aid. If we see them as lacking in *technē*, they might see us as lacking in *physis*. Their bodies, our gear. One creature's lack is another's nature. Compared to other life-forms, humans are naturally poor in the management of natural elements. Tuna swim and breathe, earthworms cultivate the soil, pigeons navigate, bats hear, dogs sniff, and even flies see and fly. In sea, earth, and sky most creatures surpass us without trouble. For this we can blame Epimetheus. He first handed out all heaven's gifts to the animals, forgetting to save any for humans—so his brother Prometheus stole fire, the basis of all human gifts, from the gods in compensation. One point of the story is that the animals already possess the things we have to fabricate.[146] Fire is thus a sign of incapacity, our deprivation of natural gifts compared to other organisms (see chapter 3). Technology to humans is nature to many animals.

Humans subcontract the natural powers of other creatures as techniques: canaries detect carbon monoxide in mines; dogs do complex chemical assays for us, sniffing out drugs and retrieving game; bees pollinate our crops and can be trained to do military duties such as minesweeping;[147] some frogs provide poison for blow dart hunters; and bacteria not only make cheese, yogurt, and medicine but help digest tricky matter inside our large intestines, outnumbering the cells in our body

146. For a meditation on this narrative, see Stiegler, *Technics and Time*.
147. Jake Kosek, "Ecologies of Empire: New Uses of the Honeybee," *Cultural Anthropology* 25, no. 4 (2010): 650–78.

tenfold.[148] The enormous biochemical creativity of plants has stocked the world's pharmacopoeia, and insects and bacteria always eventually outsmart pesticides and antibiotics. Dolphins and birds long provided Mediterranean sailors with data about wind direction. The brain is the inspiration for the computer. We do not know how to do by craft what these do by nature; nature outstrips not only our imagination but our technology. Biomimetic technologies or "bionics" is the field that testifies of this effect.[149] Aviation mimics birds; viticulture mimics yeast; Velcro mimics cockleburs; genetic modification imitates evolution itself. The sonar imitates, and reveals, the toothed whales' gift. Animals mate because they want to, but only technics harvests, stores, and combines sperm and ova outside the body. (The sperm bank is the ultimate in Heidegger's "standing reserve.") Technics means nature exposed to thought. Technology, in sum, apes zoology.

Heidegger says: "Die Technik ist eine Weise des Entbergens"—Technology is a way (or mode) of revealing.[150] Nature, too, is a kind of revelation, but importantly different. For him, *entbergen* is not simply digging up; it is a releasing of something that was implicit but in a very different form, and which had all kinds of unknown consequences. Revealing means a shift in form—in medium. Nature comes to presence on its own, but when nature comes to presence as knowledge or theory, the world is both imperiled and leveraged. In the same way, the ship reveals the sea—as a place of danger and discovery. This making visible, at once perilous and revealing, is, according to Heidegger, the chief meaning of *Technik*. Our access to cetacean nature is always technical. Our military-oceanographic sound technologies, catheters, and probes reveal the dolphin phonation system. We learn their nature only through technical means—also the way we learn our own nature. Technics reveals—and, like all crafts, substitutes—for being.

148. Francisco Guarner and Juan-R Malagelada, "Gut Flora in Health and Disease," *Lancet* 361 (2003): 512–19.

149. For biomimetic possibilities in engineering, especially at the nano level, see Bharat Bhushan, "Biomimetics: Lessons from Nature—an Overview," *Philosophical Transactions of the Royal Society* 367 (2009): 1445–86.

150. Heidegger, "Die Frage nach der Technik," 79, 81; "The Question Concerning Technology," *The Question Concerning Technology and Other Essays*, ed. and trans. William Lovitt (New York: Harper and Row, 1977), 12–13.

Consider again Thomas I. White's curious formulation that dolphin sonar is "a biological version of the technology used by submarines." Strange word, *version*, but somehow the idea—biological capabilities as a kind of device—makes sense, despite its striking reversal of the mimetic and time axes, as cetacean echolocation is millions of years older than the military-industrial innovation of sonar. White's phrase rewrites fifteen million years of dolphin natural history in terms of one hundred years of human technics. This revocability and revisability of the past we have met before as the microbe effect. In some strange way the technology is ontologically or epistemically prior to the biology (as logos): without sonar, our knowledge of dolphin capacities would be missing.[151] Our metaphors rewrite the past and nature itself; like ships, they are fundamental techniques.

The concept of media is amphibious in several senses. It moves back and forth between sea and land. The ship transforms the sea recursively into a natural medium for us. Both the sea and the ship are carriers, and it is hard to say which one is "culture" and which "nature." Their entanglement goes all the way down—but this entanglement only happens due to the ship. Without craft, the sea would be a *Ding-an-sich* beyond the horizon of knowing. The ship makes the sea into a medium—a channel for travel, fishing, and exploration—but it would not be such without the ship, at least not to us. Nature is always nature-through-culture to us, and yet nature is not culture. Nature's otherness to culture is revealed through the culture of the species in question. The arts that rule a ship—the instruments and social practices, the tackle and duties, the ropes and regimes—move the sea from the great unknown to a means, a place of transition between two destinations. "No medium has its meaning alone or in isolation from other media."[152]

Let's try this difficult definitional work one more time. A medium reveals a medium—as medium. Without other media, a medium is not a medium. Is the ship or the sea the medium? To dolphins the sea could be a medium: they are their own ships. But only nondolphins can see that the sea is a medium to them. (An undisturbed medium is rarely understood as a medium, so perhaps anthropogenic intervention in the ocean

151. In the same way, Heidegger saw techniques as prior to mathematics in modern physics.
152. McLuhan quoted in Mangold, "Traffic of Metaphor."

has made its medium-specificity clearer to cetaceans.) To us the ship is clearly a medium, but it is a medium that reveals and makes navigable another medium, the sea. The earth, says Heidegger, roars ("*tobt*"), looms, or hovers in the work of art.[153] The sea does the same in the ship. Elements that would otherwise have been formless and void take shape—take ship—with media, though they are never ultimately fully tamed. The hearth makes the fire; the coat reveals the winter weather; the documents contain the history; the brain sustains the mind; the sea disappears in the ship. "The wind," intoned Heidegger, "is 'wind in the sails.'"[154] The bridge makes the river banks appear.[155] A medium reveals the nature it rests upon as a ground of practice.

The concept of media is thus amphibious between organism and artifice. We cannot help but explore the astonishing and sometimes comically diverse morphological and functional range of living organisms as a historically sedimented set of solutions to problems of existence. If the body is an apparatus and interface—a medium, in other words—then zoology becomes the open book of comparative media studies. The bodies of living creatures, with their carapaces and antennae, heat regulation and geomagnetic sensing, high-frequency hearing and ultraviolet vision, fluid retention, secretion of silk and venom, production and sensing of pheromones, and immune systems are historically rich solutions to the problem of interacting with environments. They are techniques that await other techniques to reveal them. Animals provide alternate modes of being. Zoology shows the bestiary of diverse body shapes and endless permutations in the organization of sense ratios. As a treasury of the varieties of bodily shape and size, zoology is media theory *sans le savoir*. Once you see that bodies are historically embedded answers to the question of how to be in the world—the key question uniting media theory and the philosophy of technology—then you start to see weird and wonderful wildlife as a catalog of apparatus. If being in the world is a question of embodiment, then zoology—the study of the varieties of bodies—is its encyclopedia.

153. Heidegger, *Ursprung des Kunstwerkes*, 70.

154. Martin Heidegger, *Sein und Zeit* (1927; Tübingen: Niemeyer, 1993), 70; "der Wind ist Wind 'in den Segeln.'"

155. Martin Heidegger, *Poetry, Language, Thought*, trans. Albert Hofstadter (New York: Perennial, 2001), 150.

On its own, nature excels as *praxis* (it is a relentless problem-solver), as *poiēsis* (it is the greatest of all makers), but lacks in *theōria*. Technics makes *theōria* possible. Nature already knows how to do amazing feats—but they only seem miraculous because we do not (yet) know how to do them. Nature's knowledge is not like our knowledge: the former lacks *theōria*. Science is a constant confession of our ignorance, since it constantly reveals how much more nature knows. Birds are not smart enough to build machines to measure and visualize the earth's magnetic fields; they don't have to be. Bees see ranges of color and manage directional orientation by polarized light in ways our devices can hardly mimic. Our brains perform feats of synthesis that our computers cannot fathom. In diving, whales do things that submarine and mining engineers can hardly achieve and human divers cannot match, however astonishing their feats are (the world record in free diving—also bearing the splendid name "competitive apnea"—is over seven hundred feet). The earthworm uses the wisdom of the eons in its work. Science lags behind nature, making explicit (intelligible to humans) what was there already. Nature is rich in knowledge, but uncommunicative. The accumulated intelligence of millions of years of evolution is smarter than all the scientific papers ever published; nature holds all kinds of secrets in abeyance. For some tasks, bird brains are better than human brains. But when bird brains are revealed as theory, a new lever of moving the world comes into being. Atoms had nuclei for a long time, one assumes thanks to the microbe effect, but only since 1945 have fission bombs been built. Science changes nature by changing its medium, by putting it into networks accessible by humans.

There is a heavily folded genius to both nature and things. There is intelligence in every form of matter. As in earthworm practices, so in those of human makers. Gathered in a single clock, knife, or shoe are many lifetimes of practical knowledge. Such intelligence is not lost; it is dormant. The dormitory of animal, vegetable, and mineral knowledge is awakened by technics. Technology, in Heidegger's sense, reveals what was already there in nature, but thereby also changes it by making it subject to handling. Thus Heidegger's anxiety about modernity's stockpiling and teasing of nature from a vast historical storehouse of intelligence into formulae and energies manipulable unto destruction. Another reading of the tie between technique and nature is found among the Ameri-

can pragmatists, who viewed our arts and crafts, devices and data—all the intelligence produced over the eons and accelerated artificially into wit for storage and use—as partners with the dynamics of natural selection itself. Science, said George Herbert Mead, is nothing but "the evolutionary process grown self-conscious."[156] Whether one votes with the catastrophist Heidegger or the meliorist Mead, it is clear that science is belated. Nature always scoops it.

The ship prefigures all the communication vehicles that have so shaped the human habitat. Calendars, points, lines, planes, solids, weights, measures, compasses, clocks, fireplaces, plows, presses, typewriters, phonographs, radios, and computers all contribute to what is, how it is managed, and who manages it. Apparatus is the precondition, not the corruption, of the world. The saying of psychoanalyst Jacques Lacan has become a mandate for media history: "C'est qu'à toucher si peu que ce soit à la relation de l'homme au signifiant . . . on change le cours de son histoire en modifiant les amarres de son être."[157] That is, more or less: Whatever alters the relation of human beings to the signifier in the slightest way changes the course of their history by modifying the moorings of their being. If history is the history of apparently inconspicuous transformations in our relations to the signifier, media history becomes the key to history in general. Means that are apparently small—compass, log, and point—deserve a place in our thinking about that which is great. And note Lacan's metaphor: he figures our being as a ship. The ship is more than its moorings, but without them, it drifts or crashes. Moorings are the means that hold the ship where it should be. Being needs such holders.

156. George Herbert Mead, *Movements of Thought in the Nineteenth Century* (Chicago: University of Chicago Press, 1967), 364.

157. Jacques Lacan, "L'instance de la lettre dans l'inconscient ou la raison depuis Freud," *Écrits* (Paris: Seuil, 1966), 493–528, at 527. Quoted by, among others, Bernhard Siegert, *Passage des Digitalen* (Berlin: Brinkmann und Bose, 2003), 417; Jan Assmann, *Das kulturelle Gedächtnis: Schrift, Erinnerung, und politische Identität in frühen Hochkulturen* (1992; Munich: Beck, 2007), 173; and spun by Friedrich Kittler, *Musik und Mathematik* 1.2 (Munich: Fink, 2009), 68.

Appendix

Nonsimultaneity in Cetacean Communication

Let us imagine five dolphins A, B, C, D, and E, located at stationary points. Dolphin A makes a single statement, message M, which takes 0.1 unit of time to utter. Each dolphin then makes a single response of the same length.

A
B C
D E

This scenario assumes several improbable things:

1) a perfectly homogenous sound medium;
2) no obstacles or effects of the sea floor;
3) an invariant speed of sound propagation;
4) no effects from the earth's curvature;
5) the ability of proximate and remote dolphins to hear all messages equally well;
6) an instantaneous response by each dolphin at the end of the heard message;
7) a recognizable vocal signature of each dolphin, so that the senders can be distinguished;
8) no metadata in the messages about the time and place of sending, or about the sender;

9) stationary positioning of the dolphins during the whole conversation;
10) equivalence of AB with BC, and of AD with DE (assuming that AB equals one distance unit; the pairs of segments are located at right angles to each other);
11) the following: $\sqrt{5} = 2.2(36)$, $\sqrt{2} = 1.4(14)$.

Objective Timeline

0.0	Time 0	A calls out message M
1.0	Time 1	B hears M
1.1	Time 1 + 0.1	B replies to M with N
1.4	Time $\sqrt{2}$	C hears M
1.5	Time $\sqrt{2}$ + 0.1	C replies to M with P
2.0	Time 2	D hears M
2.1	Time 2 + 0.1	A, C, and D hear N; D replies to M with Q
2.5	Time 1 + $\sqrt{2}$ + 0.1	B hears P
2.8	Time $2\sqrt{2}$	E hears M
2.9	Time $2\sqrt{2}$ + 0.1	A, D, and E hear P; E replies to M with R
3.1	Time 3 + 0.1	B hears Q
3.3	Time 1 + $\sqrt{5}$ + .1:	E hears N
3.5	Time 2 + $\sqrt{2}$ + .1:	C hears Q
4.1	Time 4 + .1:	A and E hear Q
4.3	Time $3\sqrt{2}$ + .1:	C hears R
4.9	Time 2 + $2\sqrt{2}$ + .1:	D hears R
5.1	Time $2\sqrt{2}$ + .1 + $\sqrt{5}$	B hears R
5.7	Time $4\sqrt{2}$ + .1:	A hears R

Objectively (terrestrially), the order of messages is: M, N, P, Q, R.

For A, the order of messages is M N P Q R.

For B, the order of messages is M N P Q R.

For C, the order of messages is M P N Q R.

For D, the order of messages is M N Q P R.

For E, the order of messages is M P R N Q.

Each dolphin potentially hears the serial order differently. But is it possible for a response to a message to be heard before the message itself? Only if the response has taken the short route and the message has taken the long route around the globe.

Without standard time, lines, or right angles, it would be very difficult for dolphins to encode metadata into their messages, though we don't know what their neurophysiology is capable of. Perhaps seamarks could provide a standard spatial orientation. In interstellar communication the same problem would occur: the relevance or appositeness of a response to the previous turn would not be guaranteed. And the very notion of an "objective" time line presupposes an extraoceanic observer not immersed in the sound medium or subject to its constraints. Objectivity is a feature possible only in certain media, or perhaps only as a refraction between media.

The problem of coordinating simultaneous but mutually noncommunicating events is also a matter of database design. Suppose two people simultaneously click on the same book on Amazon.com and put it in their checkout baskets, and that both then continue shopping before they actually complete their transactions. There is only one copy in the warehouse. The book will be shown as available to the second shopper, like the light of a dead star landing on someone's retina, even though it is in fact no longer available.[1] Olbers's paradox meets the distributed multiuser database. The problem of distinct temporal origins merging into an apparent present is common to the night sky, to online systems with many authors, and to cetacean signaling. The same structure is found in libraries and memory, both of which are stocked with items that have diverse birthdates but are all more or less equally ready for recall. Thus Walt Whitman, upon exiting the lecture room in which he had grown tired of hearing a learned astronomer speak, looked up "from time to time" at the stars.[2]

We could also imagine the dolphins singing a round, such as "Frère Jacques," or having an even more complex multiturn conversation. Other scenarios await.

1. I owe this example to Julian Browne, "Brewer's CAP theorem," www.julianbrowne.com/article/brewers-cap-theorem, accessed 27 December 2012. Thanks to Ben Peters and Abe Gong.

2. Ed Folsom, "When I Heard the Learn'd Astronomer," in *The Routledge Encyclopedia of Walt Whitman*, ed. J. R. LeMaster and Donald D. Kummings (New York: Routledge, 1998), 769.