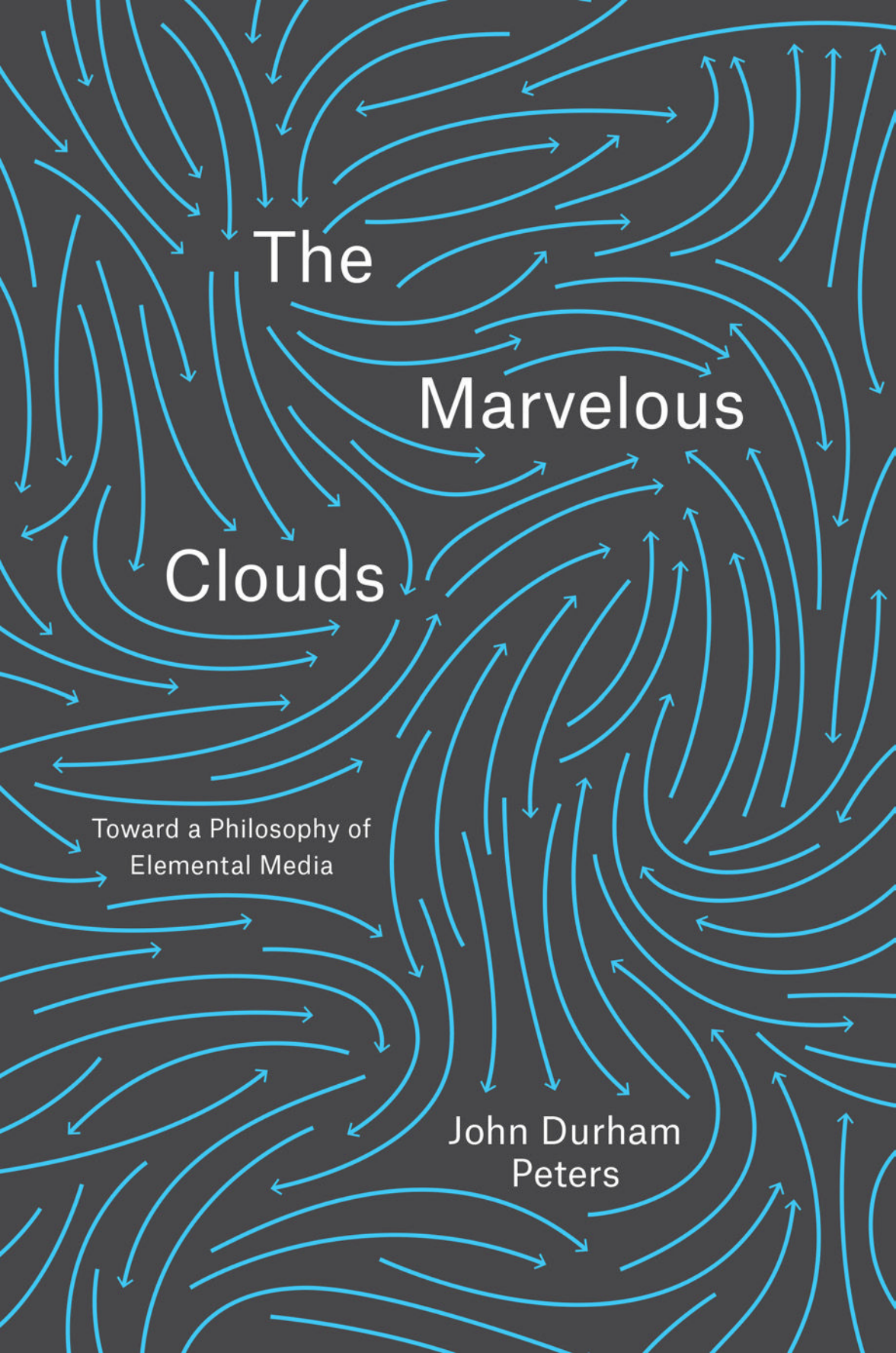
The Marvelous Clouds
Toward a Philosophy of Elemental Media
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In memory of

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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Introduction

In Medias Res

The time is ripe for a philosophy of media. And a philosophy of media needs a philosophy of nature. Media are not only devices of information; they are also agencies of order. They not only send messages about human doings and our relations with our ecological and economic systems; they are also, in the expanded sense of the media concept that I will argue for, constitutive parts of those systems. Humans and their crafts have entered into nature and have altered every system on earth and sea, and many in the sky, to the point that "nature," understood as something untouched by humans, only exists on earth where humans have chosen to set it apart as "natural." The human steering of nature, of course, does not guarantee smooth sailing, and stormy weather is blowing on the ship from several directions. In light of both the possible irreversible threat to our habitat by climate change and the explosion of digital devices, of both carbon overload in the atmosphere and superabundant data in the "cloud," it is good to open again the relationship of media to nature.

This book offers a philosophy of elemental media—the elements that lie at the taken-for-granted base of our habits and habitat—with special reference to the digital era. It is not a speculation about the future, nor a study of how computation has changed culture and society, nor of the environmental crises facing humans and other species, though these topics, so richly studied by other scholars, are among its framing concerns. My interest in media here is less in how journalism reports environmental crisis or how evidence-based critical thinking can gain a

greater voice in the well-financed din of public discussion, as critically urgent as those things are, than in something vaguer and more fundamental.[1] Media, I will argue, are vessels and environments, containers of possibility that anchor our existence and make what we are doing possible. The idea that media are message-bearing institutions such as newspapers, radio, television, and the Internet is relatively recent in intellectual history. As Jochen Hörisch notes, "Well into the nineteenth century, when one spoke of *media*, one typically meant the natural elements such as water and earth, fire and air."[2] The elemental legacy of the media concept is fully relevant in a time when our most pervasive surrounding environment is technological and nature—from honeybees and dogs to corn and viruses, from the ocean floor to the atmosphere—is drenched with human manipulation. In a time when it is impossible to say whether the nitrogen cycle or the Internet is more crucial to the planet's maintenance, I believe we can learn much from a judicious synthesis, difficult though it be, of media understood as both natural and cultural. If media are vehicles that carry and communicate meaning, then media theory needs to take nature, the background to all possible meaning, seriously.

I hope that what follows will be of interest to both general readers concerned about the human condition in our time and scholars concerned with media from diverse disciplinary orientations. "Media," understood as the means by which meaning is communicated, sit atop layers of even more fundamental media that have meaning but do not speak. A lively tradition of media events research, starting with Daniel Dayan and Elihu Katz, has shown how television constructs events such as catastrophes such as 9/11 or wars and ceremonies such as the Apollo moon landing or the Olympic Games, but we can push such insights even further. Media, understood broadly, also enter into nature, not only society—and into objects, not only events. The ozone layer, the arctic ice, and whale populations all are now what they are not only because of how they are covered by reporters, but because of how their being is altered by media, understood as infrastructures of data and control. Many forms of life now

1. See, for instance, *Media Meets Climate: The Global Challenge for Journalism*, ed. Elisabeth Eide and Risto Kunelius (Gothenburg: Nordicom, 2012).

2. Jochen Hörisch, *Ende der Vorstellung: Die Poesie der Medien* (Frankfurt: Suhrkamp, 1999), 134.

flourish as much *in silico* as *in vivo*. The practice of medicine is increasingly a branch of informatics. The forestry industry is a data business.

The old idea that media are environments can be flipped: environments are also media. Water, fire, sky, earth, and ether are elements—homey, sublime, dangerous, and wonderful—that sustain existence, and we still haven't figured out how to care for them; our efforts to do so constitute our technical history. The taken-for-granted environment for a vast majority of the human population consists of artificial life-forms loosely coupled to natural ones, if we can even make this distinction. Our very existence depends on a vast array of techniques for managing nature and culture, most of them ignored by recent communication theory due to their supposedly poor qualities of meaning-making. For a world to exist in which seven billion people could live, more or less, many basic life supports had to take hold: fire control, housing, clothing, speech, herding, agriculture, settlement, writing, and more recent utilities, each of which spans matter and mind, nature and art, biology and culture. In the life sciences, "media" already means gels and other substances for growing cultures, a usage growing from the older environmental meaning of *medium*, and in a similar spirit we can regard media as enabling environments that provide habitats for diverse forms of life, including other media.[3] Media are ensembles of natural element and human craft. The philosophy of media, once you understand media in this enlarged sense, takes on ample heft and urgency.

In discussions about various aspects of this book, I have been greeted with both lively interest and occasional strange looks. Media, some friends and colleagues have told me, are about humans, and more specifically about vehicles that mark human meaning and intention. To say that the sea, the earth, fire, or the sky is a medium, in this view, is to dilute the concept beyond the limit of utility; and even more, it is to burden media scholars, now sent from the familiar pastures of the social sciences and humanities into the natural sciences and philosophy and theology, with

3. In spring 2013 I received an ad in my inbox for 350 kinds of "dehydrated culture media," including "world-class premium quality" agar, peptones, and agaroses noted for "absence of inhibitors, excellent transparency, high hysteresis, reliable reproductibility [*sic*], and extraordinary gelling power." Not at all a bad list of media properties! Several colleagues to whom I forwarded this bit of Dada spam poetry decided that "dehydrated culture media" nicely described our field of inquiry.

an inhuman amount of homework and impossible demands for interdisciplinary mastery. What, many have asked me, is not a medium? A few have even shown an interest in my mental health: Am I really implying that clouds talk to us?

I do think there is meaning in nature and that it is precisely madness *not* to think so. (In the same way, it is crazy to think that our meanings have no ecosystem interdependencies.) But we have to rethink what we mean by meaning. If we mean mental content intentionally designed to say something to someone, of course clouds or fire don't communicate. But if we mean repositories of readable data and processes that sustain and enable existence, then of course clouds and fire have meaning. What if we took not two human beings trying to share thoughts as our model of communication, but a population evolving in intelligent interaction with its environment? The classical pragmatists understood communication in this way. What if we took technologies not just as tools that chip away at solid materials, but as means by which nature is expressed and altered, at least for human beings? Heidegger and many following him have understood technology in this way. As I show in chapter 1, the idea that media theory is about environments and infrastructures as much as about messages and content is well rooted in a variety of intellectual traditions.

Digital devices invite us to think of media as environmental, as part of the habitat, and not just as semiotic inputs into people's heads. This book starts from the idea that the advent of digital media returns us to fundamental and perennial problems of communication and civilization. So-called new media do not take us into uncharted waters: they revive the most basic problems of conjoined living in complex societies and cast the oldest troubles into relief. "Civilization," an abused and abusive term, I take as a syndrome of phenomena tied to the rise of cities: intensified power stratifications between some human beings and others (men and women, masters and slaves) and between humans and animals, division of labor, population growth, writing and documentation, increased risk of fire and disease, and increased opportunities for a few to pursue the arts and sciences. *Civilization* is a dangerous term—"a vague, complex name, of many degrees," as Emerson said—because of its whiff of moral superiority and colonizing history, but it is also useful for thinking about the historical transitions and infrastructural materials of our

species.[4] (We could not think if we had to avoid all dangerous terms.) More specifically, in the work of sociologist Norbert Elias and his followers, "civilization" was understood as a triad of pressure points: human relations with themselves, other humans, and the natural world. Civilization consists of a varying array of regimes for controlling psychic, social, and biological resources, and tracing their complex interactions was, for Elias, the task of sociology. How to manage these three lines of tension—psychological, social, and environmental—is an ongoing challenge that human beings obviously have not solved. I follow Elias in seeing civilization as our great trouble and task, a vulnerable and power-laden ensemble of practices managing humans and natural resources.

Media are civilizational ordering devices. Getting this insight requires us to see just how exceptional media were in the last century. During much of it, "media" such as radio, television, film, newspapers, and magazines were seen as providing information for voters, enticement for consumers, entertainment for workers, and ideology for dupes. Media were largely conceived, in other words, as distributors of messages and meanings designed on a human scale. They were generally taken as influential, to be sure, but not as infrastructural—as figure, but not as ground. In the past half century, as the dominant technologized form of communication has shifted from broadcasting and telephony to the Internet, things have reverted back to the historical norm of a more chaotic media world. One-to-many communication on a mass scale is still around but is much less routine than in the age of "drama for a dramatized society"[5] that filled the airwaves for a good part of the twentieth century. We are back to the age-old modes of some-to-some, one-to-few, and even one-to-none—to a communication environment in which media have become equipment for living in a more fundamental way.

What is new about new media (a term already past its prime)? There are many answers on the market: long-tail distribution, flash mobs, distributed research, user-generated content, viral fame, global connectivity, universal archive, big data, grassroots revolutions. In the Internet

4. See Adam Kuper, *Culture: The Anthropologists' Account* (Cambridge, MA: Harvard University Press, 1999), 23–46; and Fernand Braudel, *Grammaire des civilisations* (1963; Paris: Flammarion, 1993), 41–83.

5. Raymond Williams, "Drama in a Dramatised Society," in *Raymond Williams on Television: Selected Writings*, ed. Alan O'Connor (London: Routledge, 1989).

you can see an inhuman beast trafficking in porn, spam, metadata, and finance, and human beasts conducting their lives via devices. You can see state and corporate surveillance, hacking both prosocial and antisocial, bullying, and blackmail victims led to suicide. In some ways this is all so strange, and in others, all so familiar. People wasting time or socializing remotely, teenagers fooling around, heinous acts done behind the cloak of anonymity, elites using tools to monitor populations, some people getting hurt and a few others getting enormously rich by concentrated power—what else is new? Though our specific technical, political, and economic conditions are unprecedented, they also suggest, from a more distant point of view, the relative stability of the human circus.

People have always interacted across distances of time and space, but digital media intensify opportunities and troubles in person-to-person dealings. Encountering a member of the same species is a deeply rooted challenge for any animal: fight or flight, dance or mate? For humans the complexities of an encounter in the flesh are even more acute. Is the coming stranger a potential enemy, lover, ally, or trading partner? Should I greet him or her with hostility, politeness, or neglect, or some mixture of the three? (We all know about hostile politeness or polite neglect.) And once the stranger is welcomed inside the gate, the troubles are by no means over. There is no site riper with danger and embarrassment than the presence of another person, and civilization is the long story of efforts to negotiate such dangers.

So-called social media do not resolve these troubles, though one of their main appeals, as chapter 6 argues, lies in providing a form of social relations that *reduces* many of the dangers of face-to-face interaction—only for others to pop up instead. Social media invite us to think freshly about the communicative affordances of presence and the many mediations of the body. The body is the most basic of all media, and the richest with meaning, but its meanings are not principally those of language or signs, reaching instead into deep wells stocked with vaguer limbic fluids. The body is not one with itself: it is a network. Sharing the same time and space with another is already pregnant with meaning before a single word is uttered. Eons of improbable evolution have conspired to enable any encounter. The meaning of a face, voice, or gesture cannot be captured in a thousand sentences. Media, as things in the middle, are often regarded as being of secondary importance to the meanings we con-

sciously construct, but media usually harbor the deepest and greatest of meanings.

Digital media reactivate not only these old limbic fluids, but older forms of data use. Unlike the mass media of the twentieth century, digital media traffic less in content, programs, and opinions than in organization, power, and calculation. Digital media serve more as logistical devices of tracking and orientation than in providing unifying stories to the society at large. Digital media revive ancient navigational functions: they point us in time and space, index our data, and keep us on the grid. The medium of writing was first used in Mesopotamia to keep inventories of such things as bread, beer, wheat, and labor time. Lyric, epic, and treatise came later. Of course "content," whatever that means, remains important and there is plenty of it—in 2013 an average of one hundred hours of video was uploaded onto YouTube every minute—but the innovations of digital media have been more diffuse in tracking, tweeting, and tagging, in the structures of everyday life and the organization of power.

Media always concentrate power along all three civilizational axes, a fact that is easy to miss amid the waves of hype about silicon transcendence. The easiest axis to see is the second: tensions between people. The chorus and chirp of our species online can yield astonishingly detailed knowledge for those with access to the right tools. Cultural authorities have always sought to influence how people act and think, but digital media are the latest step in modern population management, a trend that dates in Europe at least to the eighteenth century and was picked up in the early twentieth, when advertisers and pollsters, armed with the tools of survey research, learned to take small samples of mass feeling and attitude, which were of course hedged about with statistical guesswork. In an online world every act leaves a trace, a record of some sort, and such documentation provides potent data to those who can access and read it. This "enclosure" of a hitherto common space has enriched and empowered a class of people.[6] A boom in data, much of it proprietary, does not necessarily mean an advance in democratic control. The Internet casts light onto many things, but rarely on itself; like all media, it comes with a built-in cloaking device. Data trackers follow us at all hours:

6. Mark B. Andrejevic, "Surveillance in the Digital Enclosure," *Communication Review* 10 (2007): 295–317.

at work, at sleep, at play. Recently a critic claimed that Google possesses more information about every digital user than Orwell ever dreamed of in *1984*.[7] The flourishing industry in "analytics" reminds us that digital media are less about meaning than power and organization; one of our chief tasks today is to democratize tools for reading big data, to wrest the lever from the computer nerds.

Digital media point to fundamental tasks of order and maintenance, the ways in which data ground our being, and the techniques that lie at the heart of human dwelling on earth. Digital media resurrect old media such as writing, addresses, numbers, names, calendars, timekeepers, maps, and money. They give new life to age-old practices such as navigating, cultivating, stargazing, weather forecasting, documenting, and fishing, which are more or less the topics of chapters 2 through 7 in this book. Those chapters review key metaphors for digital media and much more—sea, fire, sky, clouds, books, and God. When our environment is so technically saturated, when our crafts have altered the air and the deep—when Google, for instance, is a major ecosystem actor—we need to understand the intelligent contrivances, the technologies and techniques (a distinction that chapter 2 makes clear), that have made humans the planetary hegemon in recent millennia. New media invite the deepest and oldest questions of social theory. Ubiquitous computing invites us to turn from the urgency of the message to the nature of media (and the media of nature). This book accepts that invitation.

Our historical moment affords us extraordinary opportunities to learn, and this book also takes seriously the responsibility of humanists to learn and profit from the natural sciences. Many agree that we need to think beyond the culture-nature, subject-object, and humanist-scientist divides. It might be giving philosophy too grand a role to say that bad thinking has led to environmental crisis, as there are simpler explanations for our carbon-addled ways. Nonetheless, I join in treating standard forms of the subject-object distinction as both ecological and metaphysical disasters. Our data media have won just as much of a planet-steering role as have more basic nature-engineering media such as burning, farm-

7. Mattias Döpfner, open letter to Eric Schmidt, 16 April 2014, http://www.faz.net/aktuell/feuilleton/medien/mathias-doepfner-warum-wir-google-fuerchten-12897463.html

ing, herding, or building. Every medium, whether our bodies or our computers, is an ensemble of the natural and the artificial, and WikiLeaks, corn syrup, whale oil, squids, Facebook, jet lag, weather forecasts, and bipedal posture are some of the topics that belong to media theory. Some parts of this list will be discussed in this book, and so will parts of other lists.

Indeed, lists will keep popping up in this book, both as a response to the stupefaction of so many things to know and as an index of our Googlecopia. We live, as the late Ken Cmiel argued, in a time of promiscuous knowledge, and the list is one strategy to cope with and make use of our temptations amid information abundance. The comically preposterous juxtapositions of lists repeatedly point to how the world escapes our concepts. There can also be a certain desperation in a list, an exasperation that the universe is so wide and our time is so short. I have acutely felt my inadequacy in writing this book. Every spot I found to dig in collapsed beneath my feet, revealing another cavern of unmastered materials. (It is a feature of fractal phenomena that the degree of complexity is preserved at every level of magnification.) Every site yields another link. I've tried to be accurate, but I am sure many howlers remain. There are so many lifetimes of knowledge I would need to have in order to say what should be said. In a sense, writing this book was an experiment to see whether a single person could get a view on the anthropoid condition. The reader will have to judge whether it is possible, but I think it is not, at least not for this person. I take comfort in remembering that books, like films, are rich in proportion to what they cut; and lists, as roving et ceteras, hint at realms of knowledge to be held for later exploration. It has been exhilarating to keep discovering so many new pots of gold, but dizzying to see so many of them mushrooming at the end of so many rainbows. Media theory faces a crisis of uncontainable relevance, and Google is its "media a priori."

Though we need to think beyond the aforementioned divides, there are stubborn reasons why we cannot. These distinctions are both unbearable and unavoidable, in ways we will see. Humans are beings who cannot separate and cannot help but separate subject and object. This point signals my reservations about recent hipster versions of media theory interested in bulldozing the critical tradition of philosophy start-

ing from Kant onwards, a tradition whose aim was always to handle dialectically the simultaneous fusion and distinction of subject and object.[8] The bears have been loosed, and the honey of the media concept is being smeared all over the place. I fear the exhaustion of the concept, and even more the evacuation of its tragedy and difficulty. Media are the sign of both our ingenuity and our ultimate failure at mastering the negative. A media philosophy of nature does not mean a free-for-all in the object store, but rather a weighing of the disasters that loom amid all our makings.

Rather than comparing theoretical positions of diverse authors, this book treats particulars such as candles and clocks, writing systems and dolphin sonar. They are, I hope, of inherent interest, but are also meant to add up. "The work of the philosopher," said Ludwig Wittgenstein, "is a marshalling of remembrances for a specific purpose."[9] I am inspired by scholars such as Harold Adams Innis and Walter Benjamin, who thought that the collection of rich empirical detail could itself be a mode of philosophical and historical reflection; the latter hoped that every fact he collected in his unfinished study of the Paris arcades would already be theory.[10] This book, despite its occasional encyclopedic leanings, hopes to go beyond the presentation of curiosities to locate critical bottlenecks and turning points. Moorings are important both nautically and intellectually, and this book seeks to offer some.

The ship, as I argue in chapter 2, is a metaphor for how media make worlds that in turn reveal and conceal nature, and an example of a medium as an infrastructure of being. *Being* is a word that hovers somewhere between the profound and the pretentious. By thinking of media in terms of being, I want to be as basic as possible, which is always the aim in philosophy. Basics, contrary to popular opinion, are not the easiest but the hardest part of any field of learning. The more basic you get, the deeper the rabbit hole goes. Advanced topics admit of clarity and precision: biologists can agree on the Krebs cycle, mathematicians on

8. For example, Ian Bogost, *Alien Phenomenology* (Minneapolis: University of Minnesota Press, 2012).

9. "Die Arbeit des Philosophen ist ein Zusammentragen von Erinnerungen zu einem bestimmten Zweck." *Philosophical Investigations*, §127.

10. He cited Goethe's aphorism: "Das höchste wäre, zu begreifen, dass alles Faktische schon Theorie ist."

3-manifolds, and social theorists on the difference between ideology and hegemony. But ask them to define life, number, or society, and the philosophical winds start to blow every which way. For real unsettling, you have to look into the lower rather than higher levels. If you go deep enough into being, as Hegel warned, you might find that it quickly turns into nothingness. In media theory, all we might be left with is clouds—and that might not be so bad.

The exposition goes as follows. In the first chapter, I outline my intellectual debts and sketch the relevant landscape of media theory. In chapters 2 and 3, I examine sea and fire media, and in 4 and 5, the two main kinds of sky media. At first such realms as ocean, flame, and the heavens would seem to be unpromising realms for human creativity or technical handling, each being hostile to our works in its own way. But in spite of their resistance, or rather because of it, such elements are seedbeds of arts and crafts, many of them so basic that it took eco-crisis and the digital shakeup to make them obvious. Hostile environments breed art. Enmity is the mother of invention. In chapter 6 I explore the earthy media of body and writing, and chapter 7 tackles the would-be ethereal medium of Google, each medium also having its own productive difficulty. Finally, I offer a few concluding meditations.

Of late it has been fashionable in media theory, as in social and cultural theory more generally, to emphasize *materiality*, a term that means many things. This book certainly partakes of that spirit in its interest in the small fulcrums on which large levers swing. But its analysis of media as ensembles of nature and artifice is, in the end, a bit contrarian. Media are perhaps most interesting when they reveal what defies materialization. The waves and the winds bear up or destroy ships. The flame's greatest service is to convert matter into other forms or to make it vanish altogether. The sky has resisted almost all human artifice and yet has always been at the heart of human knowledge. No one has yet figured out how to store time or save the body from sickness and death, though efforts to do so constitute the history of our archival and medical techniques. The history of media is the history of the productive impossibility of capturing what exists. The black of night gives us our most exact science, astronomy; clouds that vanish yield some of our most beautiful paintings, and clouds that obscure give us some of our most precious meteorological knowledge. Above all, media capture and fail to capture time, whose

fleetingness is the most beautiful and difficult of all natural facts. We are at our best when, to quote a line from Joseph Conrad's *Lord Jim*, we submit ourselves to the destructive element.

It is in the elusive and recalcitrant that we find the homeland of media, and thus the heart of what humans have wrought. Immateriality may be our greatest achievement: points, zeroes, names, money, and language. The emphasis on materiality is a healthy counterbalance to the digital hype that we are moving from a world of atoms to one of bits, but we should not forget that immaterial (symbolic) operations lie at the heart of our oldest and most taken-for-granted media. Media, like human beings, are always in the middle between sea, earth, and sky. Media studies is thus a form of philosophical anthropology, a meditation on the human condition, which also means a meditation on the nonhuman condition. This book is meant as a craft to navigate the deep; I hope you enjoy the steering.

Chapter 1

Understanding Media

"Einer Hilfe bedarf der Mensch immer."
(The human being always needs a help.)—F. W. J. Schelling

A Medium Must Not Mean But Be

In his wonderful memoir *A Tale of Love and Darkness*, Amos Oz recounts how his parents in late 1930s and early 1940s Jerusalem would periodically make a long-distance call to relatives in Tel Aviv. Every three or four months the occasion would be solemnly arranged in advance by letter. The families on each end would meet by a pay phone at the designated hour after a long countdown. "Then all of a sudden the phone would ring in the pharmacy, and it was always such an exciting sound, such a magical moment." After all the buildup the conversation went like this: "What's new? Good. Well, so let's speak again soon. It's good to hear from you. It's good to hear from you too. We'll write and set a time for the next call. We'll talk. Yes. Definitely. Soon. See you soon. Look after yourselves. All the best. You too." And then they hung up and went back to corresponding about the next call, months away. Oz, who can be one of the funniest storytellers anywhere, plays on the humor of a conversation that is over as soon as it begins. But a series of calls discussing future calls was not just an absurdist cycle. Oz's family members weren't calling to trade news but to do something more primal—to hear each other's voices, to as-

sure themselves that they were still alive, present in real time. They were doing something as profound as the seventeen-year locusts emerging to sing and breed for another cycle. Each phone call was nervously hedging against the prospect that it might be their last, every "soon" an act of hope. The telephone as a lifeline was magnified by historical circumstances: the fate of the Jews in Palestine and Europe hung by a thread, and how bad it was in Europe was just starting to be known.[1]

Oz's kin were sharing tokens of presence by means of a communications infrastructure. The import of the call was existential, not informational. The two parties had nothing to say, but everything to mean. Seeing communication as disclosure of being rather than clarity of signal frees up the notion of "medium" for greater service. The media of sea, fire, star, cloud, book, and Internet all anchor our being profoundly, even if we can't say what they mean. The same is true for the body, as it is for nature generally, the ultimate infrastructure. [2] Wittgenstein once said: "In der Mathematik ist *alles* Algorismus, *nichts* Bedeutung."[3] (In mathematics *everything* is algorithm, *nothing* is meaning.) He could have said the same of media. And of music. And of most things that really matter.

A medium must not mean but be. Oz's relatives were maintaining their ecosystem of relations before they were trading updates. Even among people, media of all kinds serve elemental roles. Once communication is understood not only as sending messages—certainly an essential function—but also as providing conditions for existence, media cease to be only studios and stations, messages and channels, and become infrastructures and forms of life. These material, environmental senses inform the recent reach of the media concept beyond messages to habitats.[4] Media are not only important for scholars and citizens who care

1. Amos Oz, *A Tale of Love and Darkness*, trans. Nicholas de Lange (Orlando: Harcourt, 2005), 10–11, 13.

2. Paul N. Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Technical Systems," *Modernity and Technology*, eds. Thomas J. Misa, Phillip Brey, and Andrew Feenberg (Cambridge, MA: MIT Press, 2002), 185–225, at 196.

3. Ludwig Wittgenstein, *Philosophische Grammatik*, *Schriften*, vol. 4, ed. Rush Rhees (Frankfurt: Suhrkamp 1969), 468.

4. Peter Simonson, "Our Places in a Rhetorical Century," keynote address, Rhetoric Society of America, Boulder, Colorado, 24 June 2011, associationdatabase.com/aws/RSA/asset_manager/get_file/35611.

about culture and public opinion, but for everyone who breathes, stands on two feet, or navigates the ocean of memory. Media are our infrastructures of being, the habitats and materials through which we act and are. This gives them ecological, ethical, and existential import. There is little as marvelous as the sea, the sky, or another person's presence, but most philosophy of media has rushed past these elements too quickly. Birds sing, says Charles Hartshorne, not only because they are defending territory or attracting a mate, but because natural history has endowed them with a love of singing such that birdsong in some way participates in the striving for form and fitness that is the essence of evolution itself.[5]

At some level, expression and existence merge. This chapter explains the intellectual landscape for this rethinking of the media concept.

1964 in Jubilee

Marshall McLuhan's *Understanding Media* (1964) recently celebrated its fiftieth anniversary, and this book revisits his claim that media are not only carriers of symbolic freight but also crafters of existence. In the heyday of the broadcast era, a time in which the few addressed the many by means of mass communication, McLuhan protested that media were themselves the message and took media in a radically diverse way, with roads, number, housing, money, and cars figuring in his analysis alongside more typical twentieth-century media candidates such as advertising, movies, and telephones. Both of these moves—ontologizing and pluralizing of media—make him strikingly relevant in the digital era. McLuhan helped invent media studies in the spirit in which I pursue it, though the field both has and deserves a wider lineage. Much is maddening about McLuhan—his obscurity, mischievousness, and willingness to make up or ignore evidence—but his brilliance covers a multitude of sins. He has become an unmissable destination for media theorists. Essential are his ideas that each medium has a grammar, an underlying language-like set of protocols for arranging the world and the organs of

5. Charles Hartshorne, *Born to Sing: An Interpretation and World Survey of Bird Song* (Bloomington: Indiana University Press, 1992).

sensation into a distinct "ratio," and that new media can both extend and do violence to ("amputate" was his term) the bodies of those coupled with them. He had an outstanding library at his disposal and read it well.[6]

But *Understanding Media* was not the only key work of media theory from 1964. It shares a joint jubilee with the French paleoanthropologist André Leroi-Gourhan's monumental two-volume work *Le geste et la parole*, from 1964–65, translated as *Gesture and Speech*. This treatise offers an evolutionary account of human anatomy and its shaping by language and tools. The two books have an uncanny convergence in some ways: *Understanding Media* treated technologies as extended bodily organs; *Le geste et la parole* treated bodily organs as extended technologies.[7] Some other books from the same year deserve a mention as well: Stanisław Lem's *Summa technologicae*, Norbert Wiener's *God and Golem, Inc.*, Stuart Hall and Paddy Whannel's *The Popular Arts*, Herbert Marcuse's *One-Dimensional Man*, Claude Lévi-Strauss's *Le cru et le cuit*, Margaret Mead's *Continuities in Cultural Evolution*, and Gilbert Simondon's *L'individu et sa genèse physico-biologique*. The year 1964 was a good time to be thinking big thoughts about technology, culture, and society. McLuhan and Leroi-Gourhan, Lévi-Strauss and Simondon, Lem and Wiener especially saw the convergence of biological and technical evolution, and Lem and Wiener probed even the theological stakes of the collaboration of life and programming.[8]

Leroi-Gourhan has been very important for continental, especially German, media theorists because he thinks as they do—that is, morphologically, in terms of the stretchy bounds of possibility, the intertwining of form and matter, with an acute sensitivity to the technical pressures exerted upon bodily shape. For Leroi-Gourhan, the evolutionary history of the human body is inseparable from language and technology. He is the great theorist of the essential technicity of human beings. His stamp

6. For an excellent recent treatment, see Florian Sprenger, *Medien des Immediaten: Elektrizität-Telegraphie-McLuhan* (Berlin: Kadmos, 2012).

7. See Michael Cuntz, "Kommentar zu André-Georges Haudricourt's 'Technologie als Humanwissenschaft,'" *Zeitschrift für Medien- und Kulturforschung* 1 (2010): 89–99 at 89, and Kyle Joseph Stine, *Calculative Cinema: Technologies of Speed, Scale, and Explication* (PhD diss., University of Iowa, 2013), 237–58.

8. See my "Philosophy of Technology 1964/2014," Södertörn Lectures, 11 (Huddinge, Sweden: Södertörn University, 2014).

will be evident in this book, especially but not only in chapter 6, which treats his relevance for a theory of the body as a medium. Certainly not all of his claims hold up after five decades of ongoing archaeological and genetic research. (For that matter, many of McLuhan's claims don't hold up today, perhaps mostly because they didn't hold up in 1964. One reads McLuhan for sparks, not scholarship.) Leroi-Gourhan showed the coevolution of the human musculoskeletal form with techniques such as walking, gathering, chewing, speaking, drawing, writing, and remembering. He understood that the intertwinement of embodied practice and technical objects went from cranium to toe. For him the human condition was defined precisely by our standing on two feet—and by our consequent impossibility of separating nature and culture.

McLuhan and Leroi-Gourhan are not my only inspirations here. Media studies is a many-splendored field, packed with interesting studies and questions. Media scholars typically study print, broadcast, film, and Internet institutions and practices and their larger social, political, cultural, and economic consequences. Nearly three decades ago, Elihu Katz looked at this work and divided media studies, like Gaul, into three parts. He saw three streams conceiving media as givers of information, ideology, and organization. The first was a largely social-scientific tradition of empirical research on people's attitudes, behavior, and cognition in a mainstream political framework; the second was a family of critical approaches to media as battlegrounds of domination and resistance; and the third focused more historically on how media technologies shape underlying psychic and social order.[9]

Though much has happened since, Katz's diagnosis helps to show the edge space in which this book sits, namely, the third or technological tradition, which is also of course empirical and critical in its way, though it is much more liberal in what it admits into the object domain of media studies. If most mainstream media studies see media as objects or institutions, the tradition I present takes media as modes of being. Most of the recent interest in media among humanists fits in this tradition as well, and often ignores Katz's other two traditions, with their interests in audiences, institutions, and political economy, which can be a regret-

9. See Elihu Katz, "Communications Research since Lazarsfeld," *Public Opinion Quarterly* 50 (1987): S25-S45.

table omission; I personally want no part of a media studies that has altogether lost the ballast of empirical investigation and common sense.[10] The third way would include American writers such as Lewis Mumford and James Carey, Canadians such as Harold Innis and McLuhan, Frenchmen such as Leroi-Gourhan and Bruno Latour, and Germans such as Martin Heidegger and Friedrich Kittler. These figures, not all of whom recognize "media" as their central theme, take media less as texts to be analyzed, audiences to be interviewed, or industries with bottom lines than as the historical constituents of civilization or even of being itself. They see media as the strategies and tactics of culture and society, as the devices and crafts by which humans and things, animals and data, hold together in time and space. We will examine them in turn.

Leverage

Harold Innis was one of the first to insist that infrastructure should be at the heart of media theory. As a Canadian nationalist who had an acute sense of how the British, French, and American empires shaped his country's economic history and culture, and as a traveler in birch-bark canoes and railroads along old trade routes in the Canadian wilderness during research for his classic history of the fur trade, Innis was a connoisseur of chokepoints. Like Mumford, he thought media history had to be part of the history of warfare, mining, forestry, fishing, writing, and printing. (Mumford, a more sensuous thinker, would add loving, building, and making.) Like Carey, Innis thought the fact of media more important than what was relayed. A non-Marxist critical theorist, Innis was part of a mid-century chorus. The Frankfurt School, for instance, tended to see the special power of media exercised through the fabrication of dreams that teasingly placated social discontent with too easy visions of a better world, but Innis saw power at work on lower rungs of the abstraction ladder. He was interested more in organization than in content. Innis first studied staples such as fur, fish, and timber, later reconceiving

10. One example is W. J. T. Mitchell and Mark B. N. Hansen, eds., *Critical Terms for Media Studies* (Chicago: University of Chicago Press, 2010), an otherwise strong collection that reinvents media studies without regard to decades of social-scientific work.

staples as media and focusing on materials for the fabrication of written records, such as stone, clay, papyrus and paper, whose varying fortunes he traced from Egypt and Babylon through Greece, Rome, and Europe to twentieth-century North America. Innis saw media as spinners of time and space, and the whole expanse of human history as their stage. Innis's practice of media history as a mastery of detail is, as noted, inspirational for this work.

Someone with Innis's perspective never would have dreamed of using the term "old media" for the twentieth century. Impressed by digital media—smaller, faster, mobile, and programmable, scurrying like lithe little mammals around the old broadcast dinosaurs—many have come to call the great news and entertainment industries of the twentieth century "old media." They were actually "mass media," which is something more specific. Compared to mass media, digital media did seem like an enormous historical rupture. But if we place digital devices in the broad history of communication practices, new media can look a lot like old or ancient media. Like "new media," ancient media such as registers, indexes, the census, calendars, and catalogs have always been in the business of recording, transmitting, and processing culture; of managing subjects, objects, and data; of organizing time, space, and power. Media as large entertainment machines that provide news and entertainment on tap in a constant "flow," as Raymond Williams called it, are relatively unusual. The chief mode of communication in the heart of the twentieth century—audiovisual broadcasting—is the historical exception. Digital media return us to the norm of data-processing devices of diverse size, shape, and format in which many people take part and polished "content" is rare. Media offer utilities of many flavors, of which mass narrative is only one.[11] Innis is one of many who gave us a notion of media as vessels of storage, transmission, or processing. This definition is of great historical span, fitting both the hard drive and the abacus.

Media are not exclusively modern; in different shapes and sizes media have contributed to the history of life on earth and perhaps elsewhere. They are fundamental constituents of organization. They compose cities and beehives, archives and asterisms. There have been human media since the great pyramids and biblical scrolls, since the Persian postal sys-

11. My essay in Mitchell and Hansen, *Critical Terms*, develops these themes.

tem and Roman census, since Venetian counting houses and medieval cathedrals, since the emperor Qin Shihuang standardized Chinese characters, weights, and measures, began work on the Great Wall, and burned the books, thus unifying the Middle Kingdom for better or worse. Before civilization, humans had media such as graves, baskets, stars, families, and fire. We should never talk as if media did not exist before 1900 or 1800 (even though the ability to talk about media in this transhistorical way only emerged in the mid-twentieth century). All complex societies have media inasmuch as they use materials to manage time, space, and power. Kittler's point, that culture was always already a procedure of data processing, follows confidently in Innis's path. Kittler's word was *Kultur*, a term that can mean both "culture" and "civilization"—and, never shy about grand claims, he certainly meant to include both.

Innis always returned to the principle of leverage. By leverage I mean straightforwardly using a point to concentrate force over people and nature. Kingcraft, writing, control over irrigation, and calendrical prognostication were ancient techniques for funneling power to elites. Patriarchy, the concentration of power in the phallus, likewise exploits a small lever capable of large political and economic effects, and has been the rule since the beginnings of civilization, which can be understood as a systematic favoring of paterial over material powers. Civilization exploits fulcrums of all kinds: give me a point at which to stand, said Archimedes, and I will move the earth. (Hunter-gatherer societies never had such dreams or means of grandeur, and indeed most people on earth still live without access to the massive power that accrues to brokers, secretaries, and others who preside at switch points.)

One such fulcrum is documentation, discussed more in chapters 6 and 7. *Quod non est in actis, non est in mundo*: what is not in the documents is not in the world. Philip II, king of Spain during its seaborne empire's apex in the sixteenth century, liked to repeat this saying to justify the heaps of paper his mapping and information-gathering bureaus generated to administer his far-flung operations. So do recent media theorists. The saying's pithy expression of the ways in which data can both picture and manage the world has made it a favorite topos in work by German media scholars fascinated with processes that represent by intervening and intervene by representing, thus breaking down the old binary of map

and territory.[12] Like entrepreneurs, hackers, and revolutionaries, media theorists think in the ablative case: "by means of which."[13] Media are not only about the world; in ways it is our task to specify in these pages, they *are* the world. For most of my undergraduate students, a lost mobile phone means a lost limb or brain. Their lives are much more than their phones, but they live *by means of* them. These devices are the narrow gate through which their mental and social metabolism passes.

Philip's dictum also nicely evokes Innis's sense for the ways in which brokers and intermediaries—those who control the files, stand at the switch, or speak two languages—are the ones who earn fortunes and make and break empires. One of Innis's key insights was that each new medium breeds a cadre of specialists who figure out how to manipulate and program its special carrying capacities and standards. For Innis, the history of media was also an occupational history, the history of craftspeople who master medium-specific tactical skills and guard access to them—in a "monopoly of knowledge" as he called it—and then leverage that advantage to their gain. Egyptian hieroglyph-writing priests and medieval guilds provided him with vivid examples. The vast power and wealth of high-tech entrepreneurs is a more recent case. Media properties and quirks, when mastered, reveal fresh possibilities of control. (Media typically have narrow pass-through points. The same is true for living organisms.) For Innis, the task of the media historian was to understand the mischievous ratios of time, space, and power, and the blind spots and bottlenecks of infrastructures that earlier operators had figured out how to leverage.

Media have a world-leveraging power. Lenin was thinking ablatively when he saw that the key position in the Soviet Communist Party was that of secretary, since all documents passed the secretary's way, and he used it (supplemented by a wide range of other forms of ruthlessness) to gain control of the party, leading to the peculiarity that subsequent Soviet leaders were general secretaries rather than presidents. (He also

12. For instance, Cornelia Vismann, *Files*, trans. Geoffrey Winthrop-Young (Stanford, CA: Stanford University Press, 2008), 56; Siegert, *Passage*, 66 ff.

13. Marshall McLuhan to Walter Ong, 8 February 1962, *Letters of Marshall McLuhan*, ed. Corrine McLuhan, Matie Molinaro, and William Toye (New York: Oxford University Press, 1987), 285.

thought the secretary had more working-class street cred.) Lenin understood the power of recording and transmission, how traffic in documents passes for traffic in things. His successor Stalin understood something similar: the power of the editor's pencil to alter history. Stalin's pencil was one of the most lethal weapons ever, and the number of deaths that flowed from it will probably remain unknown.[14]

In media the sign *is* often the thing. The news media not only report the news: they make the news. Did William Randolph Hearst's *New York Journal* report the outbreak of the Spanish-American War or cause it? In journalism the breaking of a story is often the story itself. The headline declaring that one candidate has won the political debate not only reports events; it shapes them. Google and Facebook partake of a similar possibility-fixing power. My undergraduate students say that their romantic lives are not real until they are certified on Facebook. In real estate the title is not the house, but they who own the title also own the house. You still exist without identification papers in a foreign country, but in many practical ways you do not. Channel characteristics are not just trivialities; they are levers of abundant interest in their own right. For want of a nail, the kingdom was lost. Options traders buy and sell contracts, not tulips, wheat, or sides of beef. They traffic in dates and deals, not in goods. But hold onto the option too long, and you may end up with a vast shipment of wheat on your doorstep.[15] Sports are similarly unsentimental: it matters not what you are capable of, but what you do when it "counts" (i.e., when the public gaze of documentation is watching; we call athletic achievements "records.") The superpositioning of data over commodities, documents over values, and records over events lies at the heart not only of modern capitalism but of media operations in general.[16] Wherever data and world are managed, we find media.

14. Holly Case, "The Tyrant as Editor," *The Chronicle Review*, 11 October 2013, http://chronicle.com/article/Stalins-Blue-Pencil/142109/, accessed 11 October 2013.

15. James W. Carey, "Ideology and Technology: The Case of the Telegraph," *Communication as Culture: Essays on Media and Society* (Boston: Unwin Hyman, 1989), 216–22.

16. On modern capitalism and the invention of "Wertpapiere," see Werner Sombart, *Die Juden und das Wirtschaftsleben* (Leipzig: Duncker & Humblot, 1911), chap. 6.

Technik and Civilization

So-called new media have pushed the logistical role of media back to center stage. We live in a palimpsest of new and old. Despite occasional prophecies of decline, the most fundamental media are still with us. Body, voice, and face remain at the heart of all our interactions, as writing does at the heart of all our transactions. For that matter, the mass media of radio, television, film, and journalism soldier on, often pressed into new shapes. Old media rarely die; they just recede into the background and become more ontological. The exception might be Western Union ceasing to send telegrams in 2006, but one might also say that the telegraph did not die: it was just absorbed into the internet.

All media raise perennial problems of life in civilization. "These marvels (like all marvels) are mere repetitions of the ages," said Melville.[17] Digital media have rendered a historical and imaginative service: their endless tagging, tracking, and tracing of our doings reminds us that data management for power, profit, and prayer is both ancient and modern. Collection of useful indicia from populations is as basic a task for communication systems as the offering of drama and news. Computation, broadly speaking, runs from ancient priests watching the stars to modern ones mining "the cloud." Some administrations can take data management to baroque extremes, as in the case of Renaissance Europe, but states have always in some sense been information states.[18] The history of new media is old.[19] "Out of old fields," said Chaucer, "comes all this new corn."

Much new corn in media studies has been brought forth in the German language. This book is not the place to sketch the story and increasingly varied (domesticated) strains of so-called German media theory or the life and thought of its foremost and most controversial practitioner, Friedrich Kittler (1943–2011), though it takes its bearings from this rich body of work. Here I want to underscore the infrastructural sensibility

17. Herman Melville, *Moby-Dick* (New York: Norton, 1967), 181.

18. Jacob Soll, *The Information Master: Jean-Baptiste Colbert's Secret State Intelligence System* (Ann Arbor: University of Michigan Press, 2009).

19. Benjamin Peters, "And Lead Us Not into Thinking the New is New: A Bibliographic Case for New Media History," *New Media & Society* 11 (2009): 13–30.

and metadisciplinary ambitions of German media theory, focusing on Kittler for the sake of convenience.[20] (Note that each term in *German media theory* is troublesome.)

Kittler loves to swerve away from whatever seems most obviously of humane interest and to instead focus on the structures behind it. Content is always an epiphenomenon. The book that made him famous and caused a major crisis in the academic establishment of German literature (*Germanistik*) was *Aufschreibesysteme 1800/1900* (1985), translated into English as *Discourse Networks*.[21] For Kittler, *Aufschreibesysteme* (literally, inscription or writing-down systems) were mixes of wetware, software, and hardware. They consisted of embodied agents such as mothers or doctors, cultural processing algorithms such as educational policies and psychiatry, and technical media such as writing or phonographs. As a research method, the hunt for discourse networks paired up unsuspecting synchronic bedfellows and saw literature, human beings, and mind as effects of such networks. Kittler sometimes had a chip on his shoulder and was a sarcastic controversialist in battling all forms of what he took to be academic nonsense. (Fortunately for the would-be pugilist, there is a never-ending supply.) Much could be said about his crotchets, errors, and genius: his disdain for social history, his love of war technology, his curious gender politics, and the ways in which his reflections about the media of knowledge making were partly reconnaissance missions for a remarkably successful military campaign on behalf of media studies in Germany. But how creatively the man could think, and how stimulating he always was to read, listen to, or talk to!

In any case, Kittler clearly launched the next evolutionary step in media studies.[22] Useful here is his notion that media form a needle's eye for novel historical and existential possibilities, a notion that spans his middle work on hardware and his last phase on Greek cultural tech-

20. For the best single introduction, see Geoffrey Winthrop-Young, *Kittler and the Media* (Cambridge: Polity, 2011).

21. Ute Holl and Claus Pias, "Aufschreibesysteme 1980/2010: In memoriam Friedrich Kittler," *Zeitschrift für Medienwissenschaft* 6 (2012), 114–92, present eleven evaluations as well as Kittler's unpublished foreword.

22. See Till A. Heilmann, "Innis and Kittler: The Case of the Greek Alphabet," in *Media Transatlantic: Media Theory Between Canada and Germany*, ed. Norm Friesen, Richard Cavell, and Dieter Mersch, www.mediatrans.ca/Till_Heilmann.html.

niques. Writing was the "Engpass," or strait and narrow gate, through which all meaning had to pass before the analog media of the late nineteenth century (sound recording and cinema) broke onto the scene. The phonograph and the camera recorded temporal process, including white noise, thus breaking the monopoly of the signifier. Time axis manipulation broke the regime of real time—and this brilliant point is central to this book, especially chapter 6. Optical, acoustic, and alphabetic data flows created distinct technical and experiential regimes. On the radio we were dumb and blind, but our ears stretched over great distances of space; on the telephone we were blind but our voices and ears could span the same distances; with the phonograph we could hear into the past. Quite like McLuhan, Kittler saw how each medium extended and handicapped the human sensorium.[23]

In his last, incomplete work on music and mathematics, eccentric and rare in almost every way, Kittler treated the Greek alphabet as the checkpoint through which Hellas had to pass. As if to defy centuries of European opinion, he did not think the great thing about ancient Greece was its drama, ethics, or politics: it was its media system, consisting of combined letters, numbers, and tones. For Kittler, the world-historical breakthrough of ancient Greece was not the philosophy of Plato or the tragedies of Euripides, which he, following Nietzsche, vigorously disdained: it was rather the invention of an alphabet with vowel notation that could act as a processing medium for poetry, mathematics, and music all at once, like a universal computer before the fact. Here he built on Heidegger by making media keys to nothing less than the history of being (*Seinsgeschichte*). Media for Kittler are world-enabling infrastructures; not passive vessels for content, but ontological shifters. Inconspicuous vehicular transformations can have gigantic historical effects. History's passage does not restrict itself to humans: being, after all, is large and contains multitudes.

Kittler reserves a special spot in paradise for what we might call the engineers of being, from Archytas to Alberti to Alan Turing. In each case he treats programmers rather than philosophers as history's most im-

23. See Kittler's introduction to *Gramophon Film Typewriter* (Berlin: Brinkmann und Bose, 1986); *Gramophone, Film, Typewriter*, trans. Geoffrey Winthop-Young and Michael Wutz (Stanford, CA: Stanford University Press, 1999).

portant actors. Archytas was Plato's contemporary and probably his acquaintance: whereas the latter's enormous legacy, in Kittler's opinion, was almost entirely destructive, Archytas first defined the quadrivium (the cluster of ancient mathematical arts), was the first engineer, and invented acoustics and percussion as a musical form. Western education fixed on the wrong man: Plato loosed "ideas" on the world, but Archytas showed us how to study sound, build catapults and rattles, and play the Pythagorean music of the spheres. Alberti, the fifteenth-century Florentine humanist, mixed theory and practice in architecture, perspective painting, and cryptography, and thus exemplifies one of Kittler's recurrent themes: that the Italian Renaissance, retrospectively so celebrated for its humanism, was great actually because its artists were engineers.[24] Alan Turing, one of Kittler's enduring heroes, is the arch-programmer, the great mathematical and code-breaking genius who stands for the computational inventions that have remade the ways in which we process and access the world. For Kittler, Turing was the key figure of our epoch: ours was the *Turing-zeit*, the era of Turing.

Late in life, Kittler sometimes expressed doubts about the concept of media. For my part, I think there is plenty of sugar left in the old beet. Part of Kittler's complaint was that *Medienwissenschaft* had been institutionalized as one academic field among many. He thought media studies should consider the media of study in general. For him, as for McLuhan, media studies was not just one more field to stir into the interdisciplinary mix, but the field of fields, one either "post" or "meta" that could reorganize and engulf all the others. Of course, media studies is known for ambitious statements about itself and many other things. (McLuhan had his share of such statements.) In his most famous or notorious utterance, Kittler wrote: "Media determine our situation." Another was his declaration of what he called information-theoretic materialism, an update of Philip II: "Nur was schaltbar ist, ist überhaupt." *Schaltbar* is hard to translate, suggesting being plugged into an integrated circuit, but the gist of the statement is: Only that which is networkable or switchable exists at

24. Friedrich A. Kittler, "Leon Battista Alberti," *Unsterbliche: Nachrufe, Erinnerungen, Geistergespräche* (Munich: Fink, 2004), 11–20.

all.[25] If Google can't find you, you don't exist. Wiring precedes being. Beyond the network there is only the *Ding-an-sich*. Grids and circuit boards are ontological in their effects. At its most ambitious, media studies sees itself as a successor discipline to metaphysics, as the study of all that is.

For Kittler, both philosophy and the humanities in general refused to think about techniques, and the enormous price was blindness to the history of being.[26] In Kittler's most radical view, media studies was a privileged form of seeing being as mediated. It was a way-of-seeing field, not an object field. Kittler saw a postdisciplinary kind of media studies that did not tarry at the well-tilled crossroads of humanities and social sciences, but went to the natural sciences, mathematics, engineering, medicine, and military strategy. His late criticism of media studies turned on his productively arrogant claim that knowledge is knowledge, that there is no such thing as special field knowledge of any sort, whether *Medienwissenschaft* or any other. He was ever the rebel against specialization, with all the risks such rebellion entails. In roving broadly into many fields, Kittler made plenty of amateur errors, something that I am certainly in no position to criticize. Another of his dicta deserves more fame than it has received: "Simple knowledge will do."[27]

The idea that media studies could include what recent academic jargon calls the STEM fields is clearly salutary.[28] Indeed, media studies is one confluence of knowledge that defies the old split of *Geist* and *Natur*. More than three decades ago we were told that the innovative exchanges were happening between the social sciences and the humanities,[29] but today humanists have rediscovered the natural sciences with fresh force. And with good reason. Nature turns out to be profoundly historical. Evolutionary biology has shown just how remarkably plastic species are, as populations adapt quickly to environmental exigencies across genera-

25. Friedrich Kittler, "Real Time Analysis: Time Axis Manipulation," *Draculas Vermächtnis: Technische Schriften* (Leipzig: Reclam, 1993), 182–207, at 182.
26. Friedrich Kittler, "Towards an Ontology of Media," *Theory, Culture and Society* 26 (2009): 23–31.
27. *Gramophon Film Typewriter*, 5, *Gramophone, Film, Typewriter*, xl.
28. STEM = science, technology, engineering, and medicine.
29. Clifford Geertz, "Blurred Genres: The Reconfiguration of Social Thought," *American Scholar* 49, no. 2 (1979): 165–79.

tions. The life sciences are historical sciences, and life itself is interpretive, even rhetorical, as it adapts to the available means and looks to seize the *kairos*. All natural sciences have a hermeneutic element, but the sciences of natural history, such as cosmology, geology, evolutionary biology, paleovirology, and climatology, do so profoundly. Kittler always read works of literature and music as sources of truth, and there is something inspiring about his insistence that the humanities never give up on their cognitive claim: their task is not just the education of sensibility, but the ordering of knowledge, of which there is only one kind (with endless variants). The true humanist would also be a naturalist, one who produces knowledge about things that are, were, and are to come.

The humanities, seen broadly, are the homeland of *technē*. There is no humanity without arts, starting with the art of walking upright on two feet. We are already technical in mind and body, as Leroi-Gourhan insists. Not only do the natural sciences depend on instrumentation.[30] Humanists rely on pen, paper, computer, slide, classroom, file, voice, book, chair, glasses, and archive (library or Google). Whatever else they may be, the humanities are disciplines for the storing, transmission, and interpretation of culture (and maybe nature too). They have material conditions and media as much as any other form of inquiry. Kittler puts it polemically: "For the humanities there is nothing nontechnical to teach and research."[31] Poetry, music, dance all involve counting; without the primordial technology of writing, no humanities would exist at all. Since Rousseau, many have told the story of how our authentic humanness is violated by technology, a story still weakly resonating in some quarters.[32] The bigger sadness of this story is the divorce of the humanities from the infrastructures of being. Apparatus is the basis, not the corruption, of the world. Our beauties have counting and measure at their core. Music, the greatest of all arts humans enjoy, is mathematical and technical. For all his crankiness, Kittler saw (or heard) a sublime truth here.

The object domain of media studies is nicely captured in the title of

30. Lisa Gitelman, "Welcome to the Bubble Chamber: Online in the Humanities Today," *Communication Review* 13 (2010): 27–36, at 29.

31. Friedrich Kittler, "Universities: Wet, Soft, Hard, and Harder," *Critical Inquiry* 31 (2004): 244–55, at 251.

32. See Bernard Stiegler, *Technics and Time: The Fault of Epimetheus*, trans. Richard Beardsworth and George Collins (Stanford, CA: Stanford University Press, 1998), 100–133.

Lewis Mumford's classic book *Technics and Civilization* (1934). *Technics* was his translation of the German term *Technik*, much as we would translate *Politik* as politics or *Physik* as physics. This term deserves a revival in English. Mumford's polymathic ambitions set a course for media studies since: you should use the entire library as your source. To study media, you cannot just study media: on this point Innis and McLuhan, Carey and Kittler all agree, being scholars with an eye for preposterous analogies and miscellaneous learning. (Douglas Coupland called McLuhan an "information leaf blower.")[33] "In writing the history of media," says David Hendy, "we are, in effect, writing the history of everything else."[34] To understand media we need to understand fire, aqueducts, power grids, seeds, sewage systems, DNA, mathematics, sex, music, daydreams, and insulation; this book tackles a small subset of this roster. Technologically oriented media theorists love to unfurl a hitherto unsuspected object as a medium absolutely central to life as we know it (e.g., McLuhan on light bulbs and bicycles, clothing and weaponry). The creative vigor in German media studies since Kittler owes as much to archival mania as to theoretical innovation, the constant discovery of new materials hitherto untapped.[35] I confess to being moved by this spirit in this book's interest in ships, fire, night, towers, books, Google, and clouds. What we might call weird media theory has a bounty of objects, but that is both a blessing and a burden.

There is a danger, of course, of losing one's grip on what media are. "If everyone's somebody, then no one's anybody" (Gilbert and Sullivan), and what's true of prestige is also true of concepts: they must always stop short of complete universality. Because media are in the middle, their definition is a matter of position, such that the status of something as a medium can fade once its position shifts. A tendency in the philosophy of technology, especially object-oriented ontology, is to be so ambitious in celebrating quirky lists of things in all their varied wonder that the sometimes brutally hierarchical and unequal character of things dis-

33. Douglas Coupland, *Marshall McLuhan: You Know Nothing of My Work!* (New York: Atlas, 2010), 200.

34. David Hendy, "Listening in the Dark: Night-Time Radio and a 'Deep History' of Media," *Media History* 16, no. 2 (2010): 215–32, at 218.

35. Lorenz Engell and Bernhard Siegert, "Editorial," *Zeitschrift für Medien- und Kulturforschung* 1 (2010): 5–9, at 6.

appears from view. Bruno Latour, to whom I owe a lot, has polemically called for a "flat ontology," but in the works of some of his acolytes that can sound like a refusal to make critical judgments about the great inequality of things. Anyone interested in infrastructure, lookouts, and turning points needs old-fashioned sociology about how recalcitrant, not just how cool, "things" are. Ontology is not flat; it is wrinkly, cloudy, and bunched. Often, like the sea, it is stormy and harsh. I am only willing to go part of the way with a full philosophy of immanence. In a beautifully styled book Quentin Meillassoux has criticized what he calls "corrélationisme," the doctrine that meaning depends on a superintending human mind of some sort. [36] I fully endorse separating meaning from mind, but cannot abandon the critical project stemming from the post-Kantian critical legacy that he (like his less temperate followers) attacks. We need *Urteilskraft*, the capacity of judgment, more now than ever. The task is to find grounds for critique without a misguided subject-object distinction, an aim whose philosophical roots run from German idealism to the critical theory of the Frankfurt School, and in pragmatism and phenomenology as well.

Infrastructuralism

Infrastructure has come into prominence as a scholarly topic in the past two decades, reflecting wider political and economic changes as the Cold War waned, its large technical systems aged, and the tangle of networks known as the Internet was built. *Infrastructure* was first a military term. In World War II the British found Iceland's landing strip inadequate for their needs. As they were building a new airport in Reykjavik, they asked the Icelanders for financial support. Sorry, no, the Icelandic officials supposedly said—but feel free to take the airport with you when you leave. (The British did not, and it is still used for domestic flights.) Infrastructures are generally thought to be bulky and boring systems that are hard to carry, such as airports, highways, electrical grids, or aqueducts. Since the early nineteenth century the world has seen unprecedented development of infrastructure: railways, telegraphs, transoceanic cables,

36. *Après la finitude: Essai sur la nécessité de la contingence* (Paris: Seuil, 2006).

time zones, telecommunications networks, hydroelectric dams, power plants, weather forecasting systems, highways, and space programs. The Internet—"the new iconic infrastructure of our age," as Hillary Clinton put it—continues to motivate such questions.[37] Whatever else modernity is, it is a proliferation of infrastructures. "To be modern means to live within and by means of infrastructures."[38]

Infrastructures can be defined as "large, force-amplifying systems that connect people and institutions across large scales of space and time" or "big, durable, well-functioning systems and services."[39] Often they are backed by states or public-private partnerships that alone possess the capital, legal, or political force and megalomania to push them through. From Cheops to Stalin, infrastructures have been the playthings of dictators and tyrants; the Internet might seem a departure because of its apparent lack of centralized control, but there is plenty of state and market power shaping its development. Because of their vast technical complexity and costs, infrastructures are often cloaked from public scrutiny, their enormous risks and unintended consequences shielded from open debate. Traditional infrastructures are generally thought to be—or actively designed to be—immune to democratic governance, but remain open to sabotage if otherwise full of inertia (resistance to change).[40] They are almost always vulnerable to hijacking. Every tower invites toppling. "Once in place, infrastructures generate possibilities for their own corruption and parasitism."[41] Something there is that doesn't love a wall.

Though large in structure, infrastructures can be small in interface, appearing as water faucets, gas pumps, electrical outlets, computer terminals, cell phones, or airport security, all of them gates to bigger and submerged systems. Infrastructures are designed to reduce risk in under-

37. "Remarks on Internet Freedom," http://www.state.gov/secretary/rm/2010/01/135519.htm (accessed 25 September 2013).

38. Edwards, "Infrastructure and Modernity," 186.

39. Edwards, "Infrastructure and Modernity," 221; Paul N. Edwards, Geoffrey C. Bowker, Steven J. Jackson, Robin Williams, "Introduction: An Agenda for Infrastructure Studies," *Journal of the Association for Information Systems* 10, no. :5 (May 2009): 364–74, at 365.

40. John Keane, "Silence, Power, Catastrophe: New Reasons Democracy and Media Matter in the Early Years of the Twenty-First Century," Samuel L. Becker Lecture, 8 February 2012, University of Iowa.

41. Brian Larkin, "Degraded Images, Distorted Sounds: Nigerian Video and the Infrastructure of Piracy," *Public Culture* 16, no. 2 (2004): 289–314, at 289.

lying elements, but often produce new risks in doing so. Building systems means managing their side effects—and the side effects of the management itself. Electrical power lines, for instance, increase the risks of childhood leukemia.[42] The bigger the infrastructure, the more likely it is to drift out of awareness and the bigger the potential catastrophe. There were no train crashes before the railroad was built, and no potato famines before the monocultural overinvestment in that crop in Ireland. Leverage means vulnerability.

There are hard and soft infrastructures. Dams and websites, highways and protocols are equally infrastructural. There can be lightweight and portable as well as heavy and fixed infrastructures—a point made repeatedly by Innis. Compared with the concrete opera of Roman cities, roads, and aqueducts, the mathematics and history, philosophy and ethics, music and holidays of the Greeks and Jews are much more alive today. Indeed, what remains of Rome is its cultural engineering in religion, language, law, and the idea of Europe itself. Cultural continuity is often a greater achievement than continually functioning water or road systems: of all extant cultures, only the Chinese, Greeks, Indians, and Jews have managed to maintain their ethnic identity over multiple millennia (not without constant reinvention, of course). Software often outlasts hardware. In geologic time, all infrastructures suffer an Ozymandian fate. As Hegel noted of ancient Egypt, "The palaces of the kings and priests have been transformed into heaps of rubble, while their graves have defied time."[43] None are designed to outlast the typical life span of any civilization. The exception might be calendars, which in theory can be spun out on scales far vaster than any possible human maintenance, although any chance of keeping them closely synchronized with the sky will not last more than a few thousand years, thanks to the variability of the earth's motion. (Our calendar, as chapter 4 shows, requires updates much more often than that.) Civilization seems to have a limit of durability fixed in

42. J. D. Bowman, D. C. Thomas, S. J. London, and J. M. Peters, "Hypothesis: The Risk of Childhood Leukemia Is Related to Combinations of Power-Frequency and Static Magnetic Fields," *Bioelectromagnetics* 16 (1995): 48–59. Our choice to live irradiated in baths of wireless fields has unexplored health consequences.

43. G. W. F. Hegel, *Lectures on the Philosophy of Religion: The Lectures of 1827*, ed. Peter C. Hodgson (Berkeley: University of California Press, 1988), 321n339.

millennia, and maintenance of long-term systems of communication requires vast expense and expertise.[44]

Infrastructures tend to change incrementally, and have the inertia of previous innovations to build upon. They are improved upon modularly, and clearly illustrate the principle of path-dependence.[45] They demand labor and upkeep. They are infrastructures only to the degree that they are normalized into taken-for-granteds; they have social as well as technical components.[46] Retention of archaic functions and structures is as relevant in our media as in our tissues. Both bodily organs and technical *ὄργανα* (organa; "tools" in ancient Greek) are a hodgepodge of different environments layered upon each other. DNA is an archive of new and old. The same is true of any natural language (one reason why the history of words can be a great source of accumulated insight). We can call this the QWERTY principle: suboptimal patterns persist long past their initial conditions due to path-dependence.[47]

I am loath to introduce yet another "ism" into the scrimmage of academic brands, but if I were to do so, it would be the doctrine of *infrastructuralism*. After structuralism, with its ambition to explain the principles of thought, primitive or modern, by way of a combinatorics of meaning, and post-structuralism, with its love of gaps, aporias, and impossibilities, its celebration of breakdown, yearning, and failure, its relish for preposterous categories of all kinds and love of breathless syntax—perhaps it is time for infrastructuralism. Its fascination is for the basic, the boring, the mundane, and all the mischievous work done behind the scenes. It is a doctrine of environments and small differences, of strait gates and the needle's eye, of things not understood that stand under our worlds. Hence the quiet pun in the title of this chapter: infrastructural media are media that stand under.

44. See Marisa Leavitt Cohn, *Lifetimes and Legacies: Temporalities of Sociotechnical Change in a Long-Lived System*, University of California, Irvine, PhD diss., 2013.

45. Susan Leigh Star, "The Ethnography of Infrastructure," *American Behavioral Scientist* 43 (1999): 377–91, at 382.

46. Susan Leigh Star and Karen Ruhleder, "Steps toward an Ecology of Infrastructure: Design and Access for Large Information Spaces," *Information Systems Research* 7, no. 1 (1995): 111–34.

47. Paul A. David, "Clio and the Economics of QWERTY," *American Economic Review* 75, no. 2 (1985): 332–37; and S. J. Liebowitz and Stephen E. Margolis, "The Fable of the Keys," *Journal of Law and Economics* 33, no. 1 (1990): 1–25.

Infrastructure in most cases is demure. Withdrawal is its modus operandi, something that seems a more general property of media, which sacrifice their own visibility in the act of making something else appear.[48] Marx was a theorist of infrastructure not only in his fascination for industrial apparatus, but also in his analysis of how power relations are camouflaged. The greatest thinkers of infrastructure were never interested only in the gear; they always wanted to know why awareness of essential things so quickly fades into "beaten paths of impercipience."[49] (This is a version of the old moral mystery of why the quest to find bedrock principles of right action never finds any bedrock more certain than the ongoing quest itself.) Freud made vivid use of infrastructural metaphors, viewing the psyche in terms of cities, sewers, ruins, filing systems, and postal censorship; but he was also an analyst of clouded awareness, of our distorted communication with ourselves. Every memory trace for him was a crime scene investigation to show off his considerable forensic skills.

Perhaps the most explicit effort to understand how the fundamentals recede into the background was that of Freud's contemporary Edmund Husserl, who developed philosophical phenomenology. Marx, Freud, Husserl and their contemporaries all lived through terrific infrastructural transformations and thought that boredom and obviousness were ruses by which consciousness hides the marvelous, often devious workings that make it possible. The same is true with such nineteenth-century figures as Charles Darwin, W. E. B. Du Bois, Émile Durkheim, Charlotte Perkins Gilman, Ferdinand de Saussure, and Max Weber, with their analyses of the infrastructures of life, race, society, gender, and language. For thinkers born in the nineteenth century, it was madness not to observe the nexus, as they lived through the triumph of steam, coal, electricity, barbed wire, standard sizes, and standard time. All of them believed in the power of reason to either get to the bottom of things or make a greater mess of them. Freud's famous dictum, "Wo es war, soll ich werden" (Where it was, I should be), might be understood as the im-

48. Dieter Mersch, "Tertium datur: Einleitung in einer negativen Medientheorie," *Was ist ein Medium?*, ed. Stefan Münker and Alexander Roesler (Frankfurt: Suhrkamp, 2008), 304–21, at 304.

49. McLuhan, *Understanding Media*, 198.

perative to make all infrastructures clear. There is a deep infrastructural ethic in modern thought.

One of the key books that launched much of the recent interest in infrastructure, *Sorting Things Out* (1999) by Geoffrey Bowker and the late Leigh Star, brought a strong phenomenological heritage to infrastructure studies. Infrastructure was pushed beyond large, heavy systems to be a question of how basic categories and standards are formed, and how they are formed as ordinary. How the taken-for-granted gets constructed in the first place is a classic phenomenological question: how did the water ever become invisible to the fish? Bowker and Star see our worlds as bristling with standards and forgotten rules that produce everyday things in their everydayness and are sustained by the ghostly cumulus of bodies at work. Ordinary objects such as compact disks and pencils conceal "decades of negotiation." As Bowker and Star quip, "There is a lot of hard labor in effortless ease."[50] To break through the crust, they offer the concept of "infrastructural inversion," a cousin to what Harold Garfinkel called "breaching"—the intentional violation of a social norm to bring the background out into the open. Something similar happens with accidents and breakdowns: infrastructure comes out of the woodwork. Glitches can be as fruitful intellectually as they are frustrating practically.[51] Essence, intoned Heidegger (channeling Aristotle), is revealed in accident.[52]

Infrastructure is often as hard to see as a light rain through the window. Not only is it invisible by nature, but it can be camouflaged by design in what Lisa Parks calls "infrastructural concealment." [53] Some infrastructures (water, sewers, electrical and cable lines) are literally buried in the ground (or underwater) and others are designed to blend in with the scenery. More rarely, towers or hydroelectric dams are intentional

50. Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and its Consequences* (Cambridge: MIT, 1999); the quote from 9.35 has a useful definition of infrastructure.
51. See Peter Krapp, *Noise Channels* (Minneapolis: University of Minnesota Press, 2011).
52. "In einer *Störung der Verweisung* . . . wird aber die Verweisung ausdrücklich." Martin Heidegger, *Sein und Zeit* (1927; Tübingen: Niemeyer, 1993), 74.
53. Lisa Parks, "Technostruggles and the Satellite Dish: A Populist Approach to Infrastructure," *Cultural Technologies: The Shaping of Culture in Media and Society*, ed. Göran Bolin (London: Routledge, 2012), 64–84.

displays of power and modernity, and some architectural fashions have foregrounded the guts of a building (as in the Centre Pompidou in Paris, where extruded pipes and conduits are a flamboyant part of the design). In the twentieth century, broadcasting houses were temples of transmission that celebrated their own technicity.[54] In a similar way, as we see below, medieval clock towers were statements of civic wealth and eminence. Technologies are never only functional: any device always has an element of social display or "bling."

Forgetting seems a key part of the way infrastructures work. Star notes that they are often "mundane to the point of boredom."[55] But it all depends on what the structure is *infra* to. Infrastructure is often defined by being off the radar, below notice, or off stage. Redundancy may be boring, but the essence of robust systems is backup options. Technology, in contrast, is a concept biased towards newness: breathing, fire control, writing, or cities rarely count, even though that's where much of the hard work is. We have the unhelpful habit of isolating the bright, shiny, new, or scary parts of our made environment and calling them "technology," to the neglect of the older, seemingly duller parts. Horses were as important as tanks in both world wars, and bicycles have been as important as cars in recent decades.[56] There is a politics to boredom. "Mature technological systems reside in a naturalized background, as ordinary and unremarkable to us as trees, daylight, and dirt," says Paul Edwards, [57] He is completely right, but trees, daylight, and dirt, of course, are highly remarkable: they are also mature technological systems. ("The invariable mark of wisdom," said Emerson, "is to see the miraculous in the common."[58]) The perception of monotony is a measure of the breadth of mind: nothing would be boring to the mind of God. Studying how boring things got that way is actually a good way never to be bored. This book

54. See Staffan Ericson and Kristina Riegert, *Media Houses: Architecture, Media, and the Production of Centrality* (New York: Peter Lang, 2010).

55. "Ethnography of Infrastructure," 377.

56. David Edgerton, *The Shock of the Old: Technology and Global History Since 1900* (London: Profile, 2008).

57. Edwards, "Infrastructure and Modernity," 185.

58. *Nature, Selected Writings of Emerson*, ed. Donald McQuade (1837; New York: Modern Library, 1981), 41.

seeks to brew this elixir, wagering that the wonder of the basic can beat its banality.

Infrastructuralism suggests a way of understanding the work of media as fundamentally logistical. Logistical media have the job of ordering fundamental terms and units. They add to the leverage exerted by recording media that compress time, and by transmitting media that compress space. The job of logistical media is to organize and orient, to arrange people and property, often into grids. They both coordinate and subordinate, arranging relationships among people and things.[59] Logistical media establish the zero points where the *x* and *y* axes converge. McLuhan's slogan "The medium is the message" applies particularly well to them. They prepare the ground on which we can make such distinctions as nature and culture. They span ocean, ground, air, outer space, and cyberspace. Chapters 4 and 5 explore logistical media most fully, focusing on classic forms such as calendars, clocks, and towers. Other key examples are names, indexes, addresses, maps, lists (like this one), tax rolls, logs, accounts, archives, and the census. Money is surely the master logistical medium—a medium, as Karl Marx complained, that has no content in itself but has the power to arrange everything else around it.[60]

In arraying things around polar points, logistical media set the terms in which everyone must operate. The zero is the paradigm case of a logistical medium: an apparent nothing that marks out longitude and latitude, and orders of magnitude, and thus shapes the world; it is an operator that arranges data and regulates processing. (Few would complain if their bank accounts acquired an extra zero in the right place.) The zero is an Archimedean *παγκράτιον* (*pankration*), a lever that moves the earth. (Zero never exists in the numeral system of any natural spoken language, but is a creature of graphical practices, such as calendar making and accounting.) Brigham Young's cane served thus when it marked out the

59. Gabriele Schabacher, "Raum-Zeit-Regime: Logistikgeschichte als Wissenszirkulation zwischen Medien, Verkehr, und Ökonomie," *Agenten und Agenturen. Archiv für Mediengeschichte*, eds. Lorenz Engell, Joseph Vogl, and Bernhard Siegert (Weimar: Bauhaus Universität, 2008), 135–48, at 145. See also Judd Ammon Case, *Geometry of Empire: Radar as Logistical Medium* (PhD diss., University of Iowa, 2010); and "Logistical Media: Fragments from Radar's Prehistory," *Canadian Journal of Communication* 38, no. 3 (summer 2013): 379–95.

60. On money, see Hartmut Winkler, *Diskursökonomie* (Frankfurt: Suhrkamp, 2004), 36–49.

center spot, the temple, around which the addresses of the Salt Lake valley ever after, like it or not, would be gridded. Logistical media pretend to be neutral and abstract, but they often encode a subtle and deep political or religious partisanship. People still debate whether our era is "AD" or "CE," and whether the day after Saturday is called "Sunday" or "first day" (see chapter 4). The point—as vanishing point, decimal point, and printer's spatium—is one of the most critical of all modern media.[61] Though logistical media usually appear as neutral and given, their tilt and slant can also call forth agitation.

Infrastructuralism shares a classic concern of media theory: the call to make environments visible. Perhaps McLuhan's most fundamental ethical call, against his horrified fantasies of mankind growing into a single hive mind, was the call to awareness.[62] McLuhan saw those of us who ignored our technological habitats "somnambulists," invoking the Greek myth of Narcissus to explain our media narcosis. Blessed are they, said Kittler, who could hear the circuitry in the compact disc or see it in the discotheque's light shows.[63] Ontology, whatever else it is, is usually just forgotten infrastructure.

Being and Things

The mention of ontology brings up another figure. I confess to finding myself reluctantly drawn into Heidegger's orbit. Thanks to a small army of brilliant interpreters who've helped detoxify his thought, he is absolutely indispensable if you are interested in how φύσις (*physis*, nature) and τέχνη (*technē*, art, technology) intermingle. Heidegger has benefitted from an offshore laundering brigade made up of highly diverse spirits. To read him—the effect is enhanced by reading him in German—a kind of euphoria builds as you follow step after stunning step and behold, to use his language, the world dawning in ways it never has before. He is

61. See Wolfgang Schäffner, "The Point: The Smallest Venue of Knowledge," trans. Walter Kerr, *Collection, Laboratory, Theater: Scenes of Knowledge in the 17th Century*, ed. Helmar Schramm, Ludger Schwarte, Jan Lazardzig (Berlin: Walter de Grutyer, 2005), 57–74.

62. "Today we need also the will to be exceedingly informed and aware." *Understanding Media*, 75.

63. Kittler, *Gramophon Film Typewriter*, 5; *Gramophone, Film, Typewriter*, xli.

the great student of the diverse shapes and seasons that being can assume. His thinking is as full of surprising, strange, and brilliant moves as Bobby Fischer's chess games. Heidegger is willing to sacrifice his queen—modern philosophy's most powerful piece, the knowing ego—in favor of secondary philosophical pieces such as "being" and "thing," which he then develops to devastating effect in his inexorable march toward checkmate. As in Fischer's case, Heidegger's genius did not prevent him from making disastrous judgments, but in philosophy, especially its more existential kinds, theory and life seem less separable than in chess. The obvious point here is his unrepentant membership in the Nazi party in the early 1930s, something whose import has been broken down at agonizing length by friend and foe alike; the recent publication of his *Schwarzen Hefte* has added fuel to the fire, and has more clearly documented his anti-Semitism.

The moral mystery of great work from compromised sources is perhaps properly a theological question about the productivity of sin, and a proper reading of any thinker such as Heidegger has to be critical. His Nazi affiliation is a symptom of the defective moral and political judgment that is visible elsewhere in his life and work. He is portentous, finds it hard to see nuclear war or the Holocaust as worse disasters than bad thinking, cannot take a joke, and is painfully, irresistibly lucid about so many subjects that matter so profoundly. His understanding that technology—*Technik*—is most important not for what it does to humans or society, but for how it reorders nature is especially crucial for my arguments. What to do? The tactic of pragmatist thinkers such as Latour and Richard Rorty is to rely on him heavily and mock him relentlessly. Latour quips that Heidegger only expects to find Being in the Black Forest, and that his account of technology sees "no difference between an atomic bomb, a dam, a lie detector, and a staple."[64] In an intemperate moment, Rorty called Heidegger a "self-infatuated blowhard," but Rorty's point was to emphasize Heidegger's lack of democratic sensibility.[65] Both Rorty and Latour, however, know clearly that it is wrong to read him as

64. Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993), 65; "Can We Get Our Materialism Back, Please?" *Isis* 98, no. 1 (2007): 138–42.

65. Richard Rorty, "Heidegger and the Atomic Bomb," *Making Things Public*, ed. Bruno Latour and Peter Weibel (Cambridge, MA: MIT Press, 2005), 274–75.

a cultural pessimist who laments technology as simple forgetfulness of being; he is rather a theorist of technics, not as historic downfall, but as essential to the human estate and its "parliament of things"—one of Latour's notions that owes something to Heidegger.[66]

Latour is perhaps the "it" thinker of the moment in which this book is being written. He is ubiquitous, clever as hell, exactly the right person to help us worry productively about the anthropogenic manipulation of our habitat. This book's hope to provide a vision of the human estate in terms of ecology, technology, and theology fits Latour's orbit perfectly. He is the most prominent among many thinkers today pleading that our imagination of nature is an opportunity to reinvent everything about us and it. He is a fierce critic of any kind of hard nature-culture divide, which he thinks of as distinctive to modernity; instead, he wants us to see just how stubbornly real the "imbroglios" between humans and nonhumans can be. Ruefully, he notes the glee with which social constructionism is embraced by AIDS denialists, the Tobacco Institute, global warming skeptics, and others who invest heavily in public uncertainty about inconvenient scientific evidence. Latour thinks the critics of science have gone overboard in the rush "to emancipate the public from prematurely naturalized facts."[67] Many acres of critical scholarship have been devoted to exposing the political character of the supposedly natural, but it is just as interesting to see nature bubbling up in the midst of culture. Night, weather, grass, yeast all have an artifactual quality. One of the overriding messages in the genetic structure of sweet corn, poodles, or tulips is their coexistence with humans. DNA, as noted, is enormously responsive to environmental pressures, and thus profoundly historical. The world for Latour is shaped in concert by human and nonhuman actors, resulting in hybrid "things" that fuse will and material, craft and element.

Latour has radical ideas about nature and culture that confuse critics who read him either as a social constructionist or a realist. Neither is right: he is a philosophical pragmatist, one who recognizes both the making of facts and their terrific grip on the world, both the human shaping of nature and its recalcitrance to our plans. Latour is not the foe of science: he is its lover, and therefore prefers to see it naked. Science is onto-

66. Latour, *We Have Never Been Modern*, 142–45.
67. "Why Has Critique Run Out of Steam?" *Critical Inquiry* 30, no. 2 (2004): 225–48.

logically generative. To the question of whether microbes existed before Pasteur, Latour insists that anyone with common sense would answer with exasperation: Of course not![68] What could he possibly mean? This is not just nominalism, as if the identification of microbes brought them de novo into being. He means something stronger: in strict factuality, knowledge of nature has changed nature. Anthropogenic know-how has radically altered the population and being of microbes; whole new habitats have been opened up for them, such as yogurt containers, Petri dishes, and pharmaceuticals. Even more than populations, new knowledge has changed the past. After Pasteur discovered microbes, we forgot that they didn't exist before. Pasteur's feat was not only epistemological but historical: the past suddenly had to accommodate microbes where none were before. Discovery makes ontological ripples in history itself. What seems like common sense—that microbes were always there—turns out to be the deepest kind of idealism about the hidden constancy of unperceived things. Let's call this ontological reorganization of the past by new knowledge "the microbe effect."

Not only epistemology but politics is at stake in how we conceive of nature. What Raymond Williams said about "culture"—that it "is one of the two or three most complicated words in the English language"—certainly applies to "nature" as well.[69] The nature-culture distinction was absolutely critical for twentieth-century antiracist and feminist thought.[70] To take nature seriously as a category might set off alarms for critical scholars who've been carefully taught that concepts of nature were so irreparably infested with power that they were best left alone. There are classic sources for this idea. "Naturalization," said Roland Barthes, was the chief strategy of ideology. The domination of nature, said Walter Benjamin, was inseparable from the domination of people. Max Horkheimer and Theodor W. Adorno went further: the domination of nature not only exploited animals, vegetables, minerals, and other people, but also the bourgeois self, whose inner nature was mastered in

68. Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999), 145.

69. *Keywords: A Vocabulary of Culture and Society*, rev. ed. (Oxford: Oxford University Press, 1983), 87.

70. See Robert Bernasconi, *Nature, Culture, and Race* (Huddinge: Södertörn University, 2010), and Joan W. Scott, *The Uses and Abuses of Gender* (Huddinge: Södertörn University, 2013).

steely frenzies of asceticism. (Hedonism was a form of resistance to this chilly regime, and they did their best to foreshadow the redeemed society with wine, cigars, and fine music.) For critical theory, definitions of nature and humans were always linked: the subject was defined against the object, the human against the animal, the male against the female, the white against the black, the master against the slave. In recent decades, enormous amounts of writing around gender and sexuality, race and ethnicity have developed such ideas.

Latour's strategy is not to abandon the concept of nature but to fight for it. He is not willing to let the natural sciences walk off with all the goodies. Obviously there is a long line of social thought celebrating nature red in tooth and claw that asserts the naturalness of gender, race, class, the free market, and all the rest. From Herbert Spencer to Richard Dawkins, the social application of Darwinist ideas is often a record of domination. But there is another biological tradition that reaches from Aristotle to Marx, Dewey and Dobzhansky, and beyond, as my colleague David Depew has shown, which makes a sustained effort to build a democratic biology based on the insight that the relations of organisms and environments involve the same processes of mutual adjustment and experimentation as are characteristic of a democratic society. For Dewey, societies evolved in the same way that organisms did, by adapting to the problems that appeared before them—except that societies had the advantage of self-conscious acceleration of learning from mistakes (which he called science); he saw deliberation "as a form of species-specific natural selection." Both evolution and democratic deliberation were governed by the variation, selection, and retention of options, sometimes wastefully, painfully, and tragically—99 percent of all species that have ever existed on the earth are now extinct—but Dewey thought the learning processes were analogous. Like his sources Aristotle and Hegel, Dewey thought that biology was the basis of politics and that politics in turn was rooted in biology.[71]

Political concepts are properly subjects of dispute, and thus it is a mistake to sell concepts of nature to the highest bidder; they are critical resources in need of vigorous struggle. To take "nature" seriously is not to

71. John P. Jackson and David Depew, "Darwinism, Democracy and Race in the American Century," manuscript in progress.

say that society as it is exists is supposed to be that way, but to recognize that our milieux are also made by history and thus are changeable. The concept of nature contains multitudes and has plenty to welcome people of every variety, including nonhuman ones. Democracy, as the endless work of inclusion, needs to stretch from the human to the animal and from the organic to the inorganic.

Experience and Nature

I have touched on some Canadian, German, and French thinkers relevant to this project, but there is another tradition that, like Heidegger, takes up the task of considering what it is to dwell among friendly things. Ralph Waldo Emerson knew the splendor and strangeness of being a humanoid in this peculiar cosmos, and he was one of the greatest of all students of anthropozoic comminglings. So were the many American writers that followed in his wake. They saw many things like Heidegger—the contrast between laudable techniques and dangerous technology, the way being strikes fear into you, the wonder of the most ordinary things. Thoreau and Heidegger resonate in many ways, as Stanley Cavell has been urging for decades: both, at first glance, look like pessimists lamenting lives lived in quiet desperation but, examined more closely, are ardent fans of practice, huts, ancient Greek literature, and techniques in their fullness. Both thought that philosophical questions could be fruitfully pursued through detailed attention to shoes, clocks, or the thawing mud. Thoreau's *Walden* is a festival of cultural techniques as well as a treatise on political economy, on housekeeping. Heidegger's meditations on dwelling always return to the equipment by which we exist.

Many American thinkers in the transcendentalist wake understood something like this. Herman Melville knew to watch the horizon for storm clouds and breaching whales from the masthead of a ship, and could butcher the whales and distill their oil. Emily Dickinson was a keen observer of the ways of plants, bees, and birds, a stitcher of an elaborate herbarium, and was very well informed about the natural history of her day, as was Emerson. Walt Whitman sang of being compassed about by strange creatures—animals, native peoples, slaves to be liberated—and envisioned a democracy with wild multitudes in its heart. (We should in-

clude Mumford, the devotee of Emerson and Melville, in this lineage.) Such ideas about the mixing of humans and nonhumans resonate through the pragmatists, William James and Charles Sanders Peirce in particular, both of them first-rate natural scientists in their own right who thought any philosophy of human existence would have to begin with the fact of organic evolution. Peirce saw signs as embedded in the sporting history of life, and James saw mind as one among many useful evolutionary adaptions. Together with Dewey, Peirce and James understood communication as the cultivation of fruitful activity in an evolving community, rather than as the matching of minds. Meaning was the by-product of the selective guesswork and self-correction of populations; the human community had the extra benefit of science to steer with. This book embraces the tradition running from Emerson and Melville to James and Peirce.

The transcendental Yankees had a certain practical healthy cheer toward the ordinary realm of chatter, commerce—or "commodity," as Emerson called it, or "secondness," as Peirce did later.[72] Heidegger, for all his towering genius, possessed little feel for this realm. To be sure, few have matched Heidegger's sense for the phenomenology of tools and things, but there was little civic tide in his sea. Two key requirements for a practicing democrat are common sense and a sense of humor, neither of which were among Heidegger's strong suits. (As Ken Cmiel once said of Heidegger, quoting a martial arts film, "Beware of holy men who can't dance.") Whatever wild ideas the Americans entertained—and they did so in abundance—they always ultimately refused to forfeit simple solidarity with otherness, including the mute and simple. They were quicker to make a truce with reification, with modernity, trade, impurity and imperfection, for better or worse, most famously in James's disastrously felicitous notion of the "cash value" of truth.[73] Patience with reification might be one of the first principles of understanding both nature and our fellow creatures. There is a lovable muteness to plants, animals, and clouds.

The fundamental question for American thinkers in a transcenden-

72. Emerson, *Nature*, 7–9. "Commodity" provides "temporary and mediate" service and "mercenary benefits." And for Emerson it is clearly the zone of *technē*.

73. Kenneth Burke, *A Grammar of Motives* (1945; Berkeley: University of California Press, 1969), 277.

talist vein was the relation of experience and nature, as Dewey, the great thinker of democracy, put it. They welcomed a fruitful instrumentality as the key to what makes us humans. The pragmatist lineage shares with Heidegger the intuition that being is found in everyday practices, algorithms, and programs. Both Heidegger and the New Englanders turn to the basic and show what is locked up in a meadow, ship, or pair of shoes. Both share the infrastructural intuition that what is generally taken as obvious is not obvious at all. Both are interested in the astonishment of media, technics, and animal lives seen within a philosophical-theological horizon—the subject of this book. For neither Emerson nor Heidegger, James nor Kittler, is there such a thing as a media-free life. Embedment in media is a handsome condition. Heidegger and the pragmatists, like Thoreau trying to measure the bottom of Walden Pond, know that any effort to fathom the fathomless will only measure our bottomless capacity for wonder. The pragmatists at least also knew that the occasional spell of boredom was essential to replenishing the world.

Both traditions are also interested in experiments in emergency, in getting close to the danger in order to feel its saving power, to use one of Heidegger's incantations. Both take an interest in what King Lear called "the unaccommodated man," in what to do after the protective shell of civilization has collapsed, when we are immersed in soil, air, and weather once more. (Melville's Ahab, an explicitly Lear-like character, smashes his quadrant or "heaven-gazer" in preparation for the final showdown with the white whale, in which he will lose all his cargo, including his own person.) This concern among the Yankees not only mirrors the rapacious pioneer ethos but embodies a deeper, ethically inflected sense for the uncanny husbandry humans have for the earth. Emergency preparedness was their constant theme: Thoreau called on us to "live in all respects so compactly and preparedly, that, if an enemy take the town, [you] can, like the old philosopher, walk out the gate empty-handed without anxiety."[74] Ishmael on the Pequod and Thoreau in his cabin explored human life without its supports. They asked what happens when we leave all our materials behind. (My interest in cetaceans in the next chapter is a version of this inquiry.) What is our readiness for the catastrophe when our materials break down? When the ship crashes, what will we do then? The

74. Henry David Thoreau, *Walden* (New York: Norton, 2008), 19.

transcendentalists and their pragmatist heirs were all students of "the advantages, though so dearly bought, which the invention and industry of mankind offer."[75] They teach us to think about and prepare for the loss of technics and civilization, which is also to prepare for our own demise, and to sing a lower tone, a rumbly gratitude for being.

Media and/as Nature

The concept of media, as noted, was connected to nature long before it was connected to technology.[76] It has roots in ancient Greece and Rome, but many of its key twists and turns are medieval and modern. *Medium* has always meant an element, environment, or vehicle in the middle of things. One key ancient Greek source is Aristotle's concept of *τὸ περιέχον* (*to periekhon*)—more or less "surrounding" or environment—which expressed "sympathy and harmony between the universe and man." This concept, says Leo Spitzer in an indispensable study, had "a 'skyey' quality," suggesting atmosphere, cloud, climate, and the air.[77] The concepts of *medium* and *milieu* have long orbited each other, as twin offspring of Aristotelian material and the Latin word *medius*, middle. Medium comes directly from *medius*, while *milieu* is the French descendant of *medius locus* or middle place; a milieu, like a medium, is a place in the middle. A related input is Aristotle's theory of vision, which posited a transparent in-between that enabled the eyes to connect with the object. He obviously did not use the term *medium*, which is of Latin origin, but his concept of *τὸ μεταξύ* (*to metaxu*), the in-between, prepares the way. The crucial move comes in the thirteenth century with Thomas Aquinas, who, in translating Aristotle, smuggles in the term *medium* to account for

75. Thoreau, *Walden*, 32.

76. The key text on the history of the term is Stefan Hoffmann, *Geschichte des Medienbegriffs* (Hamburg: Meiner, 2002). From a vast literature, see also Dieter Mersch, "Res medii. Von der Sache des Medialen," *Medias in res: Medienkulturwissenschaftliche Positionen*, ed. Till A. Heilmann, Anne von der Heiden, and Anna Tuschling (Bielefeld: Transcript, 2011), 19–38; John Guillory, "Genesis of the Media Concept," *Critical Inquiry* 36 (2010): 321–62; Mitchell and Hansen, eds., *Critical Terms for Media Studies*.

77. Leo Spitzer, "Milieu and Ambience," *Essays in Historical Semantics* (New York: S. F. Vanni, 1948), 179–316, at 223, 190.

the missing link in the remote action of seeing. Ever since, media have always stepped in to fill the environmental gaps to explain contact at a distance.[78] Spitzer quotes a Scholastic author writing in Aquinas's wake, who defined the enduring role of media: "Omnis actio fit per contactum, quo fit ut nihil agit in distans nisi per aliquid medium."[79] (All action occurs by contact, with the result that nothing acts at a distance unless by some kind of medium.) A medium, like its ancestor *periekhon* and sibling *milieu*, fills in the vacuum left open between important things.[80]

With Isaac Newton, *medium* became a more instrumental concept, "an intermediate agent," a condition for the transmission of entities such as light, gravity, magnetism, and sound. Newton's medium was transparent and relatively sterile compared to other more organic conceptions, though it was still the key and divine constituent of the universe as the *sensorium dei*. The *ether*, the later term for the universal medium posited by Newton, had an austere immaterial flavor compared with *environment*'s sense of vital interconnectivity. One was transcendent and the other immanent, one dry and the other fluid, one fit for physics and the other for biology. Both senses continue to resonate today in talk about media. In particular, German idealism and romanticism both explored with great creativity the notion of medium, perhaps one deep background for the warm reception of the media concept in recent German scholarship.[81]

The decisive break happened in the nineteenth century with the slow turn of *medium* into a conveyance for specifically human signals and meanings. The telegraph as a medium of communication combined physical phenomena long observed in nature (speedy immaterial processes) with an old social practice (writing to distant correspondents). The new concept of medium blurred together signal (physics) and symbol (semiotics), yielding some of the conceptual messes around "communication" that still haunt us. Perhaps the most critical shift came with spiritualism, around 1850, when a person, typically a woman imitating

78. Wolfgang Hagen, "Metaxy: Eine historiosemantische Fußnote zum Medienbegriff," in *Was ist ein Medium?*, ed. Stefan Münker and Alexander Roesler (Frankfurt: Suhrkamp, 2008), 13–29.

79. Spitzer, "Milieu and Ambiance," 201. Eustachius a Sancto Paulo (1573–1640).

80. See Steven Connor, "Michel Serres's Milieux" (2002), http://www.stevenconnor.com/milieux/

81. See Hoffmann, *Geschichte des Medienbegriffes*.

the telegraph's ability to bridge wide chasms, came to be called a *medium*, which no longer meant a natural element but a human intermediary between the worlds of the living and of the dead. A spiritualist medium was not an environment enveloping organisms but a person communicating meanings that were distinctly human—that is, located in minds (whether incarnate or not). This was a stepping-stone to the sense prevailing in the twentieth century that media were human-made channels that carried news, entertainment, advertising and other so-called content.[82] The spiritualist quest for communiqués from distant minds went together with the shrinkage of the notion of communication to mean intentional sendings among humans.

In the twentieth century, *media* came to mean the mass media of radio and television, cinema, newspapers, magazines, and sometimes books, but the term never completely lost its environmental meaning; indeed, mass media were so pervasive and elemental that they could fit nicely into the long lineage of medium as ambiance, and some, such as McLuhan and his followers, sought a more expansive (and ancient) notion of media ecology. Social theorists, in a similar spirit, would speak of the media of money, power, or love, as artists would speak of charcoal, pencil, watercolor, or oil as their media. The term could sometimes take a singular verb, turning into a mass noun like *spaghetti* (which is also technically a plural form), but most media scholars, at least, usually stick to the plural *media are* in order to defend an interest in medium specificity. Today the term *media* carries with it more than a century's worth of discourse about modes of meaning-making—perhaps a distant semantic index of the Anthropocene, when the human stamp touches all.

My aim is not to turn back to a precritical notion of media as natural. There are compelling reasons to restrict the concept of "medium" to the semiotic dimension.[83] I take the modern human-semiotic turn as an enrichment of the concept, but it is time to graft those branches back into the natural roots in hopes of a new synthesis. This does not mean that the

82. See Wolfgang Hagen, "Wie ist eine 'eigentlich so zu nennende' Medienwissenschaft möglich?" *Was waren Medien*, ed. Claus Pias (Zurich: Diaphanes, 2011), 81–101, esp. 86–93.
83. E.g. Hartmut Winkler, "Zeichenmaschinen; oder, warum die semiotische Dimension für eine Definition der Medien unerlässlich ist," *Was ist ein Medium?*, ed. Münker and Roesler, 211–21.

sea, fire, or the sky are automatically media in themselves, but that they are media for certain species in certain ways with certain techniques; in seeing media as ensembles of nature and culture, *physis* and *technē*, I try to stir together semantic strains that speak to a historical moment in which we cannot think of computation without thinking about carbon, or of the cloud without thinking about data. Today natural facts are media, and cultural facts have elemental imprint. We can see the Internet as a means of existence, in some ways close to water, air, earth, fire, and ether in its basic shaping of environments. Notions such as "the commons," so current in digital talk, or the wide interest in Jakob von Uexküll, the biologist who made the notion of *Umwelt* famous, for instance, revive the long tradition of thinking about milieu and ambiance.[84] Today's infrastructures invite an environmental view of media, and we are fortunate that the intellectual history of the concept offers ample justification and materials for that project. [85]

Sailing on Many Craft

The reader will already have noted that this book, while a defense of the idea that technics is central to whatever it is that makes us humans, is not especially utopian about our digital technofutures. Computers and their spawn have, of course, reshaped much about how many of us work, play, and learn. Digital devices have spread like rabbits in Australia. Organisms flourish when transplanted into habitats lacking in natural enemies, and computers have spread almost zoologically into our cars and ovens, clothes and garbage, music and minds, clothing and bodies. Perhaps, George Dyson once ventured, there were even new species evolving in the silicate habitat of fiber optic cables. Computers are rather like what Donna Haraway calls "companion species living in naturecultures" such as dogs, cats, and horses, though we have lived for millennia with animals

84. Geoffrey Winthrop-Young, "Afterword. Bubbles and Webs: A Backdoor Stroll through the Readings of Uexküll," in Jakob von Uexküll, *A Foray into the Worlds of Animals and Humans* (Minneapolis: University of Minnesota Press, 2010), 209–43.

85. See Ursula Heise, "Unnatural Ecologies: The Metaphor of the Environment in Media Theory," *Configurations* 10, no. 1 (winter 2002): 149–68.

and barely three decades with household digital gadgets.[86] Chips—as implemented into platforms and programs by dreamers, designers, and venture capitalists—have drastically altered our environments. Biology, Robert Carlson dramatically claims, has become technology.[87]

Yet all the basic problems remain amid the technical upheaval. The world is still mad, smart people make catastrophically boneheaded choices, Wednesday afternoon is still Wednesday afternoon, and doctors have no answer for almost everything that ails us. Digital media have not abolished bills, backaches, or crummy weather—to say nothing of rape, poverty, or scorn. The central ethical and political problems are perennial, however much many appliances open new social and political possibilities. New inventions do not release us from old troubles. A story from Bangladesh, whose government has run a two-front campaign to improve its informational and public health infrastructures, makes my point. Because the state has boosted the term so much, *digital* in Bangladeshi slang has apparently come to attach itself to things that are newfangled or modern, including the disposable toilet "Peepoo" baggies distributed in hopes of reducing the spread of disease and keeping the water clean.[88] This felicitous coinage has discerned a crucial truth: sometimes the digital just collects the same old poop.

Things in the middle, like spines and bowels, often get demeaned, but they too deserve their place in our analysis. Small means bring about that which is great. Media show up wherever we humans face the unmanageable mortality of our material existence: the melancholy facts that memory cannot hold up and body cannot last, that time is, at base, the merciless and generous habitat for humans and things. Media lift us out of time by providing a symbolic world that can store and process data, in the widest sense of that word. Like Aristotle or Arendt, I do think there is such a thing as the human condition, and that it involves earth, world, other people, labor, work, time, speech, action, birth and death, promise

86. Donna Haraway, *The Companion Species Manifesto: Dogs, People, and Significant Otherness* (Chicago: Prickly Paradigm Press, 2003), 65.

87. Robert H. Carlson, *Biology is Technology* (Cambridge, MA: Harvard University Press, 2010).

88. Stefanie Schramm, "Ab in den Beutel," *Die Zeit*, 10 June 2010, 38. This usage seems to be rare, however.

and forgiveness. But the human condition is recursive; it is a conditional condition: our actions change the conditions they act in, especially since they change us; we speak and act, and as we do we change the conditions in which we speak and act. As Walter Ong nicely puts it, "Artificiality is natural to human beings."[89] The crossroads of humans and things defines the domain of media studies. We are conditioned by conditions we condition. We, the created creators, shape tools that shape us. We live by our crafts and conditions. It is hard to look them in the face. In the grandest view, media studies is a general meditation on conditions. To try this adventure of ideas is the task of this book. It seeks nothing less than to sketch what Heidegger called "a poetic outline of [our] being, drawn from its extreme possibilities and limits."[90]

The questions of how to define nature, humans, and media are ultimately the same question. We know and use nature only through the artifacts we make—both out of nature and out of our own bodies—and these artifacts can enter into nature's own history. "The invention of the four-wheeled carriage, the plough, the windmill, the sailing ship, must also be viewed as biological ones," says Leroi-Gourhan.[91] Music and writing are as much a part of our natural history as are endothermy and bipedalism. Our technical know-how and bodily form have coevolved. The ballooning shape of human skulls and the bulging ears of Iowa corn are alike technical achievements. The history of fire forms a large chapter in the history of nature in recent millennia, as does the anthropogenic domestication and extinction of diverse plants and animals. Media help steer nature and humans as logistical techniques linking the anthroposphere and the biosphere, whose fates are now linked. Humans are at the planetary helm: our shipwreck won't ruin the planet, which has survived much bigger catastrophes, but it could ruin us. Wreck ruins the ship, not

89. Walter Ong, *Orality and Literacy: The Technologizing of the Word* (London: Routledge, 1982), 82–83.

90. Martin Heidegger, "The Ode on Man in Sophocles' *Antigone*," *Introduction to Metaphysics*, trans. Ralph Manheim (New Haven: Yale University Press, 1987), 155.

91. André Leroi-Gourhan, *Gesture and Speech*, trans. Anna Bostock Berger (Cambridge, MA: MIT, 1993), 246; *Le geste et la parole*, vol. 2 (Paris: Albin Michel, 1965), 48: "l'apparition du chariot, de la charrue, du moulin, du navire est aussi à considérer comme une phénomène biologique."

the sea. What was always the case for human nature, at least since we acquired language, and probably much earlier with fire and bipedalism—head to toe artificialization—is now the case for all nature.

As the next chapter makes clear, an argument in favor of human technicity is not at all the same thing as an endorsement of the engineering culture of technologists. Rather, it is to attempt a better hold of the human condition by acknowledging a connection to each other and to sea, sky, and earth. Our home is among plants, animals, and the dead in all their varieties. Media are not just pipes or channels. Media theory has something both ecological and existential to say. Media are more than the audiovisual and print institutions that strive to fill our empty seconds with programming and advertising stimulus; they are our condition, our fate, and our challenge. Without means, there is no life. We are mediated by our bodies; by our dependence on oxygen; by the ancient history of life written into each of our cells; by upright posture, sexual pair bonding, and the domestication of fire; by language, writing, and metalsmithing; by farming and the domestication of plants and animals; by calendar-making and astronomy; by the printing press, the green revolution, and the Internet. We are not only surrounded by the history-rich artifacts of applied intelligence; we also *are* such artifacts. Culture is part of our natural history.[92] "That's the sort of determined creature we are," in poet Galway Kinnell's pun.[93] Microbes and bits are both media of existence. Media studies can be a form of philosophical anthropology, of asking the question with which Socrates stumped Alcibiades: What is a human being?[94] I am also stumped, but I offer one answer in the next chapter: The human is a creature sailing on many craft.

92. See Dipesh Chakrabarty, "The Climate of History," *Critical Inquiry* 35, no. 2 (2009): 197–222.

93. "Astonishment," *New Yorker*, 23 July 2012, 57.

94. Plato, *Alcibiades* I, 129e.

Chapter 2

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.

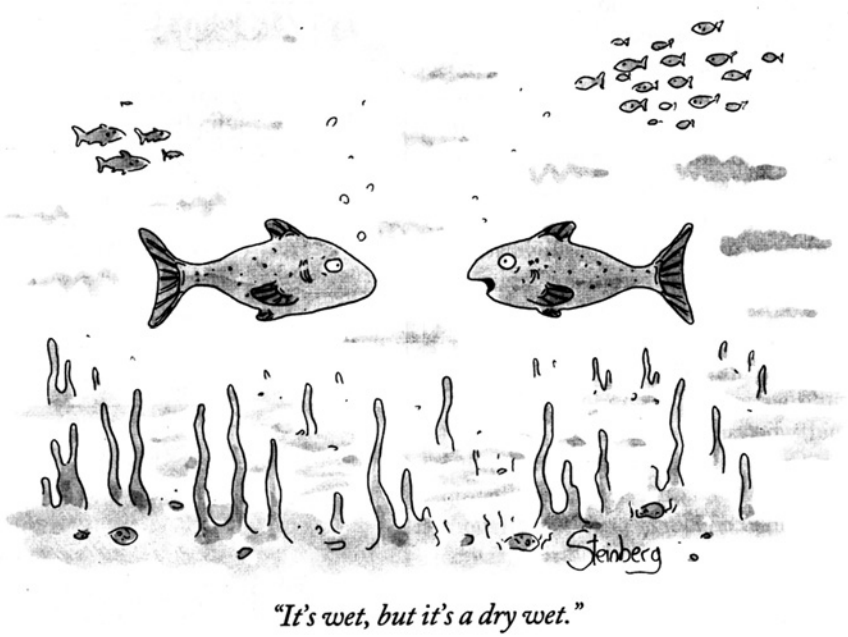

Figure 1. Connoisseurs of water. Cartoon by Avi Steinberg.

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.

Chapter 3

The Fire Sermon

> "Like the great dome of St. Peter's, and like the great whale,
> retain, O man! in all seasons a temperature of thine own."
> —*Moby-Dick*

Technics as Pyrotechnics

If the ship stands for the suite of arts and techniques that allow humans to dwell at sea, fire stands for those that let us dwell on earth. Fire is our most radical environmental shaper, our premier instrument of habitat conversion, and one of our most important elemental media. It cures the wood we use for houses and ships, clears the fields and preselects the crops we grow, yields milk and honey by controlling cattle and bees, cooks our food, smokes our meats and cures our pottery. It sets bounds to the latitudes we can inhabit and to our forays into the night. It spans heaven (lightning) and earth (volcanism), but is quenched at sea and is one of many things that separate us from whales, dolphins, and squids. It marks our rites of passage and stands for our most passionate feelings. Unlike shipping or writing, which have a largely masculine and elite history, fire is a genuinely human tool used by both men and women, though in different ways. Like some trees and wildflowers, human beings are pyrophytic plants: we grow together with fire.[1] Our arts and tools,

1. Johan Goudsblom, *Het regime van de tijd* (Amsterdam: Meulenhoff, 1997), 61.

our minds and metaphors derive in many ways from our possession of fire. According to Aeschylus, Prometheus, in stealing fire from the gods, "founded all the arts of men." If, as André Leroi-Gourhan claims, "human technicity [is] a simple zoological fact," then fire is a species attribute of *Homo sapiens*.[2]

Our species depends on fire, and fire depends upon oxygen, fuel, climate, and much more. This makes fire a particularly apt topic for meditating on the milieux in which we live. Fire helps make the earth into a human home, our *domus*. With it we have reshaped the face of the earth, tamed plants and animals, and perhaps even tamed ourselves. We have used it to build buildings and shrines, to mold metals to many ends, to touch the secrets of nature, and to dominate each other. We also use it to paint the sky with smoke, briefly marking a realm that normally only the gods can fashion. The history of fire in recent millennia is the history of civilization and its media, but also the history of wreck and disaster. Fire reveals nature as enormously plastic, as a medium of ongoing experimentation into which humans have entered as the laboratory master, and thus also something that can go up in smoke. Its study holds many lessons for our moment of climate crisis and data abundance.

Fire is useful for media theory because it suggests several reorientations, drawing our attention to the risks built into systems, our radically precarious dependence on nature, and the role of negation in forming the world. Fire teaches the fragility of the web of externalities that undergirds all media. Human ingenuity may have encompassed nature in a thousand ways, but it will not always give itself willingly to our schemes. Horace's saying still fits: "*Naturam expellas furca, tamen usque recurret*" (You can drive away nature with a pitchfork, but it will still come right back). Fire, our greatest tool, is still not mastered. Like most people alive, I have scars from fire that leapt its bounds. Fire has entered into human history, as clothing, language, and writing did later.

This chapter tries the experiment of seeing how much meaning can be wrung from a single natural element for media theory. I invite the reader to bring a match, an ample supply of oxygen, and to blow hard on any spark beneath this pile of flammables. Our habits of living in civilization

2. Leroi-Gourhan, *Gesture and Speech*, 92; *Le geste et la parole*, vol. 1: 134: "Il est certainement moins périlleux de voir dans la technicité humaine un simple fait zoologique . . . ."

are hard to burn away, and I try to read fire to make civilization, with its extensive life supports, something strange. Just as the human estate becomes clearer at sea when we have to condense our wares and ways, so too I hope fire can have a similarly clarifying effect.

Fire can be considered a medium in several ways: it is in the middle of civilization, it is an enabler of many subsidiary crafts, and it is the tool of tools. But it is a difficult case for media theory and a good test of the claim that natural elements can be understood as media, since it stretches the concept to its outer limits. It is as resistant intellectually as it is physically—and potentially also as useful. Fire is not a medium for light or sound in the same way as water or air, and it is not a habitat in the same way as sea or land; living organisms, so full of carbon, are sooner fuel for fire than dwellers in it. Nor is it a relatively steady element like sea or land: it can vanish in a puff, ceasing to exist without oxygen or fuel, but it is also as violent as it is fragile. It can be smothered by the ash it makes, "consumed with that which it was nourished by."[3] But life springs from the ashes, which play a role similar to that of manure in agriculture. Dung and ash both look useless or noxious in their immediate states—typical for sacred things—but render great post hoc services. (In Melanesian pidgin English, the term for ash is "shit belong fire.") Ash, as a potent symbol of both repentance and renewal, is something media theory might consider.

Fire is a medium because it is an enabling environment for ash and smoke, ink and metal, chemicals and ceramics. Teamed with technique, fire makes matter malleable, turning ores into tools, cold climates into warm ones, darkness into day. It chases away (and attracts) animals and clears the ground for farming. Fire can even help catch fish, since they are drawn to its light. It demands discipline and civilizes human beings in the great drama of domestication. Fire offers several dietary services: cooking sterilizes, and relieves the face from the duties of constant chewing, allowing humans to develop a shorter face and a more gracile skull that contains a larger brain.[4] Like all media, human fire is an ensemble of natural elements and cultural techniques, a means for creating other means. The history of technology among humans is largely a pyrotech-

3. Shakespeare, Sonnet 73.

4. Leroi-Gourhan, *Gesture and Speech*, 118–28, *Le geste et la parole*, 1: 169–82.

nical history. Fire is the mother of tools as well as a tool itself, a medium as well as the precondition for almost all human-made media. Fire is a meta-medium.

Fire is perhaps most relevant to media theory as an ontological operator, as an agency that calls being into nothingness and nothingness into being. (My language has already repeatedly treated fire as an agent.) At first glance, fire does not seem very promising, let alone the pivot of environmental history. In Johan Goudsblom's summary, fire is "destructive, purposeless, irreversible, and self-generating."[5] It turns objects into nought, but in its cunning negation danger and advantage come as one. Like the wind and the waves that enable the ship but threaten to sink it, fire unites curse and blessing. It has wildly varied affordances—heat, light, food, and sociability on the one hand, and injury, death, smoke, and ash on the other. Like time, burning runs in only one thermodynamic direction. There is no theoretical reason why some technology might not be one day able to reconstruct an object from its ashes, but the odds for it are as crushingly minute as those for retrieving the same water molecules from a bucket you just poured into the ocean. Fire's entropy makes complex forms simple. *Igne natura renovatur integra*, say the alchemists: By fire nature is renewed whole.

Our relation to fire is like the dolphin's relation to the sea; the two elements most mock any hope of permanence for each species. The ocean repels engineering, architecture, or infrastructure, but fire has also incinerated those things on earth. If the sea is a great impediment to cetacean engineering, why is an equally matter-mocking element so useful to us? Here again we face species specificity: for animals in water, solidity is an environmental achievement; for humans on earth, liquefaction is. The solidity of objects, within limits, is the default setting for terrestrial animals. We know and profit from many things that vanish, of course, but most things tend to stay in place within the bounds of weathering and the general flux—though many do not, such as youth, autumn foliage, or pain. The best cetaceans can do to shape matter is to make swimming whorls,

5. Johan Goudsblom, "The Civilizing Process and the Domestication of Fire," *Journal of World History* 3, no. 1 (1992): 1–12, at 5; and "The Human Monopoly on the Use of Fire: Its Origins and Conditions," *Human Evolution* 1, no. 6 (1986): 517–23.

bubble clouds, or rainbow spouts, or perhaps to make sonic shapings of time and space that humans can only glimpse in the algorithmic arts of music and prayer.

Where, in contrast, durability is a given, the question is how to liquefy and mold the earth and its things. Fire is dangerous, fickle, and destructive, a means of making matter less dictatorial and stubborn. Like points, zeroes, and language, fire is a way to negate the world, and thus a way to make it a place we can live in. It is not quite right to make carpentry or pottery the prototypes of human crafts, with their molding of a given material. Fire is a subtractive technique, a deleter, a way to make things vanish, an antidote to the pressure of objects. Fire is where nature goes to disappear; it is nature's eraser.[6] Like sound, it exists by disappearing. Dematerialization is one of fire's greatest gifts. It gives humans access to the immense and crucial realm of non-being, to "things which are not," as Paul of Tarsus said (1 Corinthians 1:28). Like Hegel's negative, fire is the great dialectician; it proves Kenneth Burke's point that human beings are "the inventor of the negative."[7] If ontology is forgotten infrastructure, fire proves something important: that nothing is critically mixed into being, like mitochondria into cells, hearths into houses, or oxygen into organisms.

Human Ecological Primacy

Anthropogenic dominance owes much to pyrotechnical crafts; our planetary helmsmanship and environmental alterations rest on a history of techniques that ultimately hearken back to fire. Claude Lévi-Strauss in *The Raw and the Cooked* famously treated the possession of fire as the essence of human culture. Only humans use fire, but it is perhaps even more remarkable that all humans use fire. Only mythological creatures manage fire as humans do—dragons, demons, and salamanders. Like music, hair care, language, food taboos, gender roles, and fear of snakes, possession of fire is a human universal, a rare robust generalization about

6. I owe these formulations to Pablo Rodriguez Balbontín.
7. Kenneth Burke, "Definition of Man," *Hudson Review* 16, no. 4 (winter 1963–64): 491–514.

human behavior. "Fire is the most important agent of change on earth."[8] Humans, of course, are not the only environmental molders; in "niche construction" the behavior of organisms can evolve to produce environments in which they are advantaged, in the way that worms aerate the soil and birds disperse seeds which then grow into trees that provide them more fruit and shelter. But only humans possess the arts of niche construction in general (Buckminster Fuller thinks that the sea helped teach us that). Our niche is potentially everywhere. Unlike almost any other large fauna, humans live at every latitude on earth—anywhere we can carry or start fire. The habitats that remain most off-limits to human settlement—the arctic, the desert, the rain forest, and of course the sea and sky—are all fire-resistant in various ways. [9]

Using fire as our first tool among many, humans have entered into geological, botanical, and zoological history. Ecologists have estimated that human-shaped environments today take up nearly one-third of the planet—an astonishing share for one species. Croplands and pastures now cover about 35 percent of the ice-free surface of the earth, and if we include timberland and other forests under human cultivation, the human share is even greater.[10] As much as 40 percent of all plant growth is used by humans, but the traces of our activity are everywhere.[11] Even the deep sea and upper atmosphere have been profoundly altered, and human activity affects almost every species in air, land or sea, shaping (often shrinking, more rarely greatly expanding) their habitats, rearranging their conditions of life, speeding their pace of evolution, or making them extinct. No century ever saw such radical ecological change as the twentieth, with its doubling of cropland, fourfold growth of the human

8. William Gurstelle, *The Practical Pyromaniac: Build Fire Tornadoes, One-Candlepower Engines, Great Balls of Fire, and More Incendiary Devices* (Chicago: Chicago Review Press, 2011), ix; see also Lewis Mumford, *Technics and Civilization* (New York, 1934), 79.

9. Johan Goudsblom, "Introductory Overview: Towards a Historical View of Humanity and the Biosphere," in *Mappae mundi: Humans and their Habitats in a Long-Term Socio-Ecological Perspective*, ed. Bert de Vries and Johan Goudsblom (Amsterdam: Amsterdam University Press, 2003), 29–31. The desert is a kind of sea, and a camel is a kind of ship that carries the water on the inside.

10. Jonathan A. Foley, Chad Monfreda, Navin Ramankutty, and David Zaks, "Our Share of the Planetary Pie," *PNAS* 104:31 (31 July 2007): 12585–86.

11. Edmund Russell, *Evolutionary History: Uniting History and Biology to Understand Life on Earth* (Cambridge: Cambridge University Press, 2011), 49.

population, ninefold growth of the pig population, sixteenfold growth of energy use, and fortyfold growth of industrial output.[12] Such lopsided dominance would have never come about without fiery leverage.

One of the main effects of human fire control is to increase power differentials between populations, including those of humans over plants and animals, and of humans over humans. Fire interacts with biotechnologies such as cattle and wheat, and with tool technologies such as metals and ink. ("Where there is metal, there must be fire.")[13] It is an essential tool in farming and has obvious uses in hunting and gathering. Fire makes large-scale agriculture possible, killing weeds, controlling competitor species, and fertilizing soil by moving the nitrogen from plant biomass above the soil back down in the form of ash if the precious stuff is not blown away in the wind. Despite the name "slash-and-burn" agriculture, which sounds like simple devastation, swidden, as it is called by specialists, accelerates the nitrogen cycle. To British colonizers in Australia, aboriginals seemed to live "on fire instead of water" since they were always burning.[14] Many ecosystems have depended on human-made fire; the North American prairie, for instance, is not a natural landscape but the result of fire cultivation by native peoples; without regular burns, it would revert to woodlands. In contrast to the narrative commonly told of white settlement of the prairie, farms were not carved out of the forest; rather, farming made the forest possible, by controlling the burns that had kept the land as prairie.[15] Fire teaches the deep historicity of what we think of as nature.

Given the position of our species as ecological hegemon, posthumanist philosophies need to be taken the right way. While the effort to think ecologically and philosophically beyond the human frame is an effort that this book joins, there are profound and urgent reasons not to forget the enormous pressures that human beings are exerting on sea, earth, sky, and all that dwells in them. It would be ironic at the dawn of the

12. John R. McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: Norton, 2000), 360–61 and passim.

13. Mumford, *Technics and Civilization*, 69.

14. Johan Goudsblom, "The Past 250 Years: Industrialization and Globalization," in de Vries and Goudsblom, *Mappae Mundi*, 369.

15. Stephen J. Pyne, *Fire in America: A Cultural History of Wildland and Rural Fire* (1982; Seattle: University of Washington Press, 1997), 84–99.

Anthropocene to treat humans as just another (surpassingly interesting) form of life. We can stop regarding the human subject as the fount of truth without missing our planetary imprint. Humans have become ecologically primary, and our species monopoly on fire has decisively remade the geosphere, biosphere, cryosphere, and atmosphere, plants and animals—and ourselves—to an unprecedented degree. Ask the species that have gone extinct in recent decades, if they could speak, whether humans should be out of the picture. They might approve of a utopia in which humans would draw back, but they'd hate any analysis that failed to take our one-sided power into account.

Fire is both a chemical and historical process. Environmental historian Stephen Pyne has taught us the enormous variety of fire practices around the world. Fire yields many artifacts, but has an artifactual quality itself as a complex and enormously variable ensemble of oxygen, fuel, human skill, and natural elements. Its mixture of nature and culture depends not only on the habitat—including weather (hot and dry, wet and cold), fuel (wood, brush, peat, petroleum, whale), and the availability of oxygen—but on the culture of its users. Fire is a key case of a fertile interaction of the human and the nonhuman, and one of our oldest actor networks. Few "natural" things are so imbued with the human stamp. Such an unpromising and hostile presence, hostile even to itself, lies behind everything humans have made.

Vestal Fire

Over the last two centuries, human-made fire powered the Industrial Revolution, moved a lot of carbon into the atmosphere, and killed millions of people. In modernity, fire has both retreated from view and multiplied in power, and fire's retooling has been as radical as any other modern transformation in art, dance, literature, music, or physics. "Man's long adventure with knowledge has, to a very marked degree, been a climb up the heat ladder."[16] With bellows, smiths have long been able to generate temperatures high enough to smelt iron, but only in the twentieth century were the white hot temperatures of nuclear fission attained,

16. Loren Eiseley, "Man the Firemaker," *The Star Thrower* (New York: Times Books, 1978), 45.

and in its wake, the knowledge of the high-temperature history of cosmic chemistry, both of which formed an exponential break with historical levels of terrestrial fire. These breakthroughs, like those in twentieth-century cosmology, no longer took the earth as the frame of reference. From the ancient smithy to nanosecond-long, ultrahot explosions produced in supercolliders, human power to make heat has seen a precipitous climb indeed.

Fire media are shiplike vehicles that make fire into something we can manage—usually just barely. Its gift at dematerialization needs containing. Pits, kilns, and blast furnaces are some concrete examples of fire control. Controlled fire use requires planning, social order, and the ability to avoid doing the first thing that jumps into one's head. It presupposes discipline and constraint, key features of "civilization" or social order among humans. Fire is our first prohibition, says Gaston Bachelard; for him, fire was social before it was natural. A fire can be as needy and high-maintenance as a baby: it requires tending or it will die, and only rarely does fire continue to burn on its own (and usually because of anthropogenic buildups of fuel, often inadvertent, such as cities or ill-managed forests). It is easier to keep fire going than to start it.

Modernity's rule is to keep fire increasingly out of sight, bathed in what Emerson called "deluges of Lethe." Industrialism was, among other things, an acceleration of the furnace arts. Coal fueled the Industrial Revolution's "carboniferous capitalism," as Mumford glumly called it; no Victorian, wearing black to hide the ash (as legend has it) could doubt that things were burning. The violence of coal mining was a shocking witness to fire's appetite. A British engineer in 1830 sketched an inverted world: "The earth seems to have been turned inside out. Its entrails are strewn about . . . . The coal which has been drawn from below ground is blazing on the surface. . . . By day and by night the country is glowing with fire."[17] (Mining often calls forth infernal musings.) Others embraced the by-products of industrial life without aesthetic objection, and until the 1960s the smokestack was a proud symbol of industrial progress. The precise story of fire's going into hiding would require more analysis, but it's clear that fire has retreated for the privileged. My father-in-

17. *James Nasmyth, Engineer: An Autobiography*, ed. Samuel Smiles (London: J. Murry, 1883), 165.

law chopped wood throughout his life to fuel a Franklin stove. My father had to bring coal to his house's furnace as part of his childhood chores in the 1940s. I have to pay a monthly gas and electric bill, and the closest I get to kindling a fire is tanking up at a gas station, turning on the stove, or adjusting the furnace setting. Yet up to three billion people still cook on open fire, and two million children are said to die per year from accidents of smoke and fire—a prospect Hillary Clinton, while serving as US secretary of state, sought to stop via a public-private partnership called the Global Alliance for Clean Cookstoves.[18] Open fire means poverty or privilege, if you own a fireplace or grill. Thoreau once contemplated eating a muskrat raw to ensure that he didn't lose touch with elementals.

Though fire regimes are ancient, many of the pyrotechnic innovations we take for granted are no more than three centuries old. Blast furnaces appeared in late medieval Europe for forging cannons and cannonballs, martial cousins of the clock and printing press, but coal made even more high-powered blast furnaces possible by the eighteenth century, to make weapons that could withstand the fire they discharged.[19] On the home front, the eighteenth century saw major improvements in the heating of buildings. Medieval and early-modern European fireplaces were inefficient fuel hogs. Benjamin Franklin's stove, from 1742, was a major step forward in producing homogeneous heat in a room: his advertising copy bragged that no longer would one be "scorched in front and froze behind." The Rumford fireplace, from 1795, included a damper to better control air flow, prevent smoky downdrafts, and otherwise keep most of the heat from going to waste. Fireproofing underwent serious development, Franklin's lightning rod (1752) doing much to protect buildings from fire from the sky.[20] Fire and fire control alike became more mobile with the invention of the portable fire extinguisher (1818), the Lucifer match (1827), and the Bunsen burner (1855). Franklin was styled as a modern Prometheus: *Eripuit coelo fulmen*, said Turgot, the French *philosophe*, of Franklin.[21] He tore the lightning bolt from heaven.

Pyne calls the distinctly modern version of fire "vestal," and sees it

18. See www.state.gov/s/partnerships/cleancookstoves/index.htm, accessed 27 June 2012.
19. Mumford, *Technics and Civilization*, 156, 87–88, 137, 156–58.
20. Gurstelle, *Practical Pyromaniac*, 70–72, 135–37, 147–51, 161.
21. William James, *The Principles of Psychology* (New York: Dover, 1890), vol. 1, 85–86.

as Europe's key contribution to the history of fire practices.[22] Vestal fire encompasses burning by human artifice. It treats anthropogenic fire as the norm. The hearth, one of the first container technologies, is its natural home. The goddess of the hearth, Vesta (Hestia in Greek), is the one goddess never portrayed in classical art, as a virginal interior not to be revealed. Vesta, like fire, is aniconic because she, the goddess of containment, evokes being itself.[23] Modernity has its Bunsen burners, matches, thermostats, and internal combustion engines, all techniques that stockpile fire into a resource on tap. The ultimate symbol of vestal fire might be nuclear fission, a process revealed only by modern science and technology, a process that has the power to incinerate the entire earth. When you turn on the hot water, pay your gas bill, or start your car, you deal in vestal fire. Such fire is as hidden as Vesta, and even its smoky output is often invisible. Pyne implicitly echoes Heidegger's complaint that modern technologies do not bring to light the nature they depend on, but rather transform it unrecognizably.[24]

Pyne sees the all but universal victory of vestal fire as a tragic metaphor for human blindness about nature's feedback loops and our rebellion against the renewing fertility of death and change. The disastrous anti-burn policy in twentieth-century forestry made the mistake of seeing fire as primarily destructive. And the more fire goes out of sight, the harder it is to manage. Perhaps never in earth's history have there been so many fires burning as today, almost all of them anthropogenic; the reign of vestal fire vastly increases the amount of fire on the earth. Instead of the random blazes in the aftermath of lightning strikes or lava flows, the fortuitous gifts or banes from fire-happy celestial or chthonic deities, or the precious spark to be tended at the heart of the community, fire is now available to most people at will. Although wild fires with their short-term terror and drama still grab the headlines, they are not the most important spewers of carbon. Wild fires are the id-like counter to the self-containing, other-suppressing ego of vestal fire that pretends to be under

22. Stephen J. Pyne, *Vestal Fire* (Seattle: University of Washington Press, 1997). In America, by contrast, fire is conceived to have a natural origin.

23. Jean-Joseph Goux, "Vesta, or the Place of Being," trans. Wm. Smock, *Representations* 1, no. 1 (1983): 91–107.

24. Martin Heidegger, "Die Frage nach der Technik," *Vorträge und Aufsätze* (Pfulligen: Neske, 1954), 83. The power plant rebuilds (*verbaut*) the river.

control in our grills and gas tanks, furnaces and server farms, cell phones and cells. Almost everywhere we see signs of fire's work in the artifacts and environments of everyday life. Vestal fire is on tap, like water, electricity, cable television, or other utilities; it is a perfect example of Heidegger's *Bestand*, on call but not fully tamed. Vestal fire follows the rule that infrastructure stays out of sight when it is working.

At the moment I am writing, several wild fires are burning out of control, devouring trees, destroying houses, driving away wildlife and people. By the time you read this, those fires will probably be out, but new fires will surely be running rampant in new places. But, even more surely, the hidden fires will still be burning away. Of all centuries in the history of civilization, unquestionably it was the twentieth that had the most catastrophic fires, at least as measured in terms of deaths and destruction. From the ovens of the Holocaust to the fire bombings of Tokyo, Dresden, and Hamburg, no era ever saw so many deaths by fire, and the slow, steady, constant burning of fossil fuels may portend yet more to come. Thirty thousand gallons of gas were burnt, on average, every second on earth in 2012, with consequences that may be irreversible. If we needed an example of the price of infrastructural neglect, vestal fire could provide it.

Electricity is the everyday manifestation of vestal fire: a cool, clean, quick current coursing through infrastructures, rather than the raging messy snapping terror of uncontrolled fire; but at one end or the other of the electrical gastrointestinal tract, there is inevitably smoke and ash. (Only when something really bad has happened do you ever see smoke from an electrical outlet or device.) Electricity is repressed fire, as we see in the supposedly eco-friendly idea of cloud computing.

In their power to shape and delete data, new media owe a lot to fire. Fire is a chief metaphor for the Internet: it is metaorganic; it extends the range of (informational) food; it empowers people to explore new time zones (the night) and territories of knowledge; it increases some kinds of sociability, demands ongoing maintenance, and produces dangers and externalities that did not exist before. Fire was the first World Wide Web, a fragile system for contagious spreads. Young people now stay up late looking at flickering firelights—TV screens, computer monitors, smart phones—as they once tended the communal well of flames. (Television has always been compared to the family hearth.) Chris Anderson, the

chief curator of TED talks, in a short essay called "The Rediscovery of Fire," extols Internet videos for restoring the power of the embodied voice speaking around the campfire.[25] We "burn" discs on our computers. Memes and themes tear through the Internet like prairie fires, or are retarded by censorship "firewalls" such as those of the Chinese government. The server farms that are key to the material infrastructure of the Internet generate vast amounts of heat, requiring air conditioning in addition to the electricity their processing takes up. (Data centers are often built in cold climates to save on cooling costs.) Touchscreen technologies fulfill a certain fantasy of touching flame. As Paul Frosh notes, "Television and computer screens (including iPads etc.) have some of the qualities of fire, especially self-illumination; unlike cinema and print, they are lit from within."[26] Information is irreducibly connected with heat and burning.

The nomenclature of media devices is a treasure trove of fire metaphors. Corporations invest enormous effort and money into branding, so the choice of a name is no trivial matter. Fire's centrality tells us something about the imagination around new media: the HTC "Wildfire," a smart phone; the Samsung "Galaxy Blaze" and "Ignite," and the BlackBerry "Torch." The Motorola "Electrify" invokes the fire-electricity link that has existed since lightning but has only been known since the mid-eighteenth century. There is the Firefox web browser, the photo sharing service Flickr, and "Flame," a piece of malware that infected computers around the Middle East in 2012. The German term for broadcasting, *Rundfunk*, contains the term *Funk* (spark) in tribute to the early history of radio, with its spark gap transmitters. The history of fire turns out to have remarkable relevance for the history of media, not only in nomenclature but in the lesson that taken-for-granted systems rest upon natural processes we never can fully master, and also in the overconfidence that firemaking devices can be contained in safety. Eons of fire control have taught us to be ready for flare-ups; what similar lessons can we take for digital media?

25. Chris Anderson, "The Rediscovery of Fire," in *Is the Internet Changing the Way You Think?: The Net's Impact on Our Minds and Future*, ed. John Brockman (New York: Harper Collins, 2011), 35–37.
26. Personal communication, 2 November 2011.

Of Oxygen and Oil

If there is no oxygen, there is no fire. Fire is a chemical reaction called oxidation; if a substance cannot combine chemically with oxygen, it cannot burn. Oxygen is the condition of fire and the condition of life for all aerobic, carbon-based organisms. It interacts with our living chemistry. It is the most abundant element in the earth's crust—about half of the mass of the crust and the atmosphere combined. Oxygen can be highly toxic: giving too much to a newborn baby can cause blindness or brain damage, and underwater divers with oxygen tanks have to be careful not to overdose on it. Most of us do not notice oxygen except in extremity—when swimming or fleeing from smoke, during pneumonia, or on an airplane. It is an infrastructure only revealed by danger.

Oxygen, in fact, has a volatile cosmic and planetary history. It is a key element in the universe, though rare compared to hydrogen or helium; 99.9 percent of the atoms in the universe are either hydrogen or helium (with hydrogen molecules outnumbering helium by an order of magnitude); hydrogen and helium were created in the Big Bang in a predictable ratio. The remaining one-tenth of one percent is the most interesting slice. Three-quarters of it is oxygen, one-eighth carbon, and all the other elements fit into the remaining eighth of one-tenth of one percent. (Since this last slice holds all the heavier elements that astronomers call "metals," its share of the total mass is much higher than its molar fraction.) The universe yields light elements like hydrogen much more generously than heavy ones like gold. Our bodies are about two-thirds oxygen by weight, since water is their primary constituent, but they could not exist without heavy elements such as carbon, nitrogen, calcium, phosphorous, potassium, sulfur, sodium, chlorine, magnesium, iron, and zinc. Even trace elements such as iodine and fluorine play crucial roles in our physiology. Such elements came not from the Big Bang but were fabricated later by expanding and collapsing supernovae, cosmic furnaces with the ultrahigh temperatures enabling synthesis of complex (heavy) nuclei, the chemical history of the universe being also a fire history. Nucleosynthesis occurs at unimaginable heats: fire, broadly conceived, is the process that yields the complex chemicals that sustain our bodies, including oxygen. Our bodies, as the cosmologists like to say, are made of stardust, and our skeletons are mineral banks for rare elements. Our flesh on a cosmic

scale is as precious as gold on an earthly scale—yet another reason why we should treasure each other. Matter on earth is 10^{30} times denser than the cosmic average. Chemistry, like biology, is a discipline that can exist only relatively late in the universe's history; it took a long time after the Big Bang for things to get chemically interesting.[27]

Oxygen is no constant in geologic history. The Great Oxygenation Event of 2.4 billion years ago was the single most catastrophic wave of extinction in the history of the planet, killing most anaerobic life forms, which were then by far the dominant life form on earth. (The vast majority of the bacteria that live in our guts and turn wine into vinegar are anaerobic.) The atmosphere has had a tumultuous history. By 1.9 billion years ago, atmospheric oxygen levels were down again; by the Carboniferous, as much as 35 percent of the atmosphere was oxygen. (It is remarkable that the whole thing did not burn to smithereens. There was certainly plenty of fuel, which we are still burning!). At levels below 12 percent oxygen in the atmosphere, no fire can start; above 25 percent, no fire can stop. Twenty-one percent, our current amount, is the sweet spot, so we are extraordinarily fortunate in this way among many others. Currently there are 7.6×10^{19} gram atoms of oxygen in the atmosphere, one of several large numbers that are astonishing in their precision (see chapter 7).[28] Analysis of isotopes shows that earth's oxygen originates from both photosynthetic and geological sources. Only a fraction of earth's oxygen is used by the respiration of living organisms; the majority is tied up in oxidized materials, such as the Himalayan granite. Mars shows what happens when all the oxygen gets trapped chemically by the ground; Mars is red because of rust. Something similar happens when peeled bananas and apples turn brown: they are oxidizing, slowly burning, mimicking the red planet. Until recently, scientists held that photosynthesis, the marvelous process by which plants take water and carbon dioxide to produce oxygen and store energy, appeared quite early in the earth's history, but the dates are in the process of revision, nearly a billion years having been recently shaved off from 3.8 to 3.5 billion years

27. Facts from Simon Singh, *Big Bang: The Origin of the Universe* (New York: Harper Perennial, 2004).

28. Malcolm Dole, "The Natural History of Oxygen," *Journal of General Physiology* (1964): 5–27, at 12.

ago down to 2.7 billion.[29] If there is a universal medium of (aerobic) life as we know it, it would be oxygen.

We live on a flammable planet, with its carbon-based life forms on earth and its oxygen-rich atmosphere in the sky, and our bodies reflect that environment. Every cell in our bodies is slowly burning. Endosymbiotically living inside each cell is an organelle, a mitochondrion, a small furnace, that unleashes energy of solar origin ultimately captured by some obliging plant. The most complex matter known in the universe, the human brain, is also on a slow burn: five minutes or so without oxygen and it is dead. (It is also the bodily organ most sensitive to variations in temperature.) Respiration is what we call fire inside a body, the flame of life inside our vitals.

Our bodies live at various heats and intensities, a bit like a large, drafty old house before modern heating; our limbs can manage for long periods at cooler temperatures and without fresh oxygen supplies, as surgeons have discovered. A more or less steady temperature holds in the core (head and thorax)—the room with the heat source or thermostat—but the other rooms can vary, so that our limbs can get much colder than 37 degrees Celsius without harm. We humans share the heterogeneous heating of our bodies—a feature called poikilothermia—with bats, among other animals, though we possess it to a much lesser degree.[30] But normally we regulate our body heat homeostatically; if all is working properly, humans are endotherms. Getting a fever in response to an infection is adaptive: fire is a germicide both outside and inside the body, purging microbes and other hostile creatures. Our bodies are fire containers, each cell an image of a vestal hearth. Heat control is one of the classic cybernetic processes that unite animals and machines, and it remains a central design problem for the chief medium of our time, the computer.

Fats and oils deserve a brief treatment to parallel that of oxygen. Biologically, lipids make cell membranes possible and are essential barriers in organisms, and membranes are gates, one of the oldest of all media. They make cells possible, and also make bubbles, beloved by philoso-

29. Nick Lane, "The Rollercoaster Ride to an Oxygen-Rich World," New Scientist 205, no. 2746 (6 February 2010): 36–39.

30. Donald Griffin, *Listening in the Dark: The Acoustic Orientation of Bats and Men* (New Haven: Yale University Press, 1958), 33 ff.

pher Peter Sloterdijk. Thermodynamically, fats are an important source of energy for burning, and the modern world's addiction to oil began not with petroleum, but with whale oil. There is no modernity without oil (as well as coal and paper), and oil is processed corpses. Fats circulate rapidly between animals, humans, and machines and serve as candles, lamps, soap, cosmetics, food, and lubricants. Oil makes fertilizer and plastics, befouls the sea, anoints kings, and fuels war machines.[31] The US Department of Commerce staffs an "oil and fats" division, oil being a strategic material, and produces detailed reports; we know, for instance, that in December 2007, 1,282.6 million pounds of salad or cooking oil were consumed in the United States. Oil is an organic material uniquely packed with energy, and few things obsess our fire-breathing species more.[32] More than anything, modern rich people want to burn fat—whether in or outside their bodies.

The human lust for oils has driven some of the most desperate environmental pillages in history. The fat of dead men was used as an ointment by the Spanish conquistadores in Mexico, who cut open their victims' corpses to harvest salve for the wounds they had acquired in swordplay.[33] Of almost equal gruesomeness today is hydraulic fracturing—"fracking"—which uses subterranean explosives and chemicals to slurp shale oil from the earth. In a classic *ordo inversus*, in some areas close to fracking, flame can shoot from the water tap. Of course the companies deny responsibility, seeing firewater as a fluke of nature.[34] Fire from the water faucet is a twisted image of vestal fire.

Whaling fits somewhere between Aztec corpses and flaming faucets on the spectrum of fat predation. Whaling was an industry apocalyptic in the scale of its butchery, often with great dangers for both the hunters and the butchers ("flensers"), especially once whaling became mechanized in the early twentieth century. But chasing Leviathans around with harpoons on small boats was not the safest enterprise either. Not

31. John Witte, "Oil," seminar paper, University of Iowa, spring 2013.

32. Here I draw on D. Graham Burnett, *Sounding the Whale: Science and Cetaceans in the Twentieth Century* (Chicago: University of Chicago Press, 2012), 12, 63–78, 92–93, 308, 330–35, 522, passim.

33. Bernal Díaz del Castillo, *Historia Verdadera de la Conquista de la Nueva España* (Mexico City: Porrúa, 2004), 107.

34. *Gasland*, dir. Josh Fox (2010).

a gallon of whale oil is burned, said Melville, "but at least one drop of man's blood was spilled for it."[35] Whaling stations also presented hazards. Whales begin to decompose within hours after death. As the rotting, liquefying internal organs build up gas, the fetid carcasses can burst, killing men in the vicinity and expelling fetuses like torpedoes. Early twentieth-century whaling stations presented scenes of Dante-scale obscenity, including one that had a lagoon thick with putrefying whale flesh that could not decompose for years because of the warmth of the sea. No less explosive was the use of whale-oil-derived glycerin for incendiary devices in World War I and after. Whale oil lubricated the gears of industry, ended up even in automotive transmission fluid, and made candles prized for the smokeless flames the little Gehennas produced. In a similar way, sperm oil was used for lanterns and lighthouse lamps, because the glass casing and lenses did not get blackened by smoke. Whale bones were burnt for charcoal, and whale blubber was an ingredient in Camay soap. The Soviets fed their mink farms with whale flesh. Sperm whales were converted into margarine, dog food, and vitamin supplements. (This is no way to treat an armless Buddha.) If there were ever a symbol of what Heidegger called *Gestell*, the "enframing" of nature into exploitable resources, the whale is it. And if there were ever a symbol of *Bestand*, energy stored as a resource on tap, oil is it.

Meaning Vague but Intense

Fire is meaning-rich, yet only rarely the vehicle of semantically precise meanings. Like wild animals and plants, fire had to be domesticated, and it was the first in a long line of domestications. It has been a human partner much longer than language, though it is difficult to pin down the early chronology of human fire control; debates about its dating turn on, for instance, whether you focus on opportunistic use, controlled cooking, or engineering of metals and ceramics.[36] Some say that *Homo erectus* and fire control are equiprimordial, which would put the first use by

35. Melville, *Moby-Dick* (New York: Norton, 1967), 178.
36. Kyle S. Brown et al., "Fire as an Engineering Tool of Early Modern Humans," *Science* 325 (2009): 859–62.

hominins almost two million years ago. ("Hominin" is not a typo, and has started to replace the former term "hominid.") Others say that the surest evidence of human-controlled fire is no more than 350,000 to 500,000 years old. (The record of naturally occurring fire goes back some four hundred million years.) The experts will continue to sift the charcoal, but the point is that fire clearly preceded "behavioral modernity" and the language-using and -abusing forms of life practiced by humans as we know them (with burial, adornment, ritual, and complex conceptual schemes). Fire use requires social organization and discipline, which clearly existed before humans became, by dint of genetic mutation or cultural bootstrapping, linguistic. Communication is deeper and older than language; fire evokes meanings that lie deeper.

Fire is the oldest trope for man and God, heaven and hell, and the subject of much of our philosophy and poetry. It stands for mind and has epistemic force. As Plato said, without fire, nothing would be visible.[37] Combustion, says Pyne, goes together with cognition. Cave paintings, heralded as marks of behavioral modernity, are fire artifacts in several ways. Only by fire light could the artists of Lascaux, for instance, have seen inside the dark cavities well enough to paint, presumably by stones filled with burning animal fat. But fire also provided the artistic media themselves—the ashen pigment materials—and the topic: fire-based hunts or the fires of the night sky (that is, if you believe that some of the marks point to constellations of stars).[38] Here the medium means on several levels and, as usual, celebrates itself. Fire remains a greatly plastic resource in the arts and inspiration for them—especially those that work in time, like music and cinema. For Sergei Eisenstein, fire was the essence of animated film; as he put it, "Fire is an image of coming into being, revealed in a process."[39]

Like McLuhan's light bulb, fire has an ablative relationship to learning. Writing, reading, and study have an old partnership with it, its very tools being pyric. *Ink* comes from the Latin *encaustum*, from the Greek ἔγκαυστος (*enkaustos*), meaning "burnt," referring to the process by which

37. Plato, *Timaeus*, 31b.

38. Pyne, *Vestal Fire*, 31–32.

39. *Eisenstein on Disney*, trans. Alan Y. Upchurch (London: Methuen, 1986), 24–33, 44–48, at 47. Thanks to Tyler Williams.

many inks were produced. (The related term *holocaustum*, meaning the burnt sacrifice of the entire animal, is the source of *holocaust*.)[40] Moses's burning bush could be a metaphor for the sacred text, kept aflame by reading but never consumed; the rabbis considered the Torah to be "written with letters of black fire upon a background of white fire."[41] Texts are often read by the light of a flame; the scholar burns the midnight oil, but fire is also the great threat to libraries. (To get a reader's pass to the Bodleian Library at Oxford, you must still recite an age-old oath not to kindle fire or flame in it.) Speed readers "burn" through a text. The electronic book readers, the "Kindle" and "Kindle Fire," evoke this lineage, and one wonders what mischief these names imply toward books as we know them.

Fire in popular music provides a repertoire of imagery for rage, devotion, passion, pain, and suffering and it shares with music the ability to generate deep meanings in processes that transcend speech. It is like eros and epistemic will alike, throbbing and pulsing with the desire to know. "Fire smolders more surely in a soul than under the embers."[42] Fire is inside our bodies, minds, and metaphors. Like death, whose great service is to lend life meaning, fire's negativity is our great tool of meaning. Fire has a fatal attraction, and not only for moths: Bachelard notes an "Empedocles complex," the urge to cast oneself into the flames. A more comic version is Robert Service's poem "The Cremation of Sam McGee," about a gold prospector in Alaska who finally feels warm while being burnt to a crisp in a funeral pyre. The theological notion of purgatory, the third space between heaven and hell where souls wait after death, presents a history of reflections on fire and its effects.[43]

Fire is both condition and content. It can be harnessed for coded data transmission in the signal pyres of the ancient Greeks and Vikings or the

40. See Giorgio Agamben, *Remnants of Auschwitz*, trans. Daniel Heller-Roazen (New York: Zone, 1999), 28–31, for a semantic history of the term *holocaust* that itself performs a kind of fire-purgation rite.

41. Susan A. Handelman, *The Slayers of Moses: The Emergence of Rabbinic Interpretation in Modern Literary Theory* (Albany: State University of New York Press, 1982), 37.

42. Gaston Bachelard, *La psychanalyse du feu* (Paris: Gallimard, 1949), 35: "Le feu couve dans une âme plus sûrement que sous la cendre."

43. Jacques Le Goff, *The Birth of Purgatory*, trans. Arthur Goldhammer (Chicago: University of Chicago Press, 1984).

smoke signals of Native Americans. White smoke from the Sistine Chapel chimney signifies that the pope has been chosen; black smoke, that the conclave is still undecided. The French call a traffic light a *feu*—a fire—recalling the earlier history of semaphores. In some languages, lighthouses are called fire towers. At the biblical day of the Pentecost, the members of a cosmopolitan crowd saw split tongues of fire over their heads, as if the differences between languages could be burnt away. But usually fire has no special message besides its burning, pulsing self. At Christmastime some television channels in the United States have shown a repeating video loop of a fireplace, but in Norway, a country with more than one million fireplaces or wood-burning stoves, a Friday night television program lit up national discussion with an eight-hour live broadcast of a fireplace burning through the night. Said one Norwegian of the show, capturing fire's appeal: "For some reason this broadcast was very calming and very exciting at the same time." Fire is a baseline of evocative vagueness from which possible messages can come, like being itself.[44] Sometimes media say nothing and everything.

Fire is a facilitator of social connection. Political protests, religious rituals, birthday parties, and romantic dinners all call for fire. Fire draws people together around the hearth or campfire. When talk lags or silence looms, flame fills the time. The Christmastide log gives off a *jolly* atmosphere, a term related to *Yule* (from a common Germanic root). The appeal of fire is not only visual: the crackling sound of a hearth fire is exciting as the loud sound of a wildfire is terrifying, both sounds colliding with the very air we breathe. The gods of the Greeks and Hebrews delighted in the heaven-ascending smoke from the barbecue of burnt animal sacrifice. Fire is strongly aromatic—as your hair and clothes will show if you stand a while by a fire. Waves of heat and smoke and the sparks of popping wood sap are as intensely tactile as the kinesthetic leaps of a fire out of control are terrifying. As in sailing, wind control is a first principle of pyrotechnics, but fires can create winds of their own, as in the firestorms created by the Allied bombing of Hamburg, Dresden, and Tokyo in World War II.

44. Sarah Lyall, "Bark Up or Down: Firewood Splits Norwegians," *New York Times*, 19 February 2013. In *Understanding Media*, McLuhan's "tribal drum" was mistranslated—happily—into Hebrew as "bonfire."

Fire is full of the kind of conjunctive meaning that must have held human ancestors together in feeling and activity before they mastered syntax and semantics. Fire easily gets inside us because it is already there: it is one of the great raw materials of meaning making. Ultimate things present themselves as fire. The god of the Hebrew Bible is a fire god: "God is a consuming fire" (Deuteronomy 4:24) and his word is a fire (Jeremiah 23:29). Few books are as full of fire as the Bible, and it would be easy to multiply examples. In his essay on fire, Gaston Bachelard noted: "L'homme est peut-être le premier objet naturel où la nature essaie de se contredire" (Man is perhaps the chief natural object in which nature tries to contradict itself). The human soul is fickle, noble, rebellious, self-sacrificing, irrational, calculating, sneaky, loyal to the point of self-destruction, in love with phantoms, and all that before breakfast. Fire, like mortals and gods, is contradiction itself. It destroys what it touches but also destroys itself. It dances in the most animated way and yet it is always cremating itself. Not all that means is semantic.

Smoke means too. Indeed, as basic lessons in semiotics insist, smoke is the index of fire. In China, offerings to the dead are made by smoke: currency and other paper items are burned, smoke being a medium for the gods, ghosts, or ancestors. In Chinese, to burn incense can mean ancestor worship; the ghosts are hungry and they like to eat smoke. When the incense, in contrast, goes out, this signals the end of the family line—there is no more posterity to burn smoke for the ancestors.[45] Many religious rituals involve human-made clouds, as do smoke signals.[46] During the Exodus and wanderings of the children of Israel, God's habitation and dress was the cloud, and clouds covered Mount Sinai to hide (and to signify) the glory of the divine presence. The cloud was also a kind of travel guide, indicating when the Israelites should move and when they should stay put.

In a less lofty register, as we know from film noir, cigarettes can serve

45. Janet Lee Scott, *For Gods, Ghosts, and Ancestors: The Chinese Tradition of Paper Offerings* (Seattle: University of Washington Press, 2007), chap. 1.

46. Menahem Blondheim, "Prayer 1.0: The Biblical Tabernacle and the Problem of Communicating with Deity," International Communication Association, Phoenix, AZ, 2012. A joke McLuhan liked: Two native Americans talking by smoke signal see the mushroom cloud of a nuclear test. One signals to the other: "Wish I'd said that."

as magic wands of mood and atmosphere. Geoffrey Winthrop-Young's wonderful memoir of the early Friedrich Kittler probes the semiotic potentials of smoking. "Never have I seen a man on more intimate terms with his cigarette. The moment he lit up, it became a protean tool: magician's wand, conductor's staff, cheerleader's baton, mountain troll's cudgel. He would tap it against the tabletop like a telegraph key to signal impatience, turn it into a samurai katana to behead misinformed objections, and hold it upright as a glowing exclamation mark to illuminate an important point. Upon finishing, he would stare at the stub in baffled gratitude, pass a moment in silent communion, and reach for the next. You didn't need to study Alan Turing to understand the concept of a universal machine; you just had to watch Kittler smoke."[47]

Like all infrastructural media, fire manages space and time. Fire is a tool used by every conquering army but it is also a tool of holding time. The torch and the hearth are two key forms of human fire in history.[48] Many cultures have had fire at their sacred center. In the Athenian prytaneion blazed a fire dedicated to Hestia (Vesta), and the Greeks carried fire from the mother city to light the flame in each colonized city. The hearth in Latin was the *focus* of the home, which yields the French *feu*, Spanish *fuego*, Italian *fuoco*, and Portuguese *fogo*, which all mean fire. At the end of the Aztec calendar's fifty-two year cycle, all fires in the empire had to be ritually extinguished. The priests then had to rekindle every fire in a kind of cosmic reboot, signaling the state's role as the giver of being. The Olympic flame, in its stagey global journey, stands for both the conquest of space and duration over time. The terms *kinship* and *kindling* are related. During the Exodus from Egypt, Nadab and Abihu were punished by fire for offering "foreign fire" (Leviticus 10:1–2) in ritual sacrifices: this could mean that they went outside the authorized fire lineages or simply that they acted without authorization. (Fire was perhaps the first kind of branding, which is, of course, a fire term.) Altar and torch, sacred and military fire media respectively, do not always clearly separate, as Innis would have predicted. "I am come to send fire on the earth" said Jesus

47. Geoffrey Winthrop-Young, "'Well, What Socks is Pynchon Wearing Today?' A Freiburg Scrapbook in Memory of Friedrich Kittler," *Cultural Politics* 8, no. 3 (2012): 361–73, at 362–63.
48. Pyne, *Vestal Fire*, 25ff, 49 ff.

of Nazareth (Luke 12:49). Whether Jesus meant the spiritual baptism of fire or the autos-da-fé that conquerors would light in his name, he was correct.

The candle also illustrates realms of meaning that lurk below syntax. "All would be horror without candles," as a devotional from the sixteenth century had it. The candle enabled reading and easy navigation at night, and was said to suppress crime. Candles were traditionally made from tallow—refined animal fat. In the eighteenth century, spermaceti candles became popular, stimulating the growth of whaling. Candles were a luxury item; candles made from animal fat were cheaper than from wax, but they were smelly and smoky. In early modern Europe, magically charmed candles were made from the human body. "The thief's candle" was made from the body fats or fingers of executed criminals; the fingers of stillborn children were prized as necromantic candles, and the entire hands of dead criminals, called "hands of glory," could be lit on fire to provide a homeopathic light against darkness and evil.[49] Candles represent lives, flickering and so easy to extinguish, in mourning rituals and at Holocaust memorials. In Shakespeare, candles always portend something doomful: "Out, out, brief candle!" cries Macbeth, and the time of Romeo's death is determined by how far down his candle has burned.[50] According to the Brothers Grimm, Godfather Death keeps a cavern full of candles, one for each person. When the candle runs down, the person dies.[51] As a tool of political protest, a candle must be held with two hands even in the slightest wind. A Christian minister in the revolutionary candlelight vigils of 1989 in Leipzig stated that candles were symbols of peace because you cannot hold both a candle and a weapon. The candle's fragility, its flickering light against the darkness, is one source of its symbolic power.[52]

49. See A. Roger Ekirch, *At Day's Close: Night in Times Past* (New York: Norton, 2005), 100–111, 41–42.

50. Arthur F. Finney, *Shakespeare's Webs: Networks of Meaning in Renaissance Drama* (New York: Routledge, 2004), 81–84.

51. "Der Gevatter Tod," *Die Märchen der Brüder Grimm* (Augsburg: Goldmann, 1981), 159–61.

52. Gaston Bachelard, *La flamme d'une chandelle*, 2nd ed. (Paris: Presses universitaires de France, 1962); Jiyeon Kang, "Coming to Terms with 'Unreasonable' Global Power: The 2002 South Korean Candlelight Vigils," *Communication and Critical/Cultural Studies* 6, no. 2 (2009): 171–92.

Fire sits in the borderlands between purity and danger, at the uncanny point of the sacred where things are both blessed and accursed. In its ritual use, fire opens a channel of communication between embodied and ethereal beings. The Valley of Hinnom to the south of Jerusalem—better known as Gehenna—provided the Sermon on the Mount with some of its most vivid imagery: "hell fire" is taken from a refuse heap that was constantly and noxiously smoldering (Matthew 5:22, 29–30); adding to the shiver was the memory that this valley was the place where children had been offered as burnt sacrifices to the Canaanite deity Moloch. Burning is a method to eliminate dangerous things or to sublimate precious things (flags, superannuated currency, holy books) by special burning rites; if you violate special rituals for pyric disposal, the social sanction can be severe.[53] There is nothing so toxic as a sacred thing out of place.

Corpses, the ultimate dangerous thing, are often (like garbage) subject to cremation. It is an odd material fact just how much ash a human body can produce: a few kilos per body. Goudsblom speculates that cremation could be a functional adaptation to keeping predators from developing a taste for human flesh. Leaving corpses around to be scavenged could inspire a dietary preference among predators, a preference that could have lethal results. One leopard in India that acquired a taste for human flesh killed 126 people over eight years.[54] Fire practices, like most cultural adaptations, usually rest upon forgotten infrastructural intelligence. Fire, natural and humanoid, is our second self, our destroying angel and guardian angel. Paul was right when he generalized: "it shall be revealed by fire" (1 Corinthians. 3:13).

Container Technologies

Media breed media to handle their side effects. Television produced the TV guide; the Internet brought forth the search engine; writing bred punctuation; and fire requires containers of all sorts such as hearths, pits,

53. Carolyn Marvin, "Theorizing the Flagbody: Symbolic Dimensions of the Flag Desecration Debate; or, Why the Bill of Rights Does Not Fly in the Ballpark," *Critical Studies in Mass Communication* 8, no. 2 (1991): 119–38.
54. Goudsblom, *Vuur en beschaving*, 128–29.

kilns, ovens, and firebreaks. Fire's fertile nihilism needs containment. Hearths, fire extinguishers, lightning rods, and insurance policies are all negations of the negation. Lewis Mumford, an infrastructural thinker if there ever was one, introduced the fruitful notion of container technologies. In *Technics and Civilization* (1934) he argued that technical history should not neglect "utensils, apparatus, utilities," which included pots and baskets, dye vats and brick kilns, and reservoirs, aqueducts, roads, and buildings.[55] He thought historians of technology overemphasized the mobile and noisier parts of the human kit, such as arrowheads and spear tips instead of hearths, pots and baskets. Later, he defined container technologies explicitly, taking them in an implicitly phenomenological way as the ground that brings out the figure but disappears in doing so. The technologies disappear from view partly because of their historical stasis, many of them having been invented in the Neolithic and hardly bettered since—in contrast to war technics which have voraciously undergone "improvement"—but partly because the archaeological record is biased toward practices that leave traces such as arrowheads and axes, and against those that don't, such as ritual or community building. Container technologies included "cellars, bins, cisterns, vats, vases, jugs, irrigation canals, reservoirs, barns, houses, granaries, libraries, [and] cities" as well as more abstract containers such as language, writing, ritual, and families.[56] The nineteenth century saw perhaps the biggest leap forward due to the chemical preservation of foodstuffs and audiovisual recording, which made it possible to capture and replay events in time. Container technologies show media at their most environmental.

Containers, like fire, have a special relation to the negative; holding presupposes vacancy. At first it seems definitional that containers be impermeable—watertight or airtight. But a complete seal fits only containers that are designed to be broken, such as time capsules, piñatas, eggshells, and tombs. Otherwise, a container implies a hole: a tap, a cork, or an outlet of some kind. Every vial needs a stopper. Containers are usually supposed not to leak, but to pour. "Incontinence" is essential

55. Mumford, *Technics*, 11. Leroi-Gourhan, *Gesture and Speech*, 134, *Le geste et la parole*, 1:190–91, also notes the disproportionate role played by "sharp objects" (*objets tranchants*) in our grasp of prehistory, although he thought them absolutely central to the rise of technics.
56. Lewis Mumford, "An Appraisal of Lewis Mumford's *Technics and Civilization* (1934)," *Daedalus* 88, no. 3 (1959): 527–36; and *Technics*, 83.

for strainers, clepsydrae, and filters.[57] A bank account is supposed to keep money without spoiling, and even improve it with interest, but it needs a withdrawal mechanism. Money itself has a relation to the negative: like all precious liquids, such as wine, oil, or water, its greatest use comes when it is poured, its value being actualized only in vanishing.

Other containers work best when empty. Everybody (especially insurance companies) would prefer that health, fire, or life insurance policies never be used. A safety net is best when empty, and the same is true of jails and other penalty boxes. The point of demilitarized zones, such as the no man's land between the former East and West Berlin or South and North Korea, is to be conspicuously vacant, an emptiness enforced by dogs, electrified fences, and machine guns. The same was true of the Cold War policy of nuclear containment: the fact of non-use was the victory. The Sabbath, from the Hebrew word for cessation, implies a much happier kind of emptiness. (Our term *vacation*, related to *vacancy*, has the same sense.) The Sabbath declares a time out from the demands of market and state, a zone (*eruv*) off-limits to intrusion, serving as a kind of calendrical punctuation.

If some containers work best when empty, no container works best when completely full. Containers that overflow, like the proverbial cup that runs over, can make beautiful fountains but are rarely strictly utilitarian. Bottles, parking lots, syringes, and schedules all need slack or they will be clogged and unusable. A building needs corridors, farming needs fallow land, and it would be bad to fill wine bottles completely to the cork, since the "ullage" (empty space in the top of the bottle) plays a key role in both maturing and pouring.[58] A hard drive stops working well when it nears maximum capacity. Economists believe some unemployment prevents rigidity in labor markets. Precision engineering leaves slack for lubrication. A network, says Bruno Latour about a container technology of recent interest, is "composed mainly of voids," echoing Heidegger's point that a jug does not consist of its base or walls, but in

57. Zoe Sofia, "Container Technologies," *Hypatia* 15 (2000): 181–201, at 192.

58. Heidegger, "Bauen Wohnen Denken," *Vorträge und Aufsätze*, vol. 7 (Frankfurt: Vittorio Klostermann, 2000), 145–64. The term *spatium* was later used by media historians Friedrich Kittler, Bernhard Siegert, and Wolfgang Schäffner for the threefold point-based media innovations of the Renaissance: perspective, printing, and accounting.

the empty space that it opens up, its "void."[59] As spatium to container, so is fire to matter.

Container technologies inevitably imply gender, and Mumford noted that the labor of containment has typically been done by women, who were often supposed to be as unobtrusive as their crafts. Explicitly opposing the idea that technology only involves extensions of the male body, Mumford's notion of containers is meant to counterbalance masculinist "power technologies" such as weapons, stones, and arrows. In contrast to most, Mumford knew that technology is a category unthinkable apart from gender.

A brilliant feminist essay building on Mumford by Zoe Sofia gives a subtle way to think about technologies as embedded in relations of holding and supply. "Extra-uterine matrices" such as houses, clothing, culture, and shelters of all kinds provide human dwellings. The things we normally consider to be technologies depend radically on hidden systems of maintenance and supply—infrastructures, though Sofia doesn't use the word. The car requires roads, gas stations, and insurance companies; the computer requires an electrical grid; discovery requires a laboratory; the infant requires a mother. Heidegger's *Bestand* (storehouse of materials) stands under any technology, and Sofia sees it as being just as worthy as the more numinous objects (like jugs and chalices) that Heidegger prefers. It is dangerous to think of technology without its grounds in utensils, apparatus, and utilities—and of course, gender relations. Sofia's entire essay is a meditation on the ablative relation: There is no A without X. Media reveal and make possible; they are necessary conditions. Sofia makes the critically important move of rounding out technologies without reinforcing a gender binary. Her point is emphatically not to balance "male" dominating technics with "female" nurturing ones, but to deconstruct the whole frame: the male body is a container too, and there are few things as violent as many cooking utensils.[60]

The womb Sofia treats as fully technological, and it is surely the most

59. Bruno Latour, "Networks, Societies, Spheres," *International Journal of Communication* 5 (2011): 796–810, at 802, and Heidegger, "Das Ding," *Vorträge und Aufsätze*, vol. 7 (Frankfurt: Vittorio Klostermann, 2000), 165–87.
60. Zoe Sofia, "Container Technologies," *Hypatia* 15 (2000): 181–201.

important of all media in bringing forth new humans into the world, in what Arendt called natality. Perhaps the most world-altering material act is that of giving birth, and it is also the process par excellence that shows the human body as essentially technical. It is very difficult for humans to give birth without assistance, and there is an entire repertoire of birthing technics developed in midwifery and obstetrics. The consequences of upright posture—a big skull and a narrow pelvis tasked with stabilizing an upright spine and locomotive legs—have made birth a fraught and dangerous event and one of the chief causes of premature death for women until recently; it is still very hazardous. There is no straightforward passage through the birth canal; the baby often needs to be turned or pulled to come out, and then it comes out typically face down, which makes it harder for the mother to maneuver. Birthing crunches bone against bone: the baby's skull and then shoulders are squished, and its cranium may need to shrink and its mother's pelvis to expand to accomplish the *delivery* (a term whose original sense meant the deliverance or rescue of the *mother*).[61] So-called natural delivery is rarely void of technics but is full of skills, gestures, coaching, social support, and technologies. (Obstetrics was one of the most important "body techniques" discussed by Marcel Mauss.) Giving birth alone is usually a sign of dereliction. Chimps may have "natural" births, with a wider pelvis that can bring the child forth without twisting, but this option is closed to their upright bipedal cousins.

Reproduction is not the old story of women as vessels, putatively passive, for the carriage of male seed, but rather the key site of human essential technicity, and it is not surprising that reproduction has been at the heart of some of the most radical biotechnological innovations in the past decades, as well as some of the bitterest political and cultural battles. Recognizing that techniques are as essential as technologies helps balance the gender contributions to technical natural history, though we should know better than ever to expect complete symmetry between any two poles of nature or culture. Any theory of technology that restricts itself to inorganic artifacts misses half of what is most creative and marvelous about what humans do as creators of both living beings and

61. Jennifer Ackerman, "The Downside of Upright," *National Geographic* 210, no. 1 (July 2006): 126–45; *Oxford English Dictionary*, 3rd ed., s.v. "deliver," v. 1.

nonliving objects. Humans reach immortality through birth and art. The term *material*, of course, comes from the term *mater* (mother), even if the philosophy that gave us that connection, Aristotle's, was none too friendly to the material or the maternal. Aristotle much preferred the "paterial," the form-giving shape of male seed (as he understood it), and so have most theorists of technology since. If *technology* only means inorganic inventions and not the body techniques that birth humans and artifacts, the philosophy of technology is fated, rather like humpbacks, to keep singing songs written by males.

Settlement and Other Containers

Though transient and fickle, fire's curative powers have something to do with human settlement in cities—a key container technology, often taken as feminizing by desert nomads (*metropolis* means mother city). Storage is one of the most complex legacies of civilization because of its ability to multiply power and extend time. Any long-term storage requires stability in space (see chapter 6). Why humans decide to settle is debated. The disadvantages, such as increased risk of marauders, vermin, and spongers, are obvious. Crowding exposed people to new diseases, as Jared Diamond has noted, and cities were typically less healthy places to live than the country; life expectancy in ancient Rome, for instance, was shorter than elsewhere in Italy.[62] Settlement creates problems of waste, sewage, and crime. It also requires one to interact with strangers, and fosters systems of social hierarchy along class and gender lines.[63] Cities require police forces, fire brigades, and sanitation.

There are, of course, agricultural motivations for settlement. Grain cultivation requires settlement for a season at least. Orchards require a long-term commitment and must be planted years before bearing fruit. Olive trees are planted for grandchildren—when the settlers and their armies start destroying olive groves, you know they are playing dirty. An

62. De Vries and Marchant, "Environment and the Great Transition," *Mappae mundi*, 106–7.
63. Nicholas Wade, *Before the Dawn: Recovering the Lost History of our Ancestors* (New York: Penguin, 2006), chapters 6–7.

orchard always stands for transgenerational continuity, as in Chekhov's *The Cherry Orchard*. But the view that settlement followed directly from agrarianization has been loosening in recent years as archaeologists have found settlement without agriculture—but obviously not of agriculture without settlement. Motives for staying put can be religious, symbolic, or artistic as much as agricultural. British archaeologist Ian Hodder argues that the domestication of plants and animals was part of a more total reorganization of how humans interacted with each other and with things, a change that was as much social and symbolic as it was economic and ecological.[64] The thesis of the ritual origins of settlement is speculative, of course, but storage of the dead, of food, and of textual artifacts all go together as efforts to fix meaning across time: they are products of human craft—more particularly, in most cases, of human firecraft.

Settlement always goes with graves; Mumford suggests the dead may have been the first humans to have a fixed address.[65] Fortunately for paleoanthropology, human remains started to be cared for deliberately many tens of thousands of years ago, within the hypothesized range of the appearance of behavioral modernity. A gravesite, a haunted place of memory and ritual visitation, is a proverbial sign of humanness that could not be achieved in a submarine world (nor do chimpanzees bury their dead, making their longer history much harder to trace.)[66] Anciently, to approach a city in Palestine, Greece, or Rome was first to come upon its cemeteries, fixed addresses that encircled the city and gave it ancestral continuity. The dead make a city; according to Cicero, the sharing of tombs was one of the strongest of all human bonds.[67] The grave is one of the most basic of all human meaning-storage devices. The Greek word *σῆμα* (*sēma*), which gives us *semantic* and *semiotic*, also means tomb, as in

64. Ian Hodder, *The Domestication of Europe: Structure and Contingency in Neolithic Societies* (Oxford: Basil Blackwell, 1990), 282–310, and *The Leopard's Tale: Revealing the Mysteries of Çatalhöyük* (London: Thames and Hudson, 2006), 18–19, 46, 82–85, 88, 206, 233–58, esp. 256–58, passim.

65. Mumford, *City in History*, 7.

66. Bernard Wood, *Human Evolution: A Very Short Introduction* (Oxford: Oxford University Press, 2005), 26, 69, 98.

67. Cicero, *De oficiis*, 1.55. "... magnum est enim eadem habere monumenta maiorum, eisdem uti sacris, sepulcra habere communia."

a burial mound, a lasting sign and reminder of the fame of the departed. *Sēma* seems tied to the sun as reminder to wake up and as symbol of the soul's return.[68]

Settlement requires environmental regulators—"extra-uterine matrices" in Sofia's terms—such as clothing, shelter, and food storage. Among several techniques of climate control, nomadism controls the climate by seasonal migration to latitudes with fairer weather. Birds, butterflies, whales, and some humans move with the seasons. Storage technics are rarely mobile except on a very small scale, and then they are typically lightweight things such as texts (meaning storage) and jewels (value storage). Without fire, the temperate latitudes in which civilization emerged would not have been settled: no one can live without technique in the winter in China, Mesopotamia, or Greece. Gates, doors, walls, roofs play a world-historical role by creating temperature-controlled microclimates. The gate was one of the earliest devices in taming and herding animals. The door is one of the most basic of all cultural techniques, being a switch that constitutes inside and outside spaces. McLuhan put it well: "Clothing and housing, as extensions of skin and heat-control mechanisms, are media of communication, first of all, in the sense that they shape and rearrange the patterns of human association and community."[69]

Cities have a complex relation to fire, taking fire into their bosom and thus becoming vulnerable to conflagrations. The history of urbanization is the history of fires and fire extinction. Wood and thatch are easy to work with and make beautiful buildings, but they are funeral pyres in waiting. The three classic methods for extinguishing fires were water, sand, and prayer, "each of which was about equally effective," as Goudsblom wryly notes.[70] Fire insurance shapes modern urban planning and architecture; indeed, the insurance industry is "a fundamental financial

68. Gregory Nagy, "Sēma and Nōēsis: Some Illustrations," *Arethusa* 16 (1983): 35–55, esp. 45–51; and Jesper Svenbro, *Phrasikleia: Anthropologie de la lecture en Grèce ancienne* (Paris: Éditions la Découverte, 1988), 23 ff.

69. Helen M. Leach, "Human Domestication Reconsidered," *Current Anthropology* 44, no. 3 (2003): 349–68, at 360; Bernhard Siegert, "Doors: On the Materiality of the Symbolic," *Grey Room* no. 47 (spring 2012): 6–23; McLuhan, *Understanding Media* (New York: Mentor, 1964), 120–21.

70. Goudsblom, "The Civilizing Process and the Domestication of Fire," 10.

component of virtually all modern infrastructures."[71] Fire brigades have a long history, and fire alarms are key among signaling systems. (Every alarm system has to devise strategies to cope with the threat of false alarms.)[72] Fire hydrants are a public face of modern plumbing and sewer systems. In the Ming and Qing palaces of China, copper and iron vats of water were kept outside of buildings as fire extinguishers on tap; in winter they were covered with quilts and sometimes warmed with fire to prevent freezing—the thing they were to defend against kept them ready. Major fires are a constant theme in Chinese urban history, with cities of buildings made of wood and bamboo. Kaifeng was one of the first Chinese cities to have organized fire control, including observers on watchtowers, during the Northern Sung.[73] The first usable fire hoses did not appear in Europe until the seventeenth century, and during the Great Fire of London large "squirts" were used, the ancestors of both toy water guns and fire hoses. Another form of urban fire control is the curfew, from the French *couvre-feu* (cover fire). When the fires are out, it is easier for the authorities to manage the night. The police can spot mischief and the fire brigade has less to worry about.

Despite such measures of fire containment, cities still catch fire. We have to cope with the side effects of our efforts to cope with side effects: asbestos is now a known health hazard; smoke alarms will blare when you toast bread; and fire extinguishers are favored weapons in college dormitory fights. In ancient Rome, Marcus Crassus would buy properties that had been burned to the ground, perhaps with his assent, and then develop them to great profit.[74] Fire has long enabled real estate speculation and renewal in cities and villages alike.[75] Different areas of London were

71. Paul N. Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems," *Modernity and Technology*, eds. Thomas J. Misa, Philip Brey, and Andrew Feenberg (Cambridge, MA: MIT Press, 2003), 185–225, at 194.

72. Deborah Lubken, "Fighting the 'False-Alarm Fiend': The Fire Alarm Telegraph and Efforts to Eliminate Erroneous Alarms," address to International Communication Association, Boston, MA, 2011.

73. Jacques Gernet, *Daily Life in China on the Eve of the Mongol Invasion, 1250–1276*, trans. H. M. Wright (New York: Macmillan, 1962), 34–38.

74. Plutarch, "Crassus," in *The Lives of the Noble Grecians and Romans*, trans. John Dryden; rev. Arthur Hugh Clough (New York: Modern Library, n.d.), 650–51.

75. Ekirch, *At Day's Close*, 48–56.

destroyed or nearly destroyed by fire over several centuries, starting in 798 and culminating in the "Great Fire" of 1666. Oslo was destroyed by fire in 1624. Moscow was burned in 1812 to drive away Napoleon's army. The worst urban fire before twentieth-century warfare was the great Chicago fire of 1871, which burned for three days and destroyed nearly four square miles (ten square kilometers) at the heart of the city, and is perhaps the source of Chicago's great architectural beauty. San Francisco's earthquake and subsequent fires in 1906 had a similar traumatic and transformative effect. Dresden burnt down in 1491 as Hamburg did in 1842, foreshadowing fire bombings to come.[76] Almost every city has had at least one horrible fire. Like pyrophytic plants and woodlands ecosystems, cities, which concentrate large amounts of flammable material in small spaces, are prime targets for annihilation and renewal by fire.

Domestication of Plants

Fire was the first key domestication; the next two were botanical and zoological. But fire was instrumental in bringing plants and animals under human control. Domestication is the process of genetic manipulation (selective breeding) to maximize traits desirable to humans, typically with the creation of mutual dependencies, and is a compelling example of the anthropogenic revision of nature. Though diverse symbiotic relationships in nature show intricate mutual adaptations, no other species besides humans systematically controls the breeding of other species. Human husbandry has radically changed botany and zoology. If our being is historical, and media studies has the task of exposing the unthought environments in which we live, then the triad of fire, plant, and animal—as three chief constituents of our home on earth—should be prime objects of inquiry.

The history of human flourishing goes together with the history of botanical flourishing: indeed, *flourishing* is a term from plant life. Our fate is cast with that of plants: they are the great mediators of the sun. Without

76. Much useful information on the Eurocentric history of urban fire is found in "Fire and Fire Extinction," *Encyclopaedia Britannica*, 11th ed. (New York: Encyclopaedia Britannica, 1911), 10: 401–18.

them, the sun's energy would only dissipate into space or be absorbed by the sea and atmosphere as heat (or bounce off the clouds and dwindling polar ice caps). We depend on plants to save solar energy as carbohydrates and to make oxygen as a by-product. Plants, thanks to photosynthesis, are the first storage media that provide the fuel for fire of all kinds.

Plants are an enormously resourceful and diverse form of life on this planet; the total biomass of plants (phytomass) is estimated to be one thousand times as great as that of animals (zoomass). Biomass on land, in turn, is estimated to be one hundred times as great as that of the oceans, a typical case of a new habitat swelling the population of a transplant. Like animals, plants emerged from the sea and retain salt in their cells. The domestication of plants afforded a huge change in human and earth history. Around ten thousand years ago, all humans were hunters and gatherers. Fifteen hundred years ago, 1 percent were. Today, about .01 percent are. This is a radical change in the human estate in a geologically brief era.[77] For the past thousands of years, the chief labor of most human beings has been the cultivation of plants (and children). Farming has been the most fundamental form of labor for millennia, starting first in the Old World as early as the ninth millennium BCE and then in the New World in the fourth. China was one of the ancient centers of agriculture, with a natural biodiversity much greater than, for instance, North America, which had been scoured by glaciers. Rice was cultivated along the Yangtze River and millet in the Yellow River basin eight to ten thousand years ago. The Fertile Crescent, of course, was another locale for the rise of agriculture and cities, with Jericho, for instance, having been continuously inhabited for eleven millennia.

Most who have studied the coming of agriculture and all that went with it agree with Jared Diamond: "The so-called blessings of civilization are mixed."[78] Not everyone agrees with his more acerbic view that agriculture was the worst mistake humans ever made. Farming was not an inevitable development: Diamond sees it as history's wrong turn, making us sick, short, and sexist. It brought us into cities and into close proximity with each other and animals (thus creating fresh germ pools), reduced variety in our diets (thus shrinking our bodies), and increased

77. Goudsblom, *Vuur en beschaving*, 63.
78. Jared Diamond, *Guns, Germs, and Steel* (New York: Norton, 1999), 18.

both pregnancy rates and repetitive work (thus disproportionately empowering men over women).[79] Diamond wants to counter the "progressivist" narrative that the Neolithic Revolution brought about a major improvement in the human estate with its cities, division of labor, writing, art, astronomy, religion, and statecraft, since it also brought about many of the abuses we still struggle with—extreme social stratification, concentration of power, and exploitative dependency on nonhuman sources of matter, power, and energy. Compared to a hunting-gathering collective, civilization is media-rich and has tremendous leverage over life and death. Innis did not want us to return to nomadic life, but he did want us to see that civilization is superior in presenting choices among methods of collective suicide.

The domestication of plants, like that of animals, was highly selective: out of a vast array of candidates, only a few were successfully domesticated, reordering the human landscape, diet, and digestive tract within a few millennia. Cereals now account for half of the calories of the human diet, leading with wheat, rice, corn, barley, and sorghum. Seven other plants add the next 30 percent: soybeans (a legume); potato, manioc, and sweet potato (root crops); sugarcane and sugar beet; and bananas.[80] Wheat, corn, and rice dominate, all of which were already domesticated thousands of years ago. The dish of macaroni and cheese is as characteristic of civilization (wheat for the noodles from agriculture, and milk for the cheese from domesticated animals) as pasta with tomato sauce is of globalization (tomatoes from Mexico, wheat from Eurasia, blended in Italy). "Food is the human-environment interaction *par excellence*."[81] Fire is a necessary condition for the vast rewriting of our metabolic condition. It domesticated the plants and animals that then rearranged our guts. Some of us even evolved to digest lactose in adulthood.

The history of maize, or corn as it is better known to Americans, from teosinte to the behemoth cobs grown in the American Midwest is told with great flair and sinister insinuation by Michael Pollan in *The Omnivore's Dilemma*. Corn's willingness to cast its coevolutionary lot with

79. Jared Diamond, "The Worst Mistake in the History of the Human Race," *Discover* (May 1987): 64–66.

80. For a fuller list, see Russell, *Evolutionary History*, 56.

81. Bert de Vries and Robert Marchant, "Environment and the Great Transition: Agrarianization," in de Vries and Goudsblom, eds., *Mappae mundi*, 71.

humans has been greatly rewarding for the species; its profitable symbiosis is rather like that of dogs and humans. Vast tracts from Pennsylvania to Nebraska are covered with endless waves of maize, "cerealian billows" as Thoreau called them, slurping up sunlight, water, and petrochemical fertilizers and overproducing starches and sugars that feed the rising obesity in the United States—three forms of storage (fossil fuels, carbohydrates, and lipids) spinning in a sickly feedback loop. Humans intervene directly in maize's sex life, and detasseling, the nasty work that serves as a rite of passage and source of summer cash for Midwestern teenagers, means pulling the tassels off corn stalks that are growing ripe for breeding. This human-led castration allows selective insemination and experimental breeding of new hybrids. Corn is a hybrid in Latour's expanded sense—a command and control mixture of botany and anthropology. (Such adaptations can be completely dysfunctional from the plant's point of view, as in the case of seedless oranges or grapes, which completely subvert fruit's role as a lure for the ingestion and spreading of seeds—and some plants have abandoned themselves entirely to human care, like the opium poppy, which is no longer found wild.)[82] In Pollan's account you can almost see the hydrocarbons oozing from decomposing prehistoric flora and fauna into petroleum deposits, then into fertilizer for corn plants which are ground into feed for a factory farm chicken, which is then slaughtered, carved up, and cooked in corn oil, breaded with corn flour, and dipped as a Chicken McNugget into corn-syrup–based ketchup, making a final landing as plaque in someone's arteries or as fat on their abs. What's good for corn isn't necessarily good for us; Pollan speculates that corn has domesticated humans.[83] In such mutual dependencies, who knows who's master and who's slave.

Flowers are also an important human accompaniment, though Africa tends to give them a minor cultural spot compared with the other continents, for sound ecological reasons. Mammals and flowering plants appeared at the same time in the Cretaceous. Flowers changed the landscape, bringing new colors, lights, and tastes.[84] In Mumford's exuberant

82. Mumford, *Technics and Human Development*, 129.

83. Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals* (New York: Penguin, 2006), 15–108.

84. Loren Eiseley, "How Flowers Changed the World," in *The Star Thrower*, 66–75.

description, "the reproductive system of the angiosperms was responsible, not merely for covering the face of the whole earth with a green carpet composed of many different species of grass—over four thousand—but for intensifying vital activity of every kind, since the nectars and pollens and seeds and fruits and the succulent leaves dilated the senses, exhilarated the mind, and immensely increased the total food supply." (Tomatoes are angiosperms.) In seeing the wondrous excess of nature's beauty, Mumford is the heir of his childhood hero Emerson. The floral bonanza is the "primal gift of life," a superabundant good for its own sake.[85] Ernst von Baer said it best: Fruits and flowers are the wedding clothes of plants.[86] Bees share canons of taste with humans: color, size, shape, scent, and sweetness appeal to both species alike, and the sun centers both their orientations to the world. As plants and bees go, so do we.[87] Vegetation is perhaps our first infrastructure of survival; without it, the ancestors of mammals could not have taken to land and survived. We remain secondarily dependent on honeybees, earthworms, and rain clouds to provide conditions for plant flourishing.

Flowers are key domesticates and have been specially grown, almost always in gardens or enclosed spaces, in China and the Mediterranean for more than three millennia for religious, medicinal, aesthetic, and social purposes, with a fascinating global variation depending on ecosystem and culture. The history of the rose, the only flower domesticated in Europe before the eighteenth century, is also the history of religion, painting, literature, and romance in western Eurasia in the past two thousand years.[88] Though Horace associated the rose with Eastern decadence (Ode 1.38), many varieties arose in Europe, and since the Middle Ages the rose became the key flower in the continent's life. The celebrated

85. Lewis Mumford, "The Flowering of Plants and Men" (1968), *Interpretations and Forecasts, 1922–1972* (New York: Harcourt, Brace, Jovanovich, 1973), 487–496, at 494.

86. Karl Ernst von Baer, "Welche Auffassung der lebenden Natur ist die richtige? Und wie ist diese Auffassung auf die Entomologie anzuwenden?" (1860), *Reden gehalten in wissenschaftlichen Versammlungen und kleinere Aufsätze vermischten Inhalts* (1864; facsimile reprint: New York: Arno, 1978), 1:239–84.

87. See *Queen of the Sun* (2010, dir. Taggart Siegel).

88. See Jack Goody, *The Culture of Flowers* (New York: Cambridge University Press, 1993), chapters 5, 8, passim.

saying attributed to François I, the sixteenth-century king of France, is as significant in what it says about botany as in what it says about sex roles: "Une cour sans femmes est une année sans printemps, et un printemps sans roses" (a royal court without women is a year without spring, and a spring without roses). The tulip, so important for Dutch economy, painting, and identity since the seventeenth century, actually came from Turkey, its name deriving from *turban* (a Persian word); Pollan devotes a lively chapter to the speculative insanities that the tulip induced in the otherwise stolid Dutch.[89] The being—the gene pool and population—of roses and tulips and many other plants has been altered by human intervention.

As a rule, domesticates, both plants and animals, are almost always more diverse in color, texture, size, and shape than their wild kin. The genetic modification of plants, in a sense, is very old, but the genetically modified crops that make many so nervous are also very distinct because of the accelerated speed of the manipulation, the threat of monoculture, and intrusive genetic alterations that risk the loss of hard-won robustness and redundancy. Age-old breeding depended on slow craft and generations; new genetic techniques cut into the genetic material itself. This is precisely Heidegger's concern about *Bestand* and *Gestell*—that nature would become raw material for human manipulation. (He published his essay on technology one year after Crick and Watson announced the discovery of DNA.)

The mark of agricultural societies is their simultaneous productivity and fragility.[90] Monocultures, for instance, are more prone to blights. Modern agriculture is in serious hock to weed killers, pesticides, and chemical fertilizers, whose use exploded in the Green Revolution: 4 million tons in 1940, 40 million tons in 1965, 150 million tons in 1990. This was another abuse of military equipment: the process of ammonia synthesis in the early twentieth century led at once to fertilizer, poison gas, and explosives.[91] Fertilizer can still be converted back into explosives; the

89. *The Botany of Desire: A Plant's Eye View of the World* (New York: Random House, 2001), chapter 2.
90. Goudsblom, *Het regime van de tijd*, 74, 85–88.
91. McNeill, *Something New under the Sun*, 22–26.

1995 Oklahoma City bombing was powered by 4,800 pounds of ammonium nitrate. Fertilizers are ablative media that enable other activities. Uncannily, corpses, whether fish, fowl, or human, are also nitrogen-laden packets of fertilizer.[92] (Bodies, as we have seen, are banks of stardust.) Many are the practices of agricultural fertilization—the burial of the dead, the use of feces, the spreading of ash or nitrates, and the direct implantation of seeds. In Freud's too clinical terms, there is no more potent mixture of eros and thanatos, of the genital and the anal, than fertilization.

A final form of agricultural fragility is the weather. Small variations in temperature and rainfall can be fatal for the subsidized agribusiness model practiced in the United States. Indeed, civilization may owe much to a spell of good weather. Samples taken from the Greenland ice suggest that the last ten thousand years, a geological epoch known as the Holocene, have been relatively temperate and steady compared to earlier periods in earth history. This means is it miraculous not only that we live on a planet with life and have evolved to this moment, but that all our infrastructures have emerged in a rare halcyon era in the earth's climate history. Humans seized the *kairos* of the Holocene. Agriculture presupposes a relatively stable climate; ice ages and civilization don't mix.[93] The main crops upon which civilization rests require a climate of alternating hot and cold, the Persephone cycle of summer and winter. If the climate were too cold, plants would never have the sunlight and warmth to germinate; if the climate were always warm, they would have less incentive to develop fruits, bulbs, and thick grains for storage during the harsher times. Plants as "storage organs" are efficient sources and reserves of energy exploitable by humans. In agriculture, media theory's interest in the power and danger of choke points finds much raw material. Plants are vessels of energy storage and transmission: processors of sunlight, carbon dioxide, oxygen, and water, the basic media of energy. They make it possible for us to benefit from the bounties of earth and sun.

92. See T. S. Eliot, "The Burial of the Dead," part 1 of *The Waste Land*.

93. Robert Marchant and Bert de Vries, "The Holocene: Global Change and Local Response," in de Vries and Goudsblom, eds., *Mappae mundi*, 47–70; Cook, *A Brief History of the Human Race*, 5–9.

And of Animals

Fire's role in the control and domestication of animals is obvious. Fire can scare away predators, drive large animals, and spring them from the brush in which they hide. Smoke can serve as a bug repellent and it plays a crucial calming role in beekeeping. "The domestic animal is an essential element in the development of human civilization."[94] The art of animal husbandry is the replacement of natural with artificial selection. The domestication of animals yields not only meat and dairy, but labor-saving motive power (oxen, horse), fertilizer and fuel, wool, leather, glue, adornment, and endless services to humans.

Not all beasts are subject to domestication. Diamond quotes Francis Galton: "It would appear that every wild animal has had its chance of being domesticated, that [a] few . . . were domesticated long ago, but that the large remainder, who failed sometimes in only one small particular, are destined to perpetual wildness." He also quotes another authority: "Many are called but few are chosen." Zebras, for instance, have too nasty a disposition for domestication. (Camels have been domesticated, but that doesn't keep them from being nasty.) Rhinoceroses have never been domesticated or even tamed, being just too sour in temperament. Domestication implies bringing a population under the human aegis, but taming occurs within the lifetime of an individual animal; for example, some elephants have been tamed, but never the entire species. Diamond is fond of alternate history, and my favorite among his droll what-ifs is the image of the Roman army being vanquished by Bantu warriors mounted on rhinos.[95] Animals have affordances just like any other media. In the New World almost all large animals were killed off by humans. The ancient Mayans had domesticated the turkey, and the Aztecs had dogs, which they occasionally ate, but no beasts of burden were domesticated. There are also definitional complexities: house sparrows and house mice, for instance, are inadvertent domesticates selectively bred to flourish in

94. Helmut Hemmer, *Domestication: The Decline of Environmental Appreciation*, trans. Neil Beckhaus (Cambridge: Cambridge University Press, 1990), vii.
95. Diamond, *Guns, Germs, and Steel*, 165, 175, 159.

human dwellings, but via a process of natural selection rather than artificial breeding.[96]

The big five domesticates are the cow, goat, horse, pig, and sheep.[97] Domesticated animals, which far outnumber humans, consume more food than all seven billion people alive, and cattle produce a major share of the methane in our atmosphere, a leading greenhouse gas. The world population of chickens averages around nineteen billion, or about three per person. Sheep outnumber people in Australia, as pigs do in Iowa by a ratio of about six or seven to one. The ratio of domestic to wild animals tilts overwhelmingly in favor of the former: wild animals are rare, and a large and concentrated population in large land animals is almost always a sign of domestication.

Some of these processes are perhaps clearest in dogs, which have served humans as hunters, guards, companions, and lunch, and are the most widely spread of all domesticated animals. Dogs were bred to bark (something that wolves, who hunt by stealth, never do), to be loyal to a master to hunt and track, and to serve as blankets and companions with prodigious skills in interpreting human moods and nonverbal communication that surpass those of species with greater intelligence such as pigs and chimpanzees. "It is probably impossible for our two species, interdependent since the dim beginning of our ascendancy on this earth, not to communicate."[98] A stray named "Bobby" was the only creature that would acknowledge philosopher Emmanuel Levinas while he languished in a German detention camp during World War II, suggesting the possibility of an animal ethics and an interspecies form of recognition. Bobby, Levinas says sardonically, was "the last Kantian in Nazi Germany."[99] Dogs reflect the condition of settled life in cities: private property above all, a major shift from the perhaps communal life of hunting and gathering. They also seem to have been bred for food.[100] Dogs, like pornography, spam, and cats, flourish online. They are sense extenders, seeing, sniff-

96. Leach, "Human Domestication Reconsidered," 357.

97. See Diamond, *Guns, Germs, and Steel*, 100, for a handy chart of domesticates, and Russell, *Evolutionary History*, 56.

98. Louise Erdrich, "Nero," *New Yorker*, 7 May 2012, 61.

99. "The Name of a Dog, or Natural Rights," trans. Seán Hand, in *Difficult Freedom: Essays on Judaism* (Baltimore: Johns Hopkins University Press, 1990), 151–53.

100. Wade, *Before the Dawn*, 110 ff.

ing drugs, tracking prey, retrieving game or sticks. They handle all the basic logistics of being in the world: pointing, setting, fetching, guarding (*hüten*), tracking (searching), herding (gathering), watching, alarming, and so on. (Freud could have spoken of prosthetic dogs.) They are Heideggerian creatures, full of watchfulness for what looms on the horizon. (In the 1950s Heidegger had a dog named Pipp.) From Chihuahuas to Irish wolfhounds, from Dachshunds to poodles, dogs exemplify this plasticity, the artifactual and historical character of much of what we think of as nature.[101]

As with dogs, so with other sorts of "nature." Humans create all kinds of conditions for evolution—which is not only a glacial process taking eons, but one responsive to quick changes within generations. Under pressure from poachers unhindered by weak states, elephants in the south of Africa, for instance, have started to lose their tusks. Tuskless elephants, of little interest to poachers, live on to breed and have offspring endowed with that survival-enhancing trait, and now some herds are nearly two-fifths tuskless, with that ratio growing. In a similar way, the ban on marijuana by the US government inadvertently sparked a series of genetic mutations and hybrids designed to cope with police surveillance, favoring smaller, less obvious, and more potent plants. The state can serve as a biological agent. Other examples of the humanoid malleability of nature include bison, corn, cotton, roses, and tulips. Biology is technology not only in the sense that its genetic structure can be directly altered, but in the sense that it can be coevolutionarily shaped with other (almost always human) species. "Once we think coevolutionarily, we encourage ourselves to examine not just how humans shape organisms but how organisms shape humans."[102]

Mammals are not the only key domesticates among animals. The silkworm was domesticated early in China, with important consequences for dress, trade, and globalization (the Silk Road). Whether we should use the term domestication or not is unclear, but microbes have also long been harnessed for service in cheese, yogurt, and beverages. Yeast is an essential part of brewing and baking, yeast cultures can last for centuries,

101. This paragraph is based on discussion with Sam McCormick, 11 June 2011.
102. Russell, *Evolutionary History*, 143. Examples from Russell and from Pollan, *Botany of Desire*, chapter 3.

and some bakeries have lineages of starter or "levain" that go back over a century and a half. Humans have laid hold of the natural *technai* of every creature they can, now including genes harvested far and wide. On our earthcraft today, it is unclear where the medium begins and ends.

I am writing these words in Iowa, a state whose land is now covered with corn, soybeans, and hog confinement facilities and is almost exclusively operated on an agribusiness model, meaning the collapse of the family farm and deleterious effects on the vitality of small towns and rural life. In Iowa it is not hard to think of plants and animals as fundamental infrastructures of existence. It is also a good place to see the payoffs and pathologies of domestication. Pigs are incubators and transfer stations for viruses, and are the most likely intermediary of the bird flu virus to humans. Pigs can be packed into areas so tight that each pig is allotted no more space than its body takes up. Other animals would not tolerate such close proximity without mutual aggression—one reason for the hideous practice in industrial poultry production of "debeaking" chickens by machine so that they don't peck each other to death. (Gregarious animals are more susceptible to domestication than solitary ones, since the presence of conspecifics reduces stress.) Hog confinement also means a concentration of pig poop that occasionally breaks the containing walls, not only emitting a cloud of stench that reeks for miles, but also dumping disease and poison into the water. You don't want to be downwind or downstream when the container ruptures. Karl Marx praised Darwin for discovering "the history of natural technology [*Naturtechnologie*], that is, the formation of the organs of plants and animals." Marx raised the idea that evolution is a technical history, and added that, for better or worse, "technology reveals the active relation of man to nature."[103] He was certainly right on both counts.

And of Humans

Humans are no longer found wild, with a few rare exceptions. You can't have seven billion members of any large animal species on a planet of

103. *Capital*, vol. 1, 493n4. "Die Technologie enthüllt das aktive Verhalten des Menschen zur Natur . . . ." Marx's term *Technologie* has an older sense as a "field of study" here.

this size without domestication. Indeed, prior to the agricultural revolution about ten thousand years ago, the total number of humans on earth was much closer proportionally to the population size of other large wild mammals today. The population explosion since 1800, ballooning the numbers of humans from about one billion to more than seven, has amplified and built on domesticating trends. In 2010 the human species passed a threshold, according to the World Health Organization: more than half of all human beings live in towns and cities. (Only 5 percent live in megacities of more than ten million people.) Here, too, fire lies remotely at the start of processes that have changed the sea, the soil, the atmosphere, fatty deposits in human arteries, our habits of sleep, and the ways in which we live with each other and ourselves.

As noted before, Norbert Elias saw "civilization" not only as a complex of city-based institutions (kingship, priesthood, division of labor, writing, etc.) but as struggles around self, other, and environmental control. For him, the civilizing process involved three fronts in need of taming: pressures inside people, pressures between people, and pressures between people and nonpeople. Fire, plants, and animals show up, figuratively or literally, at each of its fronts—psychological, social, and environmental. His classic work *The Civilizing Process* charts the shift from medieval rawness to modern delicacy, as reflected in historical documents especially from Germany, France, and England. Whereas European diners once had crude table manners, direct contact with the corpse of the slaughtered animal, and no compunctions about clean hands or teeth, Europeans later learned to hide slaughterhouses and to use forks and napkins at the table. They raised their thresholds of disgust and sensitivity, and became much more finely attuned, emotionally speaking. Modernity saw the shift toward greater civility and mildness in social interactions. As the state assumed a monopoly over the means of violence, people put away their swords and ate with cutlery. (The process seems to have started earlier in China. Elias quotes Chinese visitors as expressing alarm that Europeans ate "with their swords"—that they used knives at the table instead of pacific chopsticks!)[104] For Elias the process of civilization marks a shift in sensibility, a regulation of desire, an increase of embarrassment and disgust at our own and others' bodies, and new regimes for managing

104. Norbert Elias, *The Civilizing Process* (1939; Oxford: Blackwell, 2000), 103–7.

self, others, and nature. When people came to live in close proximity, politesse—the regulation of interaction—was a crucial form of domestication. Ethical systems for dealing with wider scales of sympathy are clearly part of civilization.[105]

Elias later saw that his original story was too local: the process of civilization was not only a European phenomenon, nor was it unique to the past five or six centuries. His analysis has been expanded in time and space by several of his followers—notably by Goudsblom, an important voice in this chapter, who saw that fire acutely posed the question of how the civilizing process could work at a number of temporal spans, including very long ranges. There are striking similarities between the developments of the deep past and the past two centuries: vast inequalities piled up, nature was transformed in radical ways, and humans learned to live in cities, to depend on large-scale technical systems, to sleep and work in regular chunks, and to walk into vast stores of desirable goods without rampaging, raping, or killing. We all know about bloody exceptions, and disciplinary institutions such as families, schools, clinics, and prisons deal with low-level offenses against civilization all the time. The human population boom brought and depended on huge changes in our relationships to habitats, each other, and ourselves. Modernity can be described as the condensed and accelerated domestication of people and nature over centuries and decades instead of millennia.

That modern humans have become like herd animals has been a staple of social criticism for two hundred years and more. Most of such talk has focused on minds and mores, but it can apply just as well to our bodies: our bones, teeth, and skulls are evidence of adaptation to a domesticated life. Especially suggestive is gracilization (thinning) of the skull and facio-cranial reduction, which humans, dogs, and pigs all seem to have undergone around the same time, probably in response to housing and the provision of stored food.[106] Pedomorphosis (also called neoteny), the retention of childlike traits into adulthood, is a characteristic widely found in domesticated populations. Our thin skulls and (relatively) cute faces point to a deep history of domestication. The structure of the face absorbs and reflects its environment. As in dogs, so in humans: domesti-

105. Karl Jaspers, *Vom Ursprung und Ziel der Geschichte* (Zurich: Artemis, 1949).
106. Leach, "Human Domestication Reconsidered," 353–56.

cated versions are cuter and more childlike in form and behavior. Compare our faces and skull thickness with those of Neanderthals (an admittedly faulty comparison point, since modern humans are not principally descended from Neanderthals) and it is easy to see that our faces are softer and our skulls more gracile. Modern brain cases also seem to be smaller than those of both Neanderthals and our *Homo sapiens* ancestors, a fact not so widely trumpeted.[107] My own mouth produced thirty-two teeth, but dentists yanked eight of them to get them to fit the limited oral real estate, and for many people third molars are redundant and require dental intervention. Bone, the supposed fixed symbol of death, is actually a highly dynamic environmental indicator, a mix of biology, geology, and history.

According to biologist Helmut Hemmer, the domestication of animals generally has the following consequences: (1) diversification of appearance; (2) decrease of motility; (3) increased floridness of sexual behavior; (4) diminishing importance of day-night and seasonal cycles; (5) decreased adaptability to stress and the requirement of life support from a more uniform, stable environment; (6) decreased timidity and an increase in social compatibility; (7) atrophy or hypertrophy of preexisting traits, and (8) "die Verarmung der Merkwelt." His translator nicely renders this last phrase as "decline in environmental appreciation," but it literally means "the impoverishment of the noticed world." Hemmer takes the notion of *Merkwelt*, the internal model an organism builds of its *Umwelt*, from biologist Jakob von Uexküll, who believed that domesticated animals become less attentive to their *Umwelt*. They spend less brain power on habitat surveillance because they live in artificial environments that provide predictability in food, shelter, and sociability.[108] Sensory vigilance is a casualty of domestication. Life in the wild involves stress and vigor, but also massive inefficiency, since so much energy must be on tap for reactivity and environmental surveillance. Wild animals in general have bigger brains than domestic ones, as they need all the sensory and cognitive candlepower they can get for tracking the many potential hazards.

107. For a nice review see Wade, *Before the Dawn*, 175–77.

108. Hemmer, *Domestication*, 92, and passim. Compare Leach, "Human Domestication Reconsidered," 349.

Hemmer does not belabor the relevance of these changes to human beings, but their relevance for civilized humans is obvious. (Item 4, the diminution of naturally-dictated temporal cycles, will come up again in the next chapter.) Drop a modern human into a forest or desert and chances are that they will have no clue how to survive without special training. Hemmer's criteria also echo the classic critique of the bovine character of modern life, and they recall McLuhan's point that technologies both extend and amputate the sense organs: hypertrophy and atrophy run together. The price of domestication is a systematic or selective obliviousness to the moorings of our being, and our infrastructural blindness has skeletal-sensory structures to match. Just as humans spend less time chewing, so they spend less time attending to the *Umwelt* (at least the natural *Umwelt*). How many of us know constellations, seasonal indicators, or animal traces, or can make a fire from scratch? In an age of anthropogenic extinctions, what is the fate of a massive blindspot to our condition doubly mediated by nature and *technē*?

Modernity, again, recapitulates in telescoped form the rise of civilization: building of an artificial environment (lighting, weather protection, immunizations), manipulation of the animal kingdom on a massive scale, new forms of agriculture, direct genetic modification, unprecedented levels of burning, a new highly specialized division of labor, and a transformation of mores (though this time toward equality rather than hierarchy). Each technological advance brings commensurate resistance and backlash. There never was an infrastructure without potential for collapse and perversion. By no means have fires gotten any easier to manage, despite the supposed advance of technics; nor has the fire of the human heart. No better example of the impoverishment of the *Merkwelt* exists than vestal fire. Danger once required constant vigilance, but now we outsource surveillance. It is possible now to be absolutely aloof to the environment and dwell in a constant sensory microclimate of houses and headphones. What the city did in its long history, and slaves have done for their masters, digital media (in the narrow sense) have done in the short span: they buffer us to many and expose us to a few things that are.

The greater the human steering of nature, as we have seen, the greater the potential catastrophe. Fire, like humans, needs shelter and fuel: and as we become dependent on fire, we also become—and this is the key point stressed by Goudsblom—*dependent on its dependencies*. Fire both

gives its users great power and subjects them to its side effects. We are deeply in debt to fire; fire is in debt to fuel; therefore, we are in debt to fuel. Fire is a jealous god and it calls for enormous expenditures and sacrifices (oil, fire insurance, alarm systems, and all the rest). The incorporation of nonhuman resources into human society increases our power and our vulnerability.[109] Environmental control is never complete, and the principle of incomplete domestication is a constant rebuke to whoever believes in complete social construction of the world: dogs attack and kill, weeds run rampant, psychopaths and corporals run amuck, and fires burn everywhere. Are we prepared for the emergencies of our dependencies? Modernity, says Paul Edwards, is "a condition of systematic vulnerability."[110] Whatever we call this strange thing, this infrastructural minestrone that we have produced in recent centuries, and whatever forms we develop, hopefully democratic, for managing it, it is part of the great changes that human beings have wrought upon the world.[111]

Everything is burning, said the Buddha. So did St. Augustine. This chorus of the two greatest representatives of asceticism in its Eastern and Western versions discerned the basic biological fact: Everything alive is on fire.[112] One could not sum up our world or condition any better. All the ease brought by digital media also primes us for new scales of catastrophe. When writing about technology, Heidegger was fond of quoting Hölderlin's lines:

> Wo aber Gefahr ist, wächst
> Das Rettende auch.

"But where danger is, grows / The saving power also." He could have been thinking of fire.

Some lines from Delmore Schwartz take us out:

> Each minute bursts in the burning room,
> The great globe reels in the solar fire,

109. Goudsblom, "The Civilizing Process and the Domestication of Fire," 8.
110. Edwards, "Infrastructure and Modernity," 196.
111. See André Leroi-Gourhan, *L'homme et la matière* (Paris: Albin Michel, 1943), 329.
112. T. S. Eliot, *The Waste Land*, lines 307–9; also see his corresponding notes.

Spinning the trivial and unique away.
(How all things flash! How all things flare!)
What am I now that I was then?
May memory restore again and again
The smallest color of the smallest day:
Time is the school in which we learn,
Time is the fire in which we burn.[113]

113. "Calmly We Walk Through This April's Day," lines 33–41. Thanks to Geoff Winthrop-Young.

Chapter 4

Lights in the Firmament: Sky Media I (*Chronos*)

> "Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days, and years."
> —Genesis 1:14

Sky Media

Many of our most important media are sky-born. Contrary to reputation, the sky is full of media and has been for a long time, though modern astronomy and space exploration have filled the sky vertiginously with staggering new things from space stations to dark matter. Sky media are as diverse as the sky itself, which never shows exactly the same face twice even in a desert. Fire is one of the oldest sky media: it has long painted the sky with artificial clouds, and in our era is remaking the atmosphere and thus our habitat. All our buildings—silos, smokestacks, temples, antennas, and above all towers—touch the sky, as do skyscrapers ("cloud scratchers" in Dutch and German). Sky media exert social control—flags and banners define territories, fireworks celebrate communities, and beacons, flares, spotlights, and skywriting send signals. Blimps, balloons, and satellites anchor much distance communication and probe the atmosphere. Not all that fills the sky is benign: drones and bombers shoot projectiles and pictures from above, and lightning bolts, a topic of great fascination to the old Heidegger, have astonished people since time immemorial. Death can come from the sky, and in the past century it has

been explicitly outfitted for war; the sky holds at least two of the five latest military "domains": land, sea, air, space, and cyberspace. Indeed the sky is profoundly heterogeneous, despite its reputation for openness and emptiness, and it has many layers of depth, like the sea, to which it is always connected by climate and culture, especially in the ways that its militarization and commercialization have gone together with profuse fantasies of both utopian alternatives and warfare. Science fiction dreams of outer space not only as a futuristic playground, but as the ultimate cosmic battleground (e.g., in *Star Wars*).

For millennia the sky has presented two faces to humanity: constants and variables, the regular motions of the heavenly bodies and the unpredictable events of the atmosphere. Correspondingly, the sky has yielded two great but very different sciences, astronomy and meteorology. One is the oldest of all sciences, and the other is quite recent, at least as a predictive science. One dealt traditionally with the χρόνος (*chronos*) of sun, moon, planets, and stars, with their cyclical constants, and the other with variables, the καιρὸς ([*kairos*) of weather, rain, hail, thunder and lightning, temperature, and clouds. One is the epitome of an exact science, and the other of a probabilistic one. Up to the twentieth century, astronomers could dream of compiling a census of all the stars, but clouds or winds are not countable in the same way, and they have defied efforts at scientific classification. With astronomy you can project backwards and forwards in time; indeed, back-projection is one way to test the alignment of ancient astral sight lines in megalithic monuments such as Stonehenge and the pyramids at Giza. Astronomy as opposed to meteorology is a science of reversibility: a movie of planetary rotations played in reverse still makes sense, but not one of cloud formations or lightning. The past and future of astronomy are theoretically symmetrical, but such is decidedly not the case in meteorology.[1] (Even in astronomy, chaotic factors such as tidal drag and seismic activity prevent the future from being an linear projection from the past, and the Big Bang is clearly an irreversible process.) The regular cycles of the heavenly bodies and the whimsical hap-

1. See the famous discussion in Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine*, 2nd ed. (Cambridge, MA: MIT Press, 1961), 31–37; and Ulrike Bergermann, "Durchmusterung: Wieners Himmel," *Archiv für Mediengeschichte* 5 (2005), 81–92.

penings of the atmosphere have long presented two models for the behavior of heavenly beings.

These two faces of the sky are the subject of this chapter and the next. The aim is not to provide an up-to-date account of our current celestial predicament, but rather to sketch its long prelude in cyclical and linear sky media such as clocks, calendars, and their celestial sources, and punctual or fractal sky media such as towers, bells, weather, and clouds. Compared to terrestrial media, celestial media—like aquatic media—are generally both more sublime and more abstract, in part because they can only rarely be touched by hand or fire; nonetheless, sky media can have a fierce political imprint. Sea and sky, "the extraterrestrial commons," are the twin sublimities that ring the human estate.[2] The two uncountable biblical magnitudes were the sands of the sea and the stars in the sky. We are dolphins with regard to the deep sky: we cannot mold or shape the stars as we can flame, flocks, or fields, though many peoples developed ritual practices—none very reliable—to curry favor with the heavens and manipulate their "influence" on our fates. The sky as a domain for human action up until recently has been almost entirely hands-free.

The sky's media-technical history is therefore quite unique, and astronomy and meteorology both deserve a full media history. The celestial spheres, thought Pythagoras, were governed by mathematics, and the means humans have used to steer their relation to the sky have number at their core. Moreover, such media, *theoretical* in the classical sense, almost always involve the reckoning of time, the greatest enigma of all. Time is the strangest thing that does or doesn't exist, as every becoming is also the negation of what once was. It is the element most resistant to materialization, although mathematics has often been its most faithful medium and translator, and like the sky, is our greatest puzzle and zone for action.

Theory, as all our metaphors still suggest, was at first related to the sky. In ancient Greek, θεωρία (*theōria*) meant looking or watching and is related to *theater* (like the English tie between *spectacle* as drama and *speculation* as thinking), both words coming from the verb θεάω (*theaō*), to see (but not from θεός [*theos*], god.) The road winding up to the Acropolis, for instance, is called οδός θεωρίας (*odos theōrias*). Those who know

2. Mette Marie Bryld and Nina Lykke, *Cosmodolphins: Feminist Cultural Studies of Technology, Animals, and the Sacred* (London: Zed Books, 2000), 19–21, passim.

some ancient Greek are tempted to translate it as "the way of theory," but it means "vista drive," which actually captures the ancient sense well. θεωρία was the experience of the celestial order as beautiful, and κόσμος (*kosmos*) meant order or arrangement, a sense that survives in our term *cosmetic*. "Philosophy emancipated itself from the mythical relation to the world precisely by making observations of the heavens into the exemplary exercise of man's vocation for theory."[3] Plato drew together these themes, seeing the sky as the place where numbers reveal time and the eyes reveal truth: "Vision, in my opinion, is the cause of the greatest benefit to us, since no account of the universe would have been given if the stars, sun, or heaven could not be seen. The vision of day and night and the months and the revolutions of the years has created the art of number, and has given us the notion of time as well as the ability to seek out the nature of the universe. From these things we have gained philosophy and there is no greater good the gods have given us than this."[4] Ever since, European thinkers have stored truth in the heavens.

Astronomy, as a science of nonmanipulable objects, has long been the greatest challenge to the view that all knowledge is media-rich. (The idea that astronomy was purely observational changed in the later nineteenth century when spectroscopy introduced an experimental element, and astronomy since has become as thick with instrumentation as any other modern science.) If metallurgy, musicianship, or seafaring had established our canons of knowing, Western thought might have embraced media as something more than vanishing enablers. But for many Greeks, the point of theory—the vision of the cosmos—was precisely that it was unsullied by craft. Astronomy models knowing as modeling, and in probably no domain except for logic are phenomena so indistinguishable from noumena; it is a rare sort of knowing that requires intense spatial

3. Hans Blumenberg, *The Legitimacy of the Modern Age*, trans. Robert M. Wallace (Cambridge, MA: MIT Press, 1985), 245. See also Jürgen Habermas, "Knowledge and Human Interests" (1965), appendix to *Knowledge and Human Interests*, trans. Jeremy Shapiro (Boston: Beacon Press, 1971), 298–317.

4. Plato, *Timaeus*, 47a–b; translation slightly modified from Andrea Wilson Nightingale, *Spectacles of Truth in Classical Greek Philosophy: Theoria in Its Cultural Context* (Cambridge: Cambridge University Press, 2004), 173.

imagination and is, as Andy Clark says, "representation-hungry."[5] Unlike forms of knowledge that take place in the practical co-constitution of knower and known, the celestial domain historically provided nothing to grab hold of. It takes cranium-busting powers of visual imagination and vigilant documentation to learn the stars, constellations, and their seasonal changes, and understanding the earth's pathway is a daunting task if you consider its elliptical shape (equation of days), slight wobble (precession) and twenty-three-degree tilt (tropics and equinoxes). After years of study our planetary movement is finally beginning to feel intuitive to me, though I still need to get oriented every time.

Of course, the history of astronomy is not medium-free: many devices probed the sky long before the telescope. Astronomy called forth some of the first databases, and Babylonian records were a crucial source for ancient Greek astronomy.[6] Hands and fingers, like trees, towers, and other artificial pointers, have lined up heavenly sight lines for millennia. Plato, a key source for the deeply rooted notion that media do not matter to real knowledge, seems to have used an armillary sphere to model the rotations of the planets while writing the *Timaeus*.[7] The sundial's gnomon (pointer), the almanac, and the astrolabe all managed the celestial vault long before the optical revolutions of 1600. Even in the most dolphinlike realm of our knowledge, we have long taken advantage of small material benefits to mark and know the sky. The mark of the human serpent, said William James, is over all, even in the sky.

Reading the Heavens

For most of human history, the sky was the best place to find a culture's values. The heavens are a source of legitimacy, meaning, and orientation for human beings and perhaps some other animals as well. The sky is a

5. Andy Clark, "Embodiment and the Philosophy of Mind," *Current Issues in Philosophy of Mind*, ed. Anthony O'Hear (Cambridge University Press: 1998), 35–52, at 44.
6. John D. North, *Cosmos: An Illustrated History of Astronomy and Cosmology* (Chicago: University of Chicago Press, 2008), 67, 95–101.
7. Francis Macdonald Cornford, *Plato's Cosmology* (London: Kegan Paul, Trench, Trubner, 1937), 74–75.

compass, calendar, and clock if you know how to read it—unless you happen to be located at one of the poles, where the stars are invariant across the seasons, and the long summertime hides them. The sky is also a map: if you know the time, date, and sky well enough and have an unobstructed view of the horizon, you can figure out where you are on the face of the earth or sea. The heavens are also a newspaper, or at least a weather report. (Why read the times, asked Thoreau, when you can read the eternities?). The Babylonians saw stars as "the writing of the sky," and Plotinus in the third century saw the stars like "letters forever being written in the sky, or like letters written once and for all and yet forever moving."[8] The sky is also a cinema in which to look for portents and observe the hosts arrayed in aerial combat,[9] and an indispensable resource for navigation, agriculture, orientation, urban planning, and religious ritual. Astrologers look to the sky to get advice about auspicious times. How a people reads the sky tells you a great deal about who they are.

Our world—not the same as our earth—would be cataclysmically different if our planet had been perpetually covered with clouds, as is Venus, which has a constant thick cloud layer composed of carbon dioxide, nitrogen, and sulfuric acid. Never being able to see the sun, moon, and stars would have enormous consequences. Lacking these coordinates of meaning-making, so essential to orientation and geometry, would make our world more like that of marine mammals. Nighttime visibility of the heavens is a small fact with massive repercussions, a strait gate through which much of human culture passes. Only in the twentieth century did nonoptical sensing of celestial bodies become possible, first with radio astronomy, unless we count Foucault's pendulum. Prior to that, all access to the heavens passed through the eye. Because the sun cloaks the heavens with light, blocking the stars with a vault of blue, the night is a condition of knowing. Said Hans Blumenberg, who spent his life studying the history and meaning of the sky, "The combined circumstance that we live on Earth and are able to see stars—that the conditions necessary

8. Ernst Robert Curtius, *Europäische Literatur und lateinisches Mittelalter* (Bern: Francke, 1948), 306, 309–10. See Plotinus, *Enneads*, 2.3.7.

9. Daniel Peterson, "Heavenly Signs and Aerial Combat," *Sunstone* (March–April 1979): 27–32.

for life do not exclude those necessary for vision, or vice versa—is a remarkably improbable one. . . . What a fragile balance between the indispensable and the sublime."[10]

Humans seem to have been observing the sky for as long as we have records. Archaeologist Alexander Marshack proposed in the 1960s that lines notched on bones dating to the Upper Paleolithic were lunar counts of the days in a month, and thus early forms of calendar making. Without knowledge of the cognitive worlds of the carvers, however, we can never decisively separate random design and intentional calculation. The cave paintings in Lascaux, France, dating from ten to thirty thousand years ago, include the picture of a bull with six dots above its shoulder that some conjecture to be a depiction of the constellation Taurus and the Pleiades, such that the painting could have a calendrical meaning. If true, it would demonstrate that stargazing, along with burial, art, sex, adornment, and ritual, was among the preoccupations of early modern humans and that at least some star clusters have been grouped in the same way for many millennia across very different cultures. (Many cultures see a big bear in the northern sky at night.) The images also seem to be acoustically placed such that the caves enabled both visual and auditory display. Their natural vaulted ceilings made excellent resonators for sound.[11] If the caves are imitations of the sky, they show that it is not only a screen for images but also a resonator for uncanny sounds such as wind and thunder.

Starting from the fourth millennium BCE, the period when major cities started to appear, evidence for systematic stargazing is more decisive. Northern Europe, especially England, has diverse ancient monuments, megalith arrangements, landscape lines, and burial sites in astronomically significant alignments. Stonehenge has long been at the center of such interest since Sir Norman Lockyer, the astronomer editor of *Nature* and discoverer of the existence of helium in the sun, started to study the

10. Hans Blumenberg, *The Genesis of the Copernican World*, trans. Robert M. Wallace (1975; Cambridge, MA: MIT Press, 1987), 3.

11. See Steven J. Waller, "Sound and Rock Art," *Nature* 363 (10 June 1993): 501, and Iegor Reznikoff, "The Evidence of the Use of Sound Resonances from Palaeolithic to Medieval Times," in *Archaeoacoustics*, ed. Chris Scarre and Graeme Lawson (Cambridge: McDonald Institute, 2006), 77–84.

site in the early twentieth century. The same is true of the astrally aligned pyramids at Giza. The field of archaeoastronomy that Lockyer helped to found tries to infer ancient sky lore from prehistoric art and architecture. New age thinkers like this kind of stuff, but lines can erupt all too easily in baroque arrays to the willing eye, so the task of the archaeoastronomer is to show in the absence of ethnographic data that the case for alignment is more compelling than chance would predict. (Celestial phenomena always arouse apophenia, but the long persistence of connect-the-dot *Gestalten* called constellations attests to a certain durability.) Megalithic monuments in England have technics such as artificial horizons, spectator posts, and lines of orientation that point to stars such as Deneb, Rigel, and Aldebaran and to winter and summer solstices: architecture pointing to astronomical facts.[12]

The sky is a tomb or a cave as well as a map, clock, or book. Many cultures see the heavens as the abode of the dead. The idea that each star represents a soul is still pervasive. The black night, "Death's second self" as Shakespeare called it, spins slowly around, dropping some stars below the horizon and bringing them back again later.[13] Planets, animals, and tides follow celestial tugs. The whole cycle suggests the wheel of life and death. And if the heavens are often treated as a tomb, tombs are often treated as observatories, or at least as gateways to the sky above. Canopic jars, used in Egyptian tombs for the preservation of the viscera, were associated with the four cardinal directions. The tomb of Qin Shihuang, the emperor who united China in the third century BCE, famous for its accompanying army of buried terra cotta warriors, was not only cardinally aligned but adorned with elaborate astronomical symbolism, including celestial bodies depicted on the ceiling.[14] Pre-Columbian North and Central America mounds and burial sites are laid out according to cosmological designs (the game of baseball may echo Native American cosmography, with its counterclockwise movement around a mound, a direction it shares with racetracks, most skating rinks, and the earth revolving around the sun.) Newgrave, a prehistoric tomb in Ireland, admits

12. North, *Cosmos*, chapter 1.

13. Shakespeare, Sonnet 73.

14. The elite continue to enjoy artificial stars. The 2014 Rolls Royce Wraith features "small fiber-optic lights in the roof upholstery simulating a starlit sky." Rory Jurnecka, "First-World Fastback," *Motor Trend* (May 2013), 42. Thanks to Daniel N. P. Peters.

a shaft of sunlight only once a year on the winter solstice.[15] Stonehenge, it has been recently suggested, was also a burial site (and a large outdoor xylophone; the hypotheses never cease). "Bury me, marry me to the sky," sings Cat Power, restating an age-old theme. More grimly, Paul Celan bewailed the victims of Holocaust ovens whose graves were in the clouds.[16]

The sky is semiotically fertile; the Romans called the zodiac the *signifer* (carrier of signs), a term you may have to read twice, and its shapes have survived for millennia. Reading the sky is a diagrammatic art.[17] The signs of the zodiac have been remarkably stable since ancient Greece and Rome and perhaps much earlier. *Zodiac* shares a root with *zoology*, though the zodiac contains more than animals (such as humans and tools). Obviously the stars we cluster together as bears, scorpions, archers, or dogs result from the earth's particular location; at no other point in the universe would they be seen to join together exactly as they do as seen from here. Our asterisms tell us we are in earth's neighborhood. We could purge constellations as the outmoded illusions of a hyperactive imagination, but these starry shapes have withstood the depaganizing efforts of the early Christians, who tried to turn the twelve signs of the zodiac into the twelve patriarchs, apostles, or angels.[18] But astronomers still use the zodiac and constellations as convenient ways of plotting celestial real estate, proving that handy orientation devices persist despite epistemological qualms. Like the QWERTY keyboard, some orientation devices are too expensive to discard and logistical techniques can pay their own way without needing subsidies from strict empirical support. That accuracy is not the only value for tools is one of the founding principles of pragmatist thought (and one of its defenses of religious ideas).[19]

The modern sky is not the same as the ancient sky. One way to explain the change is as loss. A locus classicus of this view is the homesick

15. E. C. Krupp, *Echoes of the Ancient Skies: The Astronomy of Lost Civilizations* (New York: Harper and Row, 1983), chapter 5.

16. "Todesfuge" (1947).

17. Sybille Krämer, "'Epistemology of the Line': Reflections on the Diagrammatical Mind," *Studies in Diagrammatology and Diagram Praxis*, ed. Olga Pombo and Alexander Gerner (London, 2010), 13–39.

18. Hans Georg Gundel, *Zodiakos: Tierkreisbilder im Altertum: Kosmische Bezüge und Jenseitsvorstellungen im antiken Alltagsleben* (Mainz: Philipp von Zabern, 1992), 32.

19. William James, *Pragmatism* (1907; Cleveland: Meridian, 1970), 140ff.

opening of Georg Lukács's *Theory of the Novel*, calling blessed those times in which the starry heavens marked out the path for human pilgrims to take.[20] Walter Benjamin followed up, suggesting that the invention of the planetarium in the 1920s meant the modern replacement of *Natur* with *Technik* and of an ecstatic relation to the universe with a purely optical one.[21] We should probably not indulge too fast the idea that people once lived by the stars but now live by the clock and the lightbulb. (McLuhan's complaint about "literate man's . . . indifference to the cosmic" is typical.[22]) We know more collectively about the universe than ever, and the past century has seen startling discoveries in astronomy and cosmology—the theory of relativity, Hubble's law, and the Big Bang. Astronomy as the ultimate exact science has always demanded an obsessive checkfulness and passion for precise measurement that few possess. Most people do not feel a need to bother their heads about the sky, though most farmers, sailors, and pilgrims have been decent practical astronomers, and many people long sought advice about auspicious days from almanacs and astrologers.[23] For deep popular engagement with the sky, one should turn to astrology rather than astronomy, which follows the latter as Lilith follows Eve. Some cultures have little interest in the sky and perhaps observe the heavenly bodies in the way most of us see clouds: as passing shows that are sometimes lovely but not essential to monitor since they, we suppose, are empty of cognitive content.

Distinctly modern, in my view, is not the loss of the sky but its explicit filling with technologies to go with much older techniques. (As we see in the next chapter, efforts to secularize the heavens are ancient.) Hannah Arendt makes this argument more or less with regard to Galileo's telescope and *Sputnik*. The telescope discredited naked-eye astronomy and found sunspots—impurities in a place that was classically held to be the essence of purity. Galileo combined two motifs: the fear that our senses could betray us without technical aid, and the quest to find an Archi-

20. *Theorie des Romans* (1916;Darmstadt: Luchterhand, 1974), 21.

21. Walter Benjamin, "Zum Planetarium," in *Einbahnstrasse*, ed. Detlev Schöttker (1927; Frankfurt: Suhrkamp, 2009), 75–76.

22. Marshall McLuhan, *Understanding Media* (New York: Mentor, 1964), 118.

23. On rural familiarity with the moon and the night sky, see the marvelous book, A. Roger Ekirch, *At Day's Close: Night in Times Past* (New York: Norton, 2005), 138.

medean point outside the earth. The second key event for Arendt was the sky's ceasing to be a pure space of *theōria*. She saw *Sputnik* as an absolutely epochal shift. For the first time, human artifice placed a visible object in the night sky, an action as radical as dolphins learning how to write or engineer: a complete change in the medium of mind. The eternal had become subject to making; *Homo faber* had reached into the sky and turned *theōria* into a form of action. In contrast to the Tower of Babel story that had closed skycraft to humans, the satellite was a human work in the heavens. The eternities had become susceptible to fabrication. With $E=mc^2$, humans pulled fire from the stars and used it against themselves, finding the Archimedean point and putting at risk our habitation in practice, as our theory had long wished to move beyond the earth. [24]

Timekeeping

Time is a strange habitat indeed, closely shaped by the sky—and by kings, priests, and plutocrats. The most profound media of political, economic, and religious power and control, as Harold Innis taught us, concern the keeping of time. What is time? asked Saint Augustine. He rightly considered this to be one of the great questions. His brilliant analysis did not quite solve the puzzle—but then, no one else has quite done any better before or since. Time lies at the heart of the meaning of our lives. Time flies when we are having fun, and when we age. It is at the heart of music, probably the most meaningful but least semantic of all the arts. We want good timing in opportunities, fortune in *kairos*. Time, always vanishing, is without content, constantly sucking it into the past. A lot of communication theory is stuck at the level of what Hegel called sense-certainty: thinking that the message must be the essence, seemingly the most rich and varied material we can find, when it is also what disappears the soonest, the most fickle part.[25] Experience is what you have when all the content is gone. My interest in the cultural techniques of time assumes that large philosophical questions are usefully pursued in the

24. Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958), prologue, chapter 6.
25. *Phänomenologie des Geistes*, sections on "sinnliche Gewißheit."

workings of apparently mundane devices. Sometimes simple knowledge will do. Timekeeping often involves devices with celestial philosophy built into them.[26]

Whatever time is, calendars and clocks measure, control, and constitute it. Towers and bells, in turn, are time heralds that claim dominion over space via sight and sound and proclaim its urgency. These logistical media—so fundamental that they sometimes are not seen as media at all—negotiate heaven and earth, nature and culture, cosmic and social organization and define our basic orientation to time and also to space. In so doing, they also relieve us of the burden of thinking about what time is and does. Such old media as calendars and clocks take account of the heavens and show the large consequences of small infrastructural facts. As devices whose effect is not only epistemological, calendars, clocks, and towers show us how media operate ontologically. Calendars and clocks are "quasi-objects" between nature and culture.[27] They model rigid environmental facts, the realia of the earth and sky, but there is still huge variation in their implementation. They require massive amounts of mental bandwidth to design (although popular use is quickly routinized). As constructs that synchronize earth and heaven, culture and nature, and the periodic events of history and astronomy, calendars and clocks remain among the oldest and most important of all theopolitical media of communication, with legacies visible everywhere in digital media.

Calendars and clocks in all their varieties stand between heaven and earth. Mathematical and political, they are mimics of heaven's cycles and slaves to cultural whims, abstract devices of cognitive, political, and religious organization, and among the most basic of all human means of sense making. They render the cosmos intelligible for quotidian use. Calendars are designed to coordinate periodic astronomical events (years, solstices, phases of the moon, days, etc.) with periodic human events (commemorations, anniversaries, holidays, Sabbaths, etc.), and the double job of binding earthly history to celestial cycles gives them their particular

26. See Thomas Macho, "Zeit und Zahl: Kalender und Zeitrechnung als Kulturtechniken," in *Bild—Schrift—Zahl*, ed. Sybille Krämer and Horst Bredekamp (Munich: Fink, 2003), 179–92.
27. Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993), 51ff, passim.

potency as media of communication. Clocks do so as well, though on a smaller scale, but both are at once modes of representation and instruments of intervention: they constitute time in describing it.[28] They *mediate* in the most fundamental way possible. Calendars and clocks negotiate between the heavens and the state, orient us to time and eternity, and thus fulfill, even in a secular world, the classic function of providing a meaningful orientation to the universe, which Max Weber thought the task of all religions. Calendars and clocks design both ultimate things and the texture of everyday life. Media not only bind (the past, the community) or network (space, time, people), but also organize.

Timekeeping is a mathematical and metrical art that turns on minute quantities. Many arts and sciences associated with observation of the sky—such as astronomy, musical harmony, geodesy, cosmology, neurophysiology, cartography, and navigation—treasure fine slices and precise measurement. A minor error in a logarithmic table can mean a shipwreck. (Charles Babbage's protocomputers were designed, in part, to calculate log tables.) A slow clock in the nineteenth century could cause a train crash. The difference between 3 and 3.14159 makes the world go round. Pythagoras heard numbers making cosmic music. Astronomical observation tracks almost imperceptible differences, making it, as noted, the first and paradigm of the exact sciences. Calendars themselves, however, are never pure models of natural cycles: they are always compromises, showing just how creative humans can be with natural facts.

McLuhan thought that the heart of communication was the trivium, the ancient and medieval division of the humane arts into grammar, rhetoric, and dialectic—or, as we might say, literature, oratory, and philosophy, arts all connected to language. In his last work, Kittler proposed the quadrivium instead, the equally venerable family of disciplines of arithmetic, geometry, music, and astronomy—arts all connected to number. There is a lunatic beauty to his late vision of music, the art of the muses (i.e., memory or recording), and mathematics as the sciences of our existence as creatures who count, dance, love, and sing, and who do so in metric algorithms that mimic the rhythms of the gods. (Kittler

28. Ian Hacking, *Representing and Intervening: Introductory Topics in the Philosophy of Science* (Cambridge: Cambridge University Press, 1983).

would have agreed with Peirce that "being is a matter of more or less," a quantitative matter.)[29] This book, though not following Kittler in all things, endorses the quadrivium's relevance to media theory.

These four arts can be elegantly arranged. Music and astronomy concern the heavens, and arithmetic and geometry the earth, and arithmetic is the foundation of music as geometry is of astronomy. Music and geometry are concrete, and astronomy and arithmetic are abstract. Music and astronomy are dynamic, and arithmetic and geometry static. Arithmetic and astronomy study the eternal, and music and geometry the perishable. Those who say that the mathematical or technical miss all that is most soulful miss the point: we are most human in our relations to the sky and to time. Sky media enable the quest for immortality, a humanly distinctive trait.[30]

Biocalendars

Timekeeping is not only theoretical and mathematical; it starts from life itself, as research in chronobiology tells us. Consciously systematized calendars appeared very late in human history. Life as we know it evolved on a planet with a relatively short rotation (day) and a relatively long revolution around the sun (year). The pulse of alternating days and nights seems at some level to be built into living beings from single-celled animals up. Circadian rhythms, for instance, unlike the smaller-scale timing tasks involved in auditory perception, do not require an advanced nervous system. Terrestrial protoplasm evolved in an environment marked by daily swings of light and darkness. The diurnal rhythm seems less binding for the creatures of the deep, although there is a thick ocean layer of fish and zooplankton that sinks by day and rises by night known as the deep scattering layer (nicely named after the effect it has on the acoustic media that sound it.) If the earth spun more slowly or more quickly on its axis, or life had somehow emerged at the poles instead of the middle

29. "Immortality in the Light of Synechism," *The Essential Peirce: Selected Philosophical Writings*, vol. 2 (Bloomington: Indiana University Press, 1998), 2.
30. Following Alain Badiou, *L'éthique: essai sur la connaissance du mal* (Caen: Nous, 2003), 26–32, passim.

latitudes, not only would our calendars be different; so would we. Indeed, there is an unremarked truth in the term "bipolar" used for mood disorders consisting partly of misaligned circadian rhythms: the sort of thing that happens to people living near the poles and to pilots, intercontinental flyers, college students, and cave dwellers.[31]

Though the internal time sense can be thrown off if organisms lack access to environmental cues about time (so-called *zeitgebers*), there is no question that life on this planet is periodic, a musical canon of overlapping cycles. Oysters, potatoes, fruit flies, sunflowers, sea turtles, spiny lobsters, pigeons, and bees can track the sun, orient themselves in geomagnetic fields, or consume oxygen according to daily rhythms laid down in early species history.[32] Part of the genius of honeybee navigation seems to be their chronosense, closely related to their solar-tracking powers. These remarkable acts of orientation to earth and sky often surpass human technologies, as noted in chapter 2. Humans have long-term bioperiodicities for puberty, menopause, and aging, and daily ones for hunger and sleep (all sensitive to environmental triggers). The circamensual cycle in humans or the annual migrations of birds, fish, bats, and monarch butterflies require no aid from calculated calendrics.[33]

Many of the same rhythms that shape our calendars are also written into our physiology. The human brain is endowed with remarkable, if not rigidly synchronized, and rather miscellaneous chronometric mechanisms, as the fascinating work of David Eagleman shows. Neural oscillators, pacemakers, and other mechanisms divide labor according to different scales of time and different kinds of sensory inputs (touch is slower than sight, which is slower than hearing). Some internal clocks work as oscillating chemicals, and others as neural networks. The circadian clock in humans is the suprachiasmatic nucleus, situated in the hypothalamus of each cerebral hemisphere. Its proximity to the optic chiasm may be

31. Palmiero Monteleone and Mario Maj, "The circadian basis of mood disorders: Recent developments and treatment implications," *European Neuropsychopharmacology* 18 (2008): 701–11.

32. Anthony F. Aveni, *Empires of Time: Calendars, Clocks, and Cultures* (New York: Kodansha America, 1994), chap. 1.

33. There are now "fertility trackers," among other medical informatics apps that follow ovulation, just as there are sleep apps that claim to wake you at optimal points in your sleep cycle. Thanks to Elizabeth Elcessor.

advantageous in accessing twenty-four-hour timing.[34] Sense organs are media made flesh.

As there seems to be no master clock in the brain, the human sense of unified time is a post-hoc production; Eagleman suggests "that a unified polysensory perception of the world has to wait for the slowest overall information." We experience the world as we do a live television broadcast, always with a slight delay. Our sense of the present necessarily lags while the brain buffers its diverse data streams. For Eagleman, the brain has to reckon with "the peculiarities of the equipment that supplies it," compensating for the limited channel capacities of its distinct sensory systems. Like all media, the brain's temporal interpretations can be intercepted and fooled: there are temporal illusions as well as visual and auditory ones.[35] Eagleman does not reflect on the constitutive role media metaphors play in his argument, but his picture of the brain looks like a classic infrastructure: smooth and coherent to its users, but vulnerable to hijacking if chokepoints are tweaked.

Artificial timekeeping systems can stretch far beyond a mortal life span, but biological clocks range remarkably, spanning ten orders of magnitude from the almost microsecond tracking of sounds to circadian rhythms, to estrus cycles and menopause. That organic systems can track events at the level of microseconds is stunning, since the fastest neuronal events, action potentials, are much slower, on the order of hundreds of microseconds. The brain uses the same principle as astrophysicists do: exchanging measures of time and distance. Specialized neurons compare the arrival times of different inputs to produce what is called "coincidence detection." The length of a nerve is an indirect measure of time: distance converts to delay. (Quips Eagleman: Tall people may live slightly further in the past than short ones.) The neural strategy is to read the interval between the two signals as evidence of the original stimulus. The brain can read its own states as evidence of external events to which it has no direct access; it too is a recursive medium. By pooling data from its recent states with streaming stimuli from outside, it can estimate temporal

34. Burkhard Bilger, "The Possibilian: Delving into the Mysteries of Brain Time," *New Yorker*, 25 April 2011, 54–60, 62–65, at 57.

35. David M. Eagleman, "Brain Time," *What's Next? Dispatches on the Future of Science*, ed. Max Brockman (New York: Vintage Books, 2009), 155–169.

succession. The phenomenon of "short-term synaptic plasticity" could explain how the brain recursively reads its immediate history as the index of the timing of sights or sounds, suggesting that timekeeping is a generally distributed neurological capacity and not the sole province of dedicated cells.[36] As with cetacean communications, starlight, archaeological digs, and libraries, the simultaneous access to multiple transmissions of diverse chronological origins is a fundamental problem of database organization for the brain as well.

The Day and the Year

As creatures that externalize themselves and evolve in concert with those externalizations, humans do not rely on evolutionarily honed biorhythms alone. An avidity for timekeeping is likely coextensive with human culture. Hunting and gathering, pastoral nomadism, and agriculture all depend on close observation of natural cycles, and humans had surely accumulated a wealth of oral lore coordinating plants, animal migration, and seedtime and harvest with the cycles of the sun, moon, and zodiac long before literate and numerate calendar keeping came into play.[37] Even the annual swarming of honeybees in some climes can become a loose datum for calendar keeping. Many calendars take their bearing as much from agricultural as from astronomical sources. The Gezer Calendar, probably from the tenth century BCE and discovered in 1908, is a limestone plaque that sorts the farming activities of the western part of the Fertile Crescent into one- to two-month intervals. The interest is the rendition of the twelve months in a purely agricultural way (though the lunar period is implied). Millennia later, the revolutionary French Republican calendar named its months after seasonal weather and events as well. The fall months of *Vendémiaire*, *Brumaire*, and *Frimaire*, for instance, mean grape harvest, misty, and frosty.[38] The Muslim calendar, in contrast, has no fixed relationship with the revolution of the sun and thus can never tie

36. Dean V. Buonomano, "The Biology of Time across Different Scales," *Nature Chemical Biology* 3, no. 10 (2007): 594–97.
37. Aveni, *Empires of Time*, ch. 2.
38. They sound like new names for fizzy drinks.

months to seasonal or weather cycles. It takes its bearings solely from the sky and not from the earth.

Some peoples live with an informal calendar based solely on earthly changes without regard for the heavenly signs of sun, moon, and stars. The Nuer of Sudan, according to Evans-Pritchard, had two overlapping systems of timekeeping, social and ecological, and lacked an abstract concept of time in general. Social time among the Nuer involved a complex quasi-kinship system of "age-sets" (i.e., cohorts of men who had undergone initiation rituals in the same year) that organized cooperation in time and space; social relationships and lineages of affiliation served as a grid or system through which the Nuer processed their chronologies and history. Ecological time among the Nuer was based roughly on the alternation of wet and dry seasons. They observed the sun and moon, the other celestial bodies, and wind changes and bird flights, but did not use them as points of reference in timekeeping. They had a working annual calendar and rich knowledge of how nature and the seasons affected their pastoral lives, based on rain and drought, rivers rising and falling, planting and harvest, burning fields, fishing, hunting and gathering, insect and animal life, and scarcity and plenty. Time could assume different values at different parts of the year. They counted days by "sleeps," or sometimes by suns. "The daily timepiece is the cattle clock, the round of pastoral tasks." Evans-Pritchard could not resist adding a note of cross-cultural yearning of the sort often directed at dolphins and other denizens of a clockless world: "Events follow a logical order, but they are not controlled by an abstract system, there being no autonomous points of reference to which activities have to conform with precision. Nuer are fortunate."[39]

Formal calendars require advanced knowledge of astronomy, and are key marks of civilization together with writing, mathematics, the division of labor, steep social stratification, and centralized religious/state power. Two natural facts—the daily rotation of the earth and the annual revolution of the earth about the sun—shape all calendrical systems. The monthly cycle of the moon is found in most, and other celestial re-

39. E. E. Evans-Pritchard, *The Nuer: A Description of the Modes of Livelihood and Political Institutions of a Nilotic People* (New York: Oxford University Press, 1940), chapter 3; quotes from 101, 103.

sources include solstices and equinoxes, even eclipses and comets. Guiding calendar-making was the religious and political desire to synchronize everyday life to the motions of the celestial spheres—to do consciously what potatoes and oysters do instinctively. Time is planted in heaven. To the people in Corinth, Paul of Tarsus wrote: "There is one glory of the sun, and another glory of the moon, and another glory of the stars . . ." (1 Corinthians 15:41). Whatever he meant, he well named the raw materials for calendar making, each of which yields distinct resources. Most practical calendars have almost always been made for the daylight, occasionally for the moonlight, and almost never for the starlight; using the stars provides a much more accurate model, but one with slightly creepy differences from our heliocentric focus, and which is of less immediate use to earth dwellers, though essential for seafaring and aeronautics, where small increments can lead to major deviations in destination. As always, pilots of vessels have to be closely attuned to the details, quantitative and otherwise, that anchor their being.

Calendarmaking would have been easier if the solar system operated in whole numbers. As King Alfonso X of Castile and Léon charmingly if apocryphally remarked, "If the Lord Almighty had consulted me before embarking upon Creation, I should have recommended something more simple."[40] The numerical complexity of terrestrial and solar cycles allows for a margin for cultural invention and variation; there is no single straightforward way to organize a calendar. Days, months, and years occur in incommensurable units: one complete lunar cycle (synodic month) is about 29.53059 days; and one solar year, from one vernal equinox to the next, is about 365.24219 days. Accuracy and convenience are often at odds in timekeeping, as in all forms of measurement. Human cognition and whole numbers do not harmonize efficiently with the solar system's periods. Such inconveniences lie, of course, in the nature of numbers: pi is irrational; *e* is not an integer; and musical ratios are a headache once you get beyond octaves and fifths, into repeating decimals like 4/3, a perfect fourth. The difference between number and quantity was an important discovery in ancient Greek mathematics, and was also the basis of the separation of geometry, which handles continu-

40. Quoted in Simon Singh, *Big Bang: The Origin of the Universe* (New York: Harper Perennial, 2004), 36.

ous quantities, and arithmetic, which handles discrete ones. Quantity is not the same thing as number. The diagonal of a square with sides of 1 is the square root of 2. The sound of a perfect fourth is perfectly audible. Both quantities are real and measurable, but impossible to represent arithmetically without approximation. (We will return to the benefits of vagueness.) The contrast of analog and digital goes back to the contrast of geometry and arithmetic.[41]

Though all calendars have the day and the year, determining what each precisely is turns out to be deceptively difficult. Let's start with the day: is it a unit of twenty-four hours that matches the time it takes the earth to rotate on its axis? Not exactly. The sun does take twenty-four hours, on average, to return to a point intersecting the meridian, an imaginary north-south line that bisects the sky into eastern and western halves. The sun crosses the meridian when the shadow on a sundial is the shortest: the time from one such crossing to the next is the "apparent solar day." But if you ignore the sun and measure how long the earth takes to make one complete turn, you find that it takes twenty-three hours, fifty-six minutes, and four seconds, plus change. This is called the sidereal day, or the day with respect to the stars (*sidereal* from the Latin *sidera*, or stars).

The day, as it happens, depends radically upon your frame of reference. As one of our most taken-for-granted formats, the day shows all the classic work of standardization and conflict in any infrastructure. What happened to the extra almost four minutes? Basically, the earth's revolution around the sun adds an extra increment to the year. The earth revolves around the sun in a counterclockwise path, and rotates on its axis from west to east. Its annual revolution around the sun adds one rotation to the earth's annual total. (By *revolution* I mean the orbit of the earth around the sun, and by *rotation* the earth's daily spin.) In other words, since the earth advances slightly every day in its orbit, a rotation of 360 degrees is not enough to catch up with yesterday's meridian; each day requires a full spin plus a little more to return to the same point with respect to the sun: 361 degrees, more or less. Annually, these daily increments add up to one additional rotation. If the earth were rotating from

41. Gregory Bateson, "Number is Different from Quantity," *Co-Evolution Quarterly* (1978), 44–46. See also McLuhan, *Understanding Media*, 117. Thanks to Bernhard Siegert for clarification.

east to west, we would have to subtract an annual rotation, since the earth would catch up with its previous spot with respect to the sun slightly shy of a full 360-degree rotation. (One sidereal day = 365.24219/366.24219 mean solar days = .99727 mean solar days = 23.93448 hours, or 23 hours, 56 minutes, and 4-plus seconds.)

The sidereal day is more or less constant, but the solar day varies throughout the year. The orbit of the earth around the sun is an ellipse, not a perfect circle, so the speed of its trip around the sun is not constant. When it's moving more quickly, it covers more distance and takes longer to return to the meridian. The earth is closer to the sun in the northern winter months, so the clock beats the earth in its race to the noon hour. The solar day (the interval between two consecutive solar crossings of the meridian) can take 24 hours and 10 minutes in February, but only 23 hours and 50 minutes in November. This annual variation in day length visible on the sundial was anciently encoded into the cognitive device called the analemma, a kind of compressed mirror of the earth's annual elliptical path. Clock time, the fiction that every day takes twenty-four hours, is a compromise that has no precise tie to any natural cycle.

Is your head spinning already? That is not my intention—or my fault. But if you feel dizzy, take that as proof of the representation-hungry nature of astronomy and the challenge of developing the spatial imagination to visualize heavenly patterns. Naked-eye observation can notice some of these phenomena, such as the one extra annual rotation of the earth. Sirius, the brightest star in the northern sky, was directly outside my southern window in the early morning in August; in November it was directly outside my westward window at the same time in the morning. It had shifted ninety degrees in three months. Of course it hadn't moved at all; in three months, the earth's position with respect to the sun and stars at that same time of day had advanced one quarter; in twelve months it will make an entire circle. The view of the stars afforded each night is unique to that calendar day, however slightly, while the planets and moon offer even more conspicuous calendrical markers to those equipped with a guide or *almanac* (a term that may stem from the Arabic word for sundial).

Another wrinkle in determining the day is variation in the speed of the earth's rotation. Atomic clocks need to be tweaked occasionally to match the slowing rotation of the earth. The earth's sidereal rotation

today takes about two milliseconds longer than it did a century ago, and this interval adds up to nearly three-quarters of a second per year, so leap seconds are occasionally added. On 30 June 2012, for instance, the official clock read 23:59:60 after 23:59:59, briefly suspending the sexagesimal system for the state of emergency. Tidal drag is the main culprit, but other events such as tsunamis, melting or freezing of the polar ice, and internal variations in the earth's core (seismic sloshing) contribute. The day will come when the earth's gradually slowing rotation will reach, for a brief shining moment, exactly 365 rotations (days) per revolution (year). Then, of course, it will soon drop below a whole number, giving future astronomers more calculations to make. In the past, the earth spun more quickly, with its daily rotation having gained about nine hours in the past 3.5 billion years.[42] Half a billion years ago there may have been more than four hundred days per trip around the sun, according to evidence from growth rings in fossilized mollusks and coral. (The moon's revolution about the earth also seems to have once been faster, with a month of about twenty-eight days.)

There is nothing so everyday as a "day," and yet when we want to know what it is, we quickly get confounded. (This was Augustine's complaint about time in general.) It varies depending on whether you measure it by star or sun, and if you use the sun, which is a much more salient signal for us, you have to deal with seasonal variations in the solar day. In terms of purely human time reckoning, there is no universal standard of when the day begins, and widely used options include sunrise, noon, sunset, or more artificial standards such as our midnight. Whatever a day is, it is an entity readily revealed to be a work of cultural approximation and averaging, a fudge of *physis* and *technē*. (Deconstruction works in nature as well as culture.) How odd to find such uncertainty at the base of what is most taken for granted. The deeper you probe into the media that shape meaning, the vaguer they become. Even something as mundane as the day has cosmic components.

Predictably, the year has even more complications than the day.[43] The

42. D. Shweiki, "Earth-Moon Evolution: Implications for the Mechanism of the Biological Clock?" *Medical Hypotheses* 56, no. 4 (2001): 547–51.

43. E. G. Richards, *Mapping Time: The Calendar and its History* (Oxford: Oxford University Press, 1999); and Duncan Steel, *Marking Time: The Epic Quest to Invent the Perfect Calendar* (New York: Wiley, 2000).

Babylonians reckoned the year as around 360 days, and thus chose 360 as the number of degrees in a circle (thanks also to its easy divisibility by 2, 3, 4, 5, and their multiples such as 6, 8, 9, 10, 12, and 15). Whenever we use the number 360, we are thinking in Babylonian; the same is true for our subdivision of the day into 24 hours of 60 minutes of 60 seconds.[44] Our symbol for "degree" (°) comes from the Babylonian symbol for "sun"—it both looks like the sun and represents the approximate length of our annual trip around it. This sign is hardly arbitrary: it is a visual icon referring to the sun, but in its meaning of 1/360 it functions as an ideographic sign, rather like Chinese characters or Egyptian hieroglyphs, which persists in modern phonetic languages (see chapter 6). Two millennia ago in Egypt, Babylon, China, and Greece, it was already known that the year takes 365 days and a fraction. The calendar implemented in the reign of Julius Caesar—named "Julian" in his honor—introduced a leap year every four years, pegging the year at 365.25 days, which was good to within eleven minutes and about fifteen seconds per year. This was an enormous improvement on the earlier Roman calendar, and it settled the European calendar for centuries. Not everyone was pleased with Caesar's change; Cicero griped about the stars now rising in accord with imperial edict.[45] His sarcasm, however, does point to an old fact of power: the ways in which kings seek to command or secretly imitate the heavenly bodies. The sky has always been political.

Those eleven-plus minutes—what happened to them? They added up, and the Julian calendar lagged behind the sun one day about every 128 years. (The annual lost increment = 365.25 − 365.24219 = .00781 mean solar day = 1/128 of a day.) By the sixteenth century, the Julian calendar was about ten days off from its calibration at the Council of Nicea in 325 CE, which had set 21 March as the vernal equinox. The spring equinox was being heralded by the Julian calendar a week and a half behind the solar schedule, detaching the ecclesiastical calendar from the interaction of earth and sun. In 1582, Pope Gregory XIII took action and pushed the date forward ten days from Thursday 4 October to Friday 15 Octo-

44. Harold Adams Innis, "A Plea for Time," *The Bias of Communication* (1951; Toronto: University of Toronto Press, 1991), 64–65.

45. Plutarch, "Caesar," *The Lives of the Noble Grecians and Romans*, trans. John Dryden, rev. Arthur Hugh Clough (New York: Modern Library, n.d.), 888.

ber in one massive correction. Thus he introduced the Gregorian calendar, which uses the Julian calendar but omits three leap years every four hundred years. A leap occurs in years ending with a double 00 not divisible by 400: thus 1700, 1800, and 1900 were not leap years, but 1600 and 2000 were. This time it was not Cicero but Protestant countries that griped, resisting the innovation for the predictable religious and political reasons of not wanting to be seen as taking orders from the Vatican. After 170 years of confusion in dealings with France and the continent, England and its colonies finally made the switch in 1752. Englishmen went to bed on Wednesday 2 September and awoke on Thursday 14 September. Rumors of calendar riots, the common folk clamoring to have their eleven days back, have been greatly exaggerated, and seem to have been perpetuated by a Hogarth print.[46] Russia (like Greece and Turkey) did not make the switch until the twentieth century, with the result that the Russian "October Revolution" of 1917 took place in what we now call November.

Further minor tweaks will doubtless need to be made; no calendar designed for everyday use matches the sky perfectly. And as with the day, the sidereal year is different from the tropical year—about twenty minutes faster on average, or about one degree (that is, one day) every seventy-two years, an observation the Greek astronomer Hipparchus in the second century BCE is said to have been the first to make.[47] The equinox moves around the ecliptic, the plane of the earth's path, inching twenty minutes backwards around the orbital plane every year from east to west, taking 25,772 years to complete a clockwise trip around the sun. "The precession of the equinoxes," as it is known, messes with the zodiac big time. We are nearly a month out of alignment from the ancient houses of the zodiac. Precession results from the earth's ultraslow wobble on its axis, rather like a big top. This discovery was made nearly eighteen centuries before the telescope. You could do a lot with small and simple media such as eye and hand, strings, sticks, dials, and written records.

46. Robert Poole, "'Give Us Our Eleven Days!': Calendar Reform in Eighteenth-Century England," *Past and Present*, no. 149 (1995): 95–139.

47. The key ancient source on the precession of the equinoxes is Ptolemy, *Almagest*, book 7.

Calendars and Conflict

All calendars are only good for the time being. Astronomical facts are unstable in nonlinear ways and civilization has a relatively short maximum durability; so far, the upper limit of communication between distant civilizations—defined as sharing a language as opposed to deciphering traces—is about four to five thousand years. But calendars are too potent constructs of affiliation to leave untouched. Most of the fight about calendars is about their fit not to the sky but to the earth, and a perfect mimicry of celestial patterns would never quench conflicts about how time is kept. Calendars are preeminent signals of identity, and instruments of institutional control. Whoever sets the time rules the society: this truism holds for ancient priests and astrologers and for admirals, physicists, and programmers today.

Calendars are particularly important items for religious ritual. Gutenberg produced the first printed almanac in 1457; the Bible came eight years later. Calendars may be as religiously important as scripture, and Jews, Hindus, Buddhists, Jains, Muslims, and Baha'is each have their own. Christianity has at least three, and Roman Catholics, Eastern Orthodox, and Armenian Orthodox can still end up celebrating Christmas on different dates. The chief motive of Gregory's calendar reform was to keep Easter, the most important of the Christian "movable feasts," from drifting too far out of its spring season. In contrast to Christmas, which always falls on 25 December (for Western Christianity) regardless of the day of the week, Easter always falls on a Sunday, varying widely from year to year (22 March to 25 April are its theoretical limits); holidays in general vary between regular (e.g., Cinco de Mayo) and floating dates (US Thanksgiving). The definition of Easter as the first Sunday after the first full moon after the vernal equinox was set in the Council at Nicea in 325 CE after long disputes among early Christians. It is a remarkably messy definition since it requires specifications of the (1) human week, (2) lunar cycle, and (3) solar cycle. But it succeeded in its overt political purpose: to find a date for Easter that would never coincide with Passover. The Nicene Council thus drove a further wedge between Christians and Jews and also laid down the law for Christian schismatics such as the Quartodecimans ("Fourteenthers") who continued to celebrate Easter on the fourteenth day of Nisan, the date of Passover Eve. Ironically

enough, the Christians had to revert to the lunisolar logic of the Jewish calendar—otherwise foreign to their Julian tradition—to prevent Easter from matching Passover. In the classic pattern the cost of fighting the foe was internalizing his logic, and the lunar reckoning of Easter is one of many Jewish contributions to the Christian unconscious. Calendars are never neutral maps: people signal allegiance and identity by the holidays (holy days) they observe.[48]

Indeed the Jewish calendar is of particular interest. The Jews borrowed a lunisolar calendar, one that uses both the sun and the phases of the moon, from the Babylonians, and after diverse refinements have a calendar that slips about six minutes a year, or one day every 216 years. Like the Chinese, they use a version of the nineteen-year Metonic cycle (comprising 235 months; seven months are intercalated over the nineteen-year period). But the Jews were also nervous about projecting too much energy into the heavens: sighting the moon was religiously acceptable, since it gave you the time of the month, but people risked idolatry if they speculated about the future by looking at other heavenly signs (Deuteronomy 18:20). Too much stargazing could be a sin. The Jewish scripture starts with an account of the creation of the world in which one of the very first items created was the day itself—which is characteristically defined in the Hebrew style as starting in the evening (Genesis 1:5). Moreover, the book of Genesis gives divine sanction to the seven-day week, culminating in the Sabbath or day of rest. Sabbath observance has always been one of the key markers of Jewish identity, as are high holidays such as Yom Kippur (Day of Atonement), Pesach (Passover) and Rosh Hashanah (New Year's), which are also considered Sabbaths, though they may fall on other days of the week besides the seventh. Sabbath observance is perhaps the most intense form of calendrical religiosity, a temporal fencing off in time and space (marked by the "eruv," a fence that encloses the Sabbath space), a "time out" from the secular flow.

Indeed, one clear mark of modern times is the waning of the Sabbath, as that of the night.[49] The BBC under its founding director, the devout

48. Whole paragraph based on Eviatar Zerubavel, "Easter and Passover: On Calendars and Group Identity," *American Sociological Review* 47 (1982): 284–289.

49. James W. Carey, "Technology and Ideology: The Case of the Telegraph," *Communication as Culture* (Boston: Unwin Hyman, 1989), 201–30, at 227–28.

Scottish Presbyterian John Reith, observed a broadcast Sabbath, programming sparsely on Sundays, leaving the field wide for pirate transmitters offshore.[50] In the early to mid-twentieth century, the wonderfully named "League for Safeguarding the Fixity of the Sabbath against Possible Encroachment by Calendar Reform," led by Rabbi Moses Hyamson, fought to keep the Sabbath from becoming unhinged from its ordained place in the seven-day cycle, but calendar reform was a minor threat compared to shopping, sports, broadcasting, cinema and their 24/7 logic. In a similar spirit, Seventh-day Adventists make an interpretation of the calendar into an article of faith. The Sabbath has always been a chief form of resistance to state and market power.[51] Celebrating the Sabbath on the first instead of the seventh day by early Christians not only served purposes of sociological demarcation but also commemorated the Resurrection. The ancient Jews, for their part, may have made Saturday the last day of the week to avenge their Egyptian captors, who venerated Saturday as the first day.[52]

Another feature of the Jewish calendar is of general relevance: its governance by central authority. After the destruction of the Second Temple in 70 CE, the diaspora calendar was coordinated by remote control by signal flares and messengers from the Sanhedrin in Jabneh, which maintained a monopoly on sighting the new moon. In an era before swift communication, the slow movement of such time-sensitive data was a major inconvenience, and one adaptation was the institution of double holidays (such as Pesach) for those in the diaspora, thus allowing for a fudge factor in timing. Hillel II ended Jerusalem's month-declaring monopoly in 356 CE, allowing each Jewish community to determine the new moon, which was much more workable for a scattered people, though the double holidays remained. (Who gives back a holiday?) A key sign of sovereignty is the right to declare a holiday, a right intimately connected with the right of pardon; both involve the suspension of time.

The Muslim calendar, in contrast, is strictly lunar, with a "hegiral year" of either 354 or 355 days made of twelve lunar months, and it makes one

50. Adrian Johns, *Death of A Pirate* (New York: Norton, 2011), 15.

51. Carey, "Technology and Ideology," 227.

52. "Calendar," *Encyclopaedia Britannica*, 11th ed. (New York: Encyclopaedia Britannica, 1911), 4: 987–1004, at 988.

complete rotation through all the seasons once every thirty-two Muslim years. As noted, the Muslim calendar, unlike solar calendars, has no relevance for seedtime and harvest. Thus Ramadan, the month in which the faithful fast during the daylight hours, can sometimes fall in the long and hot days of summer, and sometimes in winter when shorter days and cooler weather make it easier to fast. The month starts when the new moon is sighted, though a standard worldwide calendar is now in place for Muslims. (Ramadan is the tricky month, since some Islamic schools require that the new moon be sighted before beginning the fast.) For Muslims, Pope Gregory's worries about the calendar drifting out of sync with the seasons would be irrelevant. The Muslim calendar's first year is 622 CE on the Gregorian calendar and uses the abbreviation AH ("anno hegirae," in the year of the hegira). Since the Muslim year goes faster, one cannot find its equivalent by simply subtracting 622 from the Gregorian date. Doing so would yield a date that is yet to come, as the Muslim year is about 97 percent as long as the Gregorian year. Eventually—after about twenty thousand years—the Muslim calendar will catch up and pass the Gregorian calendar.

Most states in history have had expert classes charged with maintaining the calendar and divining auspicious days (for sowing, marriage, waging war). Among the Aztecs, for instance, a priestly class maintained a complex calendar with a nested system of two cycles, a 365-day agricultural-political calendar and a 260-day religious-sacred calendar. The two cycles coincided every 18,980 days: 52 years of the 365-day year or 73 years of the 260-day year. The calendar was the central computer of the Aztec social order, a massive program that directed agriculture, war, reproduction, labor, and religious ritual. It took a special interest in Venus, whose 263 days of visibility closely matched its sacred calendar; for the Babylonians, Greeks, and Romans as well, Venus was the planet presiding over love and fertility, and they all must have noticed that its period coincided roughly with that of human gestation. The managers of the Aztec calendar had what Innis would call a "monopoly of knowledge" in reckoning dates and declaring auspicious and inauspicious times. The calendar was a device of abstract calculation (a cognitive tool), but it also took form in concrete works of sculptural art in stone. A model of cosmic cycles, the Aztec calendar was also an instrument of rule. Astrological prognostications have often served as ideological supports. In many cul-

tures still, wedding dates are set by astrologers who check for favorable alignments, though the notion that some dates are particularly uncanny is not confined to exotic people such as the Aztecs; consider our Friday the Thirteenth, or the spike in weddings on 7 July 2007 and 11 November 2011.

Every calendar invites resistance. The Qumran sectaries of the Dead Sea Scrolls, for instance, hated the lunisolar calendar imposed by their Greek conquerors, and observed instead what they called "true calendar." A more recent example is a question faced by anyone who writes about historical spans of more than two thousand years: To BC or not BC? Contemporary Jews and others sometimes resist the Christianity of the Gregorian calendar by preferring the designation BCE ("before the Common Era") to BC ("before Christ"), and CE ("Common Era") to AD ("Anno Domini"—in the year of the Lord). That an implicit profession of faith is built into Anno Domini is unquestionable: the calendar bears witness of Jesus as the Christ that came at the noon of history; Dionysius Exiguus (Dennis the Little), the sixth-century monk who launched the Christian calendar, designed it so that "the Passion of our Redeemer might shine forth more clearly."[53] The idea that the course of history has a middle point, with a negative direction (before Christ) and a positive one (after his birth), is obviously Christian. The hitch is that when Dennis figured out this dating, Christians had not yet imported the notation or concept of zero, so that 1 BC skips directly to 1 AD—the reason why purists claimed that the new millennium began in 2001 and not in 2000, which would have been only 1999 years after Christ's putative birth date. (Before the Y2K problem was the Y0K problem.) That almost everyone celebrated the new millennium in 2000 instead of 2001 shows again that accuracy is not the overriding value in calendars.

The abbreviations BCE and CE started to be used in the aftershock of the Holocaust and the founding of the state of Israel. James Michener's *The Source* (1965) opens with an archaeologist picking a bullet off a heap in the young state of Israel, and carrying on an interior monologue about how to date the bullet, which he places about 1950. The reckoning of dates in terms of Anno Domini, he reflects, is frowned on in Israel as

53. Leofranc Holford-Stevens, *The History of Time: A Very Short Introduction* (Oxford: Oxford University Press, 2005), 122.

in Arab countries, just as Anglophobes might not like it that the point of zero longitude is in Britain, but neither meridian is easily ignored in practice.[54] This smart reflection not only notes the similarity of the zero points ("meridians") of geography and history, but how hard they are to work around. Grids, once established, resist resistance. Even today, the nomenclature of BC and AD has its defenders. The mayor of London, in a 2011 editorial whinging about the BBC's adoption of BCE and CE, correctly notes something always true in calendrical reforms: "This is not some trivial bureaucratic thing: it is a change with subtle but extensive ramifications."[55]

Calling the eras BCE and CE instead of BC and AD doesn't change the infrastructure. An ironic symmetry: as Christians had to internalize the lunar calendar to define Easter, so Jewish scholars internalized the Christian notion of a zero point, a before and after in history, without changing the grid and its grand meridian of time. Abraham Lincoln supposedly asked, "If I call a dog's tail a leg, then how many legs does it have?" His answer: "Four—calling a tail a leg doesn't make it one." In the same way, using BCE instead of BC doesn't keep time from turning on a single point. Names are easier to change than meridians. (In an ecumenical gesture, however, I've gone along with the corrected usage here.)

Calendar Reform and Inertia

Calendars are good examples of the QWERTY principle and they possess a deep cultural conservatism—appropriately enough for media that store time.[56] As Zerubavel argues, calendars are mnemonic devices for long-term cultural remembrance and often preserve forgotten relics.[57] Quirks of the Roman world live on in the twenty-first century. July and August,

54. James Michener, *The Source* (New York: Random House, 1965), 23.

55. Boris Johnson, "BC or BCE? The BBC's Edict on How We Date Events is AD (Absolute Drivel)," *Telegraph*, 26 September 2011. Joke: "You hear they've opened a Jewish branch of Boston College? Yeah, it's called BCE."

56. Astronomers still sometimes use Julian dates, and many telescopes default to the Julian setting.

57. Eviatar Zerubavel, "Social Memories: Steps to a Sociology of the Past," *Qualitative Sociology* 19 (2006): 283–99, at 294.

formerly Quintilis ("fifth") and Sextilis ("sixth"), owe their names to the vanity of two men dead for nearly two thousand years, Julius Caesar and Caesar Augustus. We call our ninth, tenth, eleventh, and twelfth months September, October, November, and December, which of course mean seventh, eighth, ninth, and tenth. (In a similar way, noon, traditionally viewed as the sixth hour after dawn, means "ninth.") The calendar gods have a sense of humor; calendars, like all systems of nomenclature, yield instances of delicious arbitrariness. Evolution, both cultural and natural, incrementally imports extant structures into new ones.

Because calendars are fonts of the legitimacy of old time, revolutionaries and reformers often start by attacking the calendar. In the twentieth century the revolution would proverbially first take over the television station, but calendars are systems of broadcasting, and a change there also marks a shift of power. A lasting legacy of al-Qaeda was to have established new days of remembrance: 9/11 in the United States, 7/7 in the United Kingdom. The French Revolution tried to institute a ten-day week (like that of the ancient Greeks) and strip away its accumulated religious content. The Republicans converted twenty-four hours into ten, dividing each hour into one hundred minutes and each hour into one hundred seconds, bringing the same decimal zeal to the calendar that led to the metric system of weights and measures. They wanted to weaken the grip of religious holidays and the Sabbath, replacing holidays celebrating saints, for instance, with days named after plants and minerals. After fits and starts, Napoleon abolished the revolutionary calendar in 1806, doubtless to widespread relief. In a similar spirit, the early Soviet Union experimented with a five-day week for about a decade, and then gave up; it was obvious that working four days and resting one meant more work than working five and resting two. The grip of the seven-day circle is tenacious.[58] The week has become second nature for anyone reading this book, squirming its way into our biochronologies. Some things even the French and Russian revolutions could not change.

Indeed, the almost biological force of the seven-day week has mysterious origins, but it seems clearly tied to the seven heavenly bodies visible in the ancient world: sun, moon, Mars, Mercury, Jupiter, Venus, and Sat-

58. Eviatar Zerubavel, *The Seven Day Circle: The History and Meaning of the Week* (New York: Free Press, 1985).

urn. (The discoveries of Uranus and Neptune were modern.) The legacy of skycraft is clear in the English Saturday, Sunday, and Monday, but obscured for the other days of the week because they take their names from the Germanic versions of the same gods. Romance languages show the seven moving bodies more clearly, and names for the days show cultural embroidery of an apparently natural system. Other languages operate with ordinal numbers. In modern Greek, for instance, Sunday is "the Lord's Day," Monday is "second day," and Tuesday is "third day," and so on to Friday, which is "preparation day" (presumably for the Sabbath). In Russian, by contrast, Sunday is "Resurrection Day," Monday is, splendidly, "the day after not working," Tuesday is "second day," Wednesday is "middle" (like the German *Mittwoch*), Thursday is "fourth day," and Friday is "fifth day."[59] Obviously the Greeks and Russians start counting in different places, though they both call Saturday "Sabbath," preserving an echo of the Jewish tradition. Indeed, when the week starts and ends is as arbitrary as when the day does. The modern weekend is a composite of the seventh and the first day, though Monday often feels like the first day. Months have a similar arbitrary quality: how many of us readily remember which months have thirty days and which have thirty-one without resorting to the mnemonic technique of counting knuckles? Calendars, like all symbols, have arbitrary elements but feel unstoppable.

Many of these infrastructural shenanigans can be seen in China, the country that may have the world's longest and most tumultuous calendar history. The ancient Chinese *Book of Rites* (*Liji*, 礼记) lists things that can change with regimes: measures, ceremonies, flags, vessels, weapons, clothing, and calendars. (Strikingly, it treats these things as being more variable than emotions and ethics.)[60] The Chinese calendar served as an instrument of imperial rule and identity by mediating natural cycles, with emperors proclaiming the seasons and issuing almanacs to manifest their harmony with the "mandate of heaven."[61] Chinese calendar keeping was thus highly unstable compared with the pragmatic and enduring

59. Quakers also use an ordinal system for the weekdays to avoid honoring the pagan gods.

60. Li Chi: *The Book of Rites*, part 2, trans. James Legge (Whitefish, MT: Kessinger, 2003), 61–62.

61. Nathan Sivin, "Mathematical Astronomy and the Chinese Calendar," in *Calendars and Years II: Astronomy and Time in the Ancient and Medieval World*, ed. John M. Steele (Oxford: Oxbow, 2011), 39–51.

	SUN	MOON	MARS	MERCURY	JUPITER	VENUS	SATURN
English	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dutch	zondag	maandag	dinsdag	woensdag	donderdag	vrijdag	zaterdag
German	Sonntag	Montag	Dienstag	Mittwoch	Donnerstag	Freitag	Samstag
French	dimanche	lundi	mardi	mercredi	jeudi	vendredi	samedi
Spanish	domingo	lunes	martes	miércoles	jueves	viernes	sábado
Italian	doménica	lunedì	martedì	mercoledì	giovedì	venerdì	sabato
Portuguese	domingo	segunda-feira	terça-feira	quarta-feira	quinta-feira	sexta-feira	sábado
Modern Greek	Κυριακή (Kuriakē) (Lord's day)	Δευτέρα (Theftera) (Second)	Τρίτη (Tritē) (Third)	Τετάρτη (Tetartē) (Fourth)	Πέμπτη (Pemptē) (Fifth)	Παρασκευή (Paraskevē) (Preparation)	Σάββατο (Savvato) (Sabbath)
Russian	воскресенье (resurrection)	понедельник (after no work)	вторник (second)	среда (middle)	четверг (fourth)	пятница (fifth)	суббота (sabbath)

Figure 2. Names of weekdays in selected European languages

Julian calendar. Every new emperor had the right to proclaim a new calendar in the same way that Western emperors had the right to issue new coins with their image and superscription, meaning a constant revolution in the logistics of time. Between 200 and 1300 CE, China averaged several new calendars each century, and even today there are two main calendars operative (see below).[62] As a consequence, astronomy was a closely watched tool of governance, one reason why Western clock technology, introduced by Jesuit missionaries in the sixteenth century, was considered both fascinating and dangerous.

In twentieth-century China the calendar was subject to just as much revolutionary upheaval as everything else. The traditional calendar used lunar cycles for marking social events and solar cycles for agricultural planning, using twenty-four seasonal markers (*jieqi*, 节气), each representing a move of fifteen degrees along the ecliptic. A nested system of ten- and twelve-day cycles made a sixty-day cycle, regulating festivals and farming. The full moon and new moon marked likely times for festivals, one of several features the traditional Chinese calendar shares with

62. Joseph Needham, Wang Ling, and Derek J. de Solla Price, *Heavenly Clockwork: The Great Astronomical Clocks of Medieval China* (Cambridge: Cambridge University Press, 1960), 6n3, 173–78.

the Jewish calendar. The week was first introduced into China by Christian missionaries during the Ming, but as late as the nineteenth century most of China was still indifferent to the seven-day cycle, though elites in Shanghai and other port cities involved in trade with foreigners were starting to follow its rhythms. (There is an element of pull as well as push in calendars.) In the reforms of 1898, many schools converted to a seven-day week. One question was whether to call the new unit by a religious name, *Libai* (礼拜, worship), or something more neutral, *Xingqi* (星期, date of starts). In a nice feat of bootstrapping, Sun Yat-sen announced that the implementation of the Gregorian calendar in China would take place on 1 January 1912, leading to predictable confusion about when the new year should be celebrated: at first officials celebrated the Western new year in relative solitude, while the great majority of Chinese stuck to the traditional lunar new year.

The exclusively solar "yang" calendar undercuts the moon-based "yin" calendar, the source of festive time in China. The Kuomintang (Nationalist) party tried to eliminate the latter in the late 1920s, in an unsuccessful spasm of modernizing discipline similar to those of the French Republicans and Soviets. The Chinese Communist Party more pragmatically kept the dual system, loading the Gregorian calendar with new holidays and making traditional holidays into occasions for socialist consciousness-building. In 2008 the Chinese government finally acknowledged three traditional holidays besides New Year: Tomb-Sweeping Day, the Duanwu (Dragon Boats) Festival, and Mid-Autumn Day. All seem to have been designed, in part, to relieve the tremendous pressure upon the national transportation infrastructure during the week-long Spring Festival by spreading out times for family reunions across the year. The two-day weekend was only introduced officially in 1995 (which helped stir the consumer market in China by encouraging people to shop).[63] Indeed, probably the main pressure on calendars today comes from the market more than the palace or temple. New holidays such as Valentine's Day, Mother's Day, and Halloween are pushed across the world as new occasions to celebrate and to consume. The Parsees of India are governed by

63. These three paragraphs owe much to the excellent paper by Meng Li, "The Time War: The Chinese Calendar and Its Modern Reform," Department of Communication Studies, University of Iowa, 2011.

three calendars, and the Chinese have two, but dealing with overlapping calendars—academic, fiscal, shopping, sports, television, and election—is the fate of all modern people. Perhaps the most important calendar of the mid-twentieth century was the broadcast schedule, organizing the leisure time and attention of entire nations.[64] Every religion may have its calendar, but every calendar probably has its religion as well, if even the religion of secular reason, consumerism, or hectic multitasking.

The Beleaguered Night

The latest scheme for calendar reform comes from the auspiciously aligned team of an economist and an astronomer. The Hanke-Henry Permanent Calendar proposes a year of 364 days: exactly fifty-two seven-day weeks, in which every date would always fall on the same day of the week every year. Even more radically, they propose abolishing time zones so that the entire world would operate—as all air traffic already does—on universal coordinated time (UTC),[65] which prevents confusion about variations in time zones and daylight saving time. (Pilots call it "Zulu" time.) Their proposal respects the seven-day week and the Sabbath, thus heading off two perennial sources of resistance to calendar reform. They claim that their calendar would yield a "harmonization dividend" for business and life in general. For instance, the quarters of the current year are not equal, with the first totaling ninety days (ninety-one in a leap year), the second ninety-one, the third ninety-two, and the fourth ninety-two. Such variability is a headache for accounting and messes up interest payments. A permanent calendar would prevent us from having to rejigger schedules annually—all automatic payments would happen the same day, course schedules would remain constant from year to year, and one out of seven birthdays would be stuck on Monday forever. (Easter would still bounce all over the place.) Hanke and Henry respect the Sabbath,

64. See Paddy Scannell and David Cardiff, *A Social History of British Broadcasting, 1922–1939* (Oxford: Blackwell, 1991), 157–73.

65. This abbreviation is itself an artifact of an infrastructural power struggle: English speakers wanted to call it CUT, for "Coordinated Universal Time," and French speakers proposed TUC, for "Temps Universel Coordonné." UTC, meaningful in neither language, was the compromise.

but not the sun, and suggest—it is not clear how seriously—that workers in a country like Russia could all be required to report at the same time. (Farmers and other sun-dependent workers would get an exemption.) Workers in Moscow would come to work in the predawn darkness, and those in Vladivostok would do so as the sun began to set.[66]

Perhaps the ultimate victim of their calendar would be the night. In revising the calendar for logistical smoothness, they forget about the ways in which our bodies and rhythms orient to the sun and the stars. Humans are sun-dependent, and our mental health and biorhythms are deeply sensitive to solar triggers. Hanke and Henry's suggestion to ignore natural zeitgebers is the latest step in the process of domestication. In contrast to wild animals, domesticates "distribute their activities more uniformly over the course of the day [and night]."[67] Sleep, another hybrid of nature and history, seems to have had a very different pattern among Europeans as recently as three centuries ago. In the early modern world, night was still radically different from the day: an ocean of darkness lit by rare pools of light and barely tamed by the reach of law, police, and church, and open for spiritual and carnal, laborious and ludic adventures of all sorts. It was common for people to sleep in two periods of about four hours each, separated by an hour or so of wakefulness. Such segmented sleep seems the natural pattern, so the question should be how "seamless" or "consolidated" sleep became the norm.[68] E. P. Thompson showed how modern humans came to be regular and clocklike in our work, but it is perhaps equally curious that our rest became so regular. Continuous sleep, though the norm, remains hard to achieve, and babies, the old, students, artists, and people on vacation all revert to a more segmented pattern of sleep. European integration puts the tradition of an afternoon nap in countries such as Spain and Greece under duress. The smoothing out of time is a sure sign of domestication.

Before the modern age, the night was a general condition for all humans that structured work, city life, mischief, courting, and rest. In the seventeenth century, optional darkness began to be an aristocratic privi-

66. Steve H. Hanke and Richard Conn Henry, "Changing Times," *Globe Asia* (January 2012), 18–20.

67. Helmut Hemmer, *Domestication: The Decline of Environmental Appreciation*, trans. Neil Beckhaus (Cambridge: Cambridge University Press, 1990), 91.

68. Ekirch, *At Day's Close*, 261–62, 300–303.

lege. Louis XIV lit up Versailles like a bonfire, and European elites colonized the night with their balls, theater, and masques. (Sleeping late was also an aristocratic privilege; Dracula was a count, after all.) The divide remains in lighting: one sociological measure for class standing in Mexico is the number of light bulbs in a dwelling. But much of the planet is now bathed with artificial light, each bulb a triumphant bit of European vestal fire. With his preference for the drastic, McLuhan missed a lot of history when he said, "The electric light ended the regime of night and day . . . ."[69] In Europe and North America, the assault on the night began well over a century and a half before Edison's bulb.

Whether we moderns have lost the stars, we have clearly entered into new relations with night. If more than half the earth's human population is urban, probably a majority of people now living have never seen the Milky Way with their naked eyes due to the urban light canopies that obscure the night, another effect of vestal fire. (The Milky Way is also harder to see in the Northern Hemisphere, where 90 percent of humans live.) There are campaigns for dark skies—in Britain for instance—that hope to set aside stargazing parks where the night sky won't disappear. These will be a boon not only for human observers, but for birds whose sleep cycles are disturbed by the artificial suns of streetlights.[70] The conquest of night by illumination has direct physiological effects, no less on us than on birds. Light is a key zeitgeber and many people—not only pilots—have ungeared their sleep from the day-night cycle. But the ancient cycle continues to tug at our habits, one of many deep neurophysiological structures in our plastic brains. Indeed, even pilots are tied to the day-night cycle: long westward flights generally leave in the morning to maximize daylight, and long eastward flights generally leave in the evening to minimize the night. We humans, like some plants, are heliotropes: we follow the sun.

Like many reforms, the Hanke-Henry Permanent Calendar is a mixture of sense and nonsense. In making the universal time and jet lag its norm, it is the latest version of human timekeeping enveloping natural cycles. The bond of body to earth is found in our sleep and waking. The Julian calendar ignored the moon; the Muslim calendar ignores the solar

69. McLuhan, *Understanding Media*, 60.
70. Miriam O'Reilly, "Let There Be Light," *Guardian* 14 April 2012, 18–19.

year; the Hanke-Henry calendar would ignore the night. We humans spend perhaps more time dreaming than anything else (since we can do it both when awake and asleep) but modern continuous sleep cuts off our access to the netherworlds.[71] ("Night is pleasing to us," wrote Borges, "because, like memory, it erases idle details.")[72] Whale oil played its part in burning away the dark by both lighting candles and lubricating the gears of clocks that measured it out. Unlike the sea, which can never be mastered, or the deep sky, which can never be touched, the night can be almost entirely subsumed by fire, candles, streetlights, laws, police, city walls, dogs, spells, and incantations. The uncaptured portion remains a breeding ground for dreams, crimes, and radio broadcasts.[73] In contrast to the early modern period, when nightfall meant a cessation of most institutions and utilities, including the rule of law, today services are expected to function 24/7—police, fire department, hospitals, electricity, radio, television, cable, Internet, and so on, smoothly spanning day and night. This is one small contribution to and sign of human domestication. The contrast of heaven and earth is not only spatial, up and down; it is also temporal, day and night.

The Sundial

This chapter closes with a swing medium between calendar and clock, the sundial, and a more general consideration of how the stars and sun especially create geographic orientation.

The sundial was the most important ancient timekeeper before the mechanical clock.[74] Both powered and directed by the sun, the sundial is a shadow projector, a kind of celestial cinema whose aim is not the trivial mimesis of earthly things, but the quadrivial indication of heavenly

71. Ekirch, *At Day's Close*, chs. 11–12.

72. Jorge Luis Borges, "A New Refutation of Time," *Selected Non-Fictions*, ed. Eliot Weinberger (New York: Penguin, 1999), 323.

73. See David Hendy, "Listening in the Dark: Night-Time Radio and a 'Deep History' of Media," *Media History* 16, no. 2 (2010): 215–32.

74. Herodotus, *History*, 2.109, says that the sundial, gnomon, and twelve-part division of the day came to Greece from Babylon. There are biblical sundials: a miraculous backwards movement of the shadow is reported in Isaiah 38:8 and 2 Kings 20:10–12; see also James 1:17.

changes.[75] A device of computation whose umbrageous plottings index the solar pathway across the sky, the sundial has taken a wide variety of shapes and emplacements. Key to the instrument are the gnomon or pointer (in ancient Greek, *gnōmōn* = judge or interpreter) and a surface on which its shadow is cast. It traces the entire day, as long as the clouds consent. Classical authors recognized the sundial's output as a kind of writing and drawing, *scriptio* by shadow.[76] Sundials are autographic instruments and thus harbingers of the graphic revolution of the nineteenth century: like seismographs and kymographs, cameras and phonographs, sundials "write" natural phenomena without human intention or translation into a symbolic language. The gnomon is early in a long line of nonhuman knowers and scientific instruments. "The black of the ink on the white page reflects the old shadow coming from the sun by the needle of the gnomon," notes Michel Serres.[77] (Ink is liquid shadow.) The sundial sits quite outside the grammatological strictures that Jacques Derrida thinks so dominated the European history of writing, as it has no language or syntax, and certainly no claim to "voice." It belongs to a fertile estuary of writing practices—graphing, charting, mapping, gridding, compiling, designing, composing, figuring, reckoning—that are just as essential as the writing of language (see chapter 6).

As a shadow writer or skiagrapher, the sundial projects the modes and moods of the sun. As Serres notes, it was first a scientific instrument for modeling the sky rather than a precision timekeeper, sooner an observatory than a clock. It could function as a calendar as well, as the length of the gnomon's shadow during the day varies with the time of the year, and of course with latitude. The point of the sun's "culmination"—its daily crossing of the meridian, the moment of the shortest shadow somewhere around the time we call "noon"—crawls north in winter and spring and south in summer and fall. North of the Tropic of Cancer the

75. See Jacques Aumont, "'Verklärte Nacht': Der Himmel, der Schatten und der Film," trans. Michael Cuntz, *Zeitschrift für Medien- und Kulturforschung* 1 (2010): 11–31.

76. See Vitruvius, book 9; Pliny, *Naturalis historia*, book 35, chapter 5, on the origins of drawing as "umbra hominis lineis circumducta"; and Steffen Bogen, "Schattenriss und Sonnenuhr: Überlegungen zu einer kunsthistorischen Diagrammatik," *Zeitschrift für Kunstgeschichte* 68, no. 2 (2005): 153–76.

77. Michel Serres, "Gnomon: Les débuts de la géométrie en Grèce," *Éléments d'histoire des sciences*, ed. Michel Serres (Paris: Bordas, 1989), 63–99, at 68–69.

noon shadow, which always points due north, will be the shortest on the summer solstice (around 21 June) and the longest on the winter solstice (around 21 December). Within the tropics, there will be times when the there is no noon shadow at all, since the sun is directly overhead; by definition, this never occurs north and south of the tropics. Sundials with carefully plotted projections on the receiving surface can show the time of year as well. Indeed, Al-Khwārizmī, the Persian mathematician whose name gives us the word *algorithm*, was a student of sundials. Algorithms at first were not just strings of code, but modelings of sky paths.

Old media carry old time. It is customary to adorn sundials, sky media par excellence, with lapidary mottos about the fleetingness of time, preferably in a dead language such as Latin: "Ultima multis" ([Today is] the last day for many); "Lente hora, celeriter anni" (Slowly the hour, quickly the years); "A lumine motus" (Moved by the light); and "Volat irreparabile tempus" (Time flies irretrievably). "Pereunt et imputantur" means "They perish and are called to account," the apparent subject being "horae" (the hours), but implying any being destined to a final judgment.[78] There are many good ones in English. I would offer: "It is the shadow that tells the time." J. V. Cunningham's lines are better:

> I who by day am a function of the light
> Am constant and invariant at night.

There is also Hilaire Belloc's more sour approach:

> I am a sundial and I make a botch
> Of what is done far better by a watch.

Sundials have also been mounted on graves, an ever ready emplacement for media devices. Indeed, all time-telling media rooted in the sky call us into the void.

78. For a vast multilingual compendium of mottos, see Mrs. Alfred (Margaret) Gatty, *The Book of Sun-Dials*, enlarged by H. K. F. Eden and Eleanor Lloyd (London: George Bell, 1900), 203–486.

Orientation

The face of the sundial is a small image of the sky. The daily rotation of its shadow tracks the sun's path across the sky, and its legacy is the hour hand of the clock. In the morning hours from dawn to noon, the sun is in the east; from noon to dusk, the sun is in the west. If the 6–12 axis on a sundial points due north (i.e., is aligned with the meridian), the morning hours, when the sun is in the east casting its shadow to the west, will be from six to twelve. When the sun crosses the meridian at noon (more or less), the shadow will point straight to 12 or north (in the Northern Hemisphere), and in the afternoon its shadow will be in the east, moving from 12 to 6. The hour hand makes one rotation in twelve hours, roughly as the sun sweeps the sky during the day or as the stars sweep the sky during the night; that the sun only shines for half the day is the reason why standard clock faces have twelve rather than twenty-four hours. In the Northern Hemisphere the sky spins counterclockwise (east to west) around the North Star, so the shadow mirrored on the sundial moves clockwise. If clocks had been developed in the Southern Hemisphere, "clockwise" would run counterclockwise, as joke clocks do in Australia.

The sky infests the built environment in terms of our cardinal directions. (*Cardinal* is from the Latin word for hinge or axis.) The infrastructure of right angles and perfect circles testifies to the fact that humans live between earth and sky. North-south and east-west lines meet at right angles; if the earth's spin were more wobbly, perhaps our geometry would not have been so rigorous. Right angles have been built into settled human environments. The room in which I write has hundreds or thousands of right angles in books, magazines, papers, walls, windows, a computer monitor, and boxes; and fewer but still dozens of circles in CDs, audio speakers, pens and pencils, coins, buttons, knobs, balls, a clock face, and a ceiling fan. Plato was right to think of geometrical shapes as earthly copies of heavenly forms, as were the Freemasons to treat the compass and the square as fundamental tools of orientation. As Kittler notes, "Ever since the Egyptian and the Babylonian ages, Eurasia has been in love with the right angle."[79]

79. Friedrich Kittler, "Perspective and the Book," trans. Sara Ogger, *Grey Room* no. 5 (fall 2001): 38–53, at 44.

Not all cultures have east, west, north, and south, which seem more important for large-scale societies that span diverse terrains, although pragmatic need is never the only motivation for celestial inquiry. (Here again perhaps it was the sea that taught the land to navigate.) A comparative study of 127 languages found four sources for naming cardinal directions: the sky; the winds; other directional terms such as *up*, *down*, *beside*, and *below*; and distinctive features of the local landscape. In the Seneca language "north" is expressed as "The sun isn't there," and in Navajo "it revolves . . . the Big Dipper." (In the Southern Hemisphere, "The sun isn't there" would designate south).[80] Note the asymmetry between east-west and north-south. North and south have absolute reference points, the two terrestrial poles. There is a fixed star in the north; and theoretically there could be one in the south, but there just doesn't happen to be one visible to the naked eye in the right place. East and west, however, are always relative to position ("deictic") and have no invariant indicators. Most languages develop terms for east and west before north and south, given the salience of the sun among environmental cues. It is relatively easy to determine latitude with a view of Polaris and the horizon, but specification of longitude eluded navigators until the eighteenth century, as we will see in the next chapter. Longitude is always a moving target. North-south is an axle; east-west is a wheel. As a geopolitical division, "East and West" is a lot more slippery than "North and South."

Orientation is an enormously rich celestial resource for meaning making. States have long laid out their architecture to match (and take legitimacy from) the heavens.[81] Many cities are cardinally oriented. Beijing's Forbidden City—the palace complex of the Ming and Qing dynasties—is perfectly aligned on a north-south axis. Sundials (*gui*, 晷) throughout the grounds point their gnomons at Polaris as if it were a geostationary satellite, dictating the north-south orientation of the grounds and also reflecting the latitude of Beijing in their tilt. The pyramids at Giza are laid out on a precise east-west, north-south grid (though their astral orientation is more complex). So are many cities and states. This

80. Cecil H. Brown, "Where Do Cardinal Direction Terms Come From?" *Linguistic Anthropology* 25, no. 2 (summer 1983): 121–61.

81. Hugh W. Nibley, "Tenting, Toll, and Taxing," *Western Political Quarterly* 19, no. 4 (1966): 599–630.

Figure 3. Sundial (*gui*, 晷) in the Forbidden City, Beijing, China. Author photo, November 2011.

is especially true in regions where lines were drawn in the age of imperialism, such as the United States, Canada, Australia, and to a lesser extent Africa. Each of the ninety-nine counties of the state of Iowa, all laid out in the nineteenth century, has its four sides defined by straight line cardinal directions unless a river intervenes. Most planned cities align with cardinal directions—a key exception being Brasilia, whose architect said he preferred curved space like that of Einstein and of women's bodies. The sky governs the directions of our streets and rooms, desks and closets. East, west, north, and south are both earthly orientations and celestial patterns; as resources for basic coordinates of organization, they belong among our key media.[82] From Confucius to Thoreau, moralists have praised the North Star as a model of constancy and virtue. Who says abstract points lack meaning?

Islam, for instance, a religion for which sky media are constitutive,

82. "Kirchen und Gräber zum Beispiel sind nach Aufgang und Niedergang der Sonne angelegt, die Gegenden von Leben und Tod . . . ." Heidegger, *Sein und Zeit*, 104.

has long-standing arts of global orientation. Muslims use the heavens to structure their everyday lives (1) in their lunar calendar; (2) in the five daily calls to prayer, timed by shadows and twilight phenomena shown by sundial or astrolabe; and (3) praying in the direction of Mecca (called the qibla), determined by historically varying methods (today, of course, including apps and websites). The calendar and public calls to prayer provide temporal orientation as the qibla provides spatial orientation. Muslims took the magnetic compass from China in the thirteenth century and used it first for seafaring, but it was soon adapted to finding the qibla, specifically the stone shrine, the Ka'aba, the axis mundi of Islam. Sacred things happen in alignment with Mecca (such as Qur'an recitation and the slaughter of animals) and profane things happen perpendicular to it (such as bodily necessities), though there has been great variability in reckoning the qibla. Islamic mosques, neighborhoods, cities, and even rooftop ventilators in Cairo were designed to point to Mecca. Here is a whole civilization whose architectures and daily practices share a single point of orientation and whose astronomical instruments reflect that religious mandate.[83] Here again, pointing is full of meaning.[84]

How natural and deeply rooted is orientation? As noted, protoplasm as we know it emerged on this planet and has a deep physical connection with the earth. "The geophysical characteristics of the planet Earth dictate the physiological traits of living organisms."[85] Many animals have the capacity to orient themselves by geomagnetic fields, especially insects and birds; and one explanation for cetacean strandings is magnetic disturbances. (Though the earth's magnetic field changes, it is much more stable than weather patterns or water currents.)[86] Cows and deer also orient themselves in this way; recent research has discovered that cattle align their bodies along a north-south axis while resting and grazing. So do red deer and roe deer. When magnetic north differs from true north

83. David A. King, "Astronomy and Islamic Society: Qibla, Gnomonics, and Timekeeping," *Encyclopedia of the History of Arab Science*, ed. Roshdi Rashed, 3 vols. (London: Routledge, 1996), 1:128–84.

84. See Peter Szendy, *À coup des points: La ponctuation comme expérience* (Paris: Minuit, 2013).

85. Shweiki, "Earth-Moon Evolution," 547.

86. See Helene M. Lampe and Sara Östlund-Nilsson, "Animal Navigation in Air and Water,"in *Kompassrosen: Orientering mot nord* (Oslo: Nasjonalbiblioteket, 2009), 28–39.

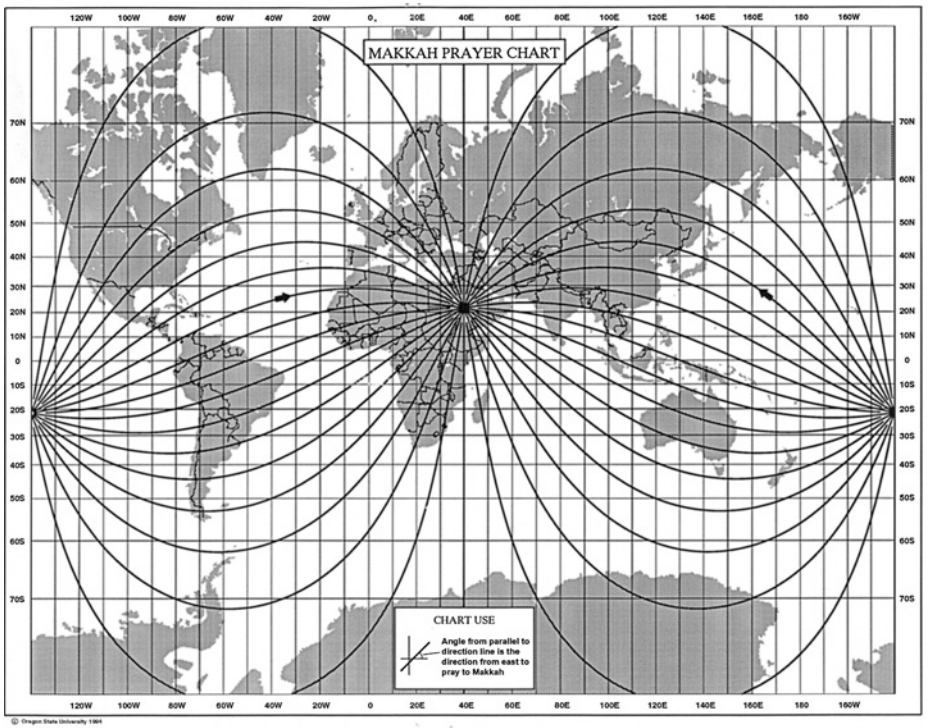

Figure 4. Mecca as axis mundi. Source: http://media.isnet.org/iptek/gapa/MakkahPrayerChart.html.

and wind and sun are not factors, they line up with magnetic north. The earth's magnetic field, though very subtle, provides an environmental cue, and how it is received and what advantage a north-south alignment provides remains a mystery.[87]

Magnetic fields may even affect humans. Experiments have shown statistically significant differences in cerebral electrical activity (EEGs) depending on cardinal orientation. One study showed that people sleeping in an east-west orientation entered the REM phase of sleep more quickly than did those who slept in a north-south orientation; the latter had higher alpha powers than the former, though I'd like to see replicated

87. Sabine Begall et al., "Magnetic Alignment in Grazing and Resting Cattle and Deer," *Publications of the National Academy of Science* 115, no. 36 (9 September 2008), 13451–55.

results.[88] Another study, following the discovery of biological magnetite crystals in the temporal regions of human brains and testing the possibility that humans, like worms, birds, and whales, could detect geomagnetic fields, found little evidence of such sensitivity but did note a puzzling set of EEG changes for research subjects located near the north pole; as the authors tantalizingly conclude, "The question of whether people in the Northern Hemisphere retain some form of compass or magnetic field transducer tuned to true north must remain an unlikely, but testable hypothesis."[89] The evidence for the human ability to sense cardinal points without external cues is obviously mixed, but the Wiltschkos, experts on magnetoreception in animals, speculate that there may be a vague inherent ability in humans that is muted under modern conditions.[90] Apart from brains, cardinal orientation is certainly built into many buildings and cultures. When Heidegger wrote of "the earth" informing human works, he perhaps didn't know how literally true that was.[91] Apps run deep.

Perhaps our bodies are themselves aligned along celestial lines. This was the proposal of Robert Hertz, a brilliant anthropologist of Durkheim's school who died in World War I. Hertz asked why so many cultures actively suppress the left hand and have elaborate systems of favoritism for the right that cannot be explained by the slight differential in strength and dexterity between the two. (Our closest evolutionary relatives, chimpanzees, show no systematic preference for the right hand.)[92] The Qur'an, for instance, has elaborate right-left protocols for everyday life, and it remains a profound faux pas to offer someone your left hand in the Middle East. The good are "righteous" and the evil are "sinister"—such examples could be multiplied.

88. Gerhard Ruhenstroth-Bauer et al., "Influence of the Earth's Magnetic Field on Resting and Activated EEG Mapping in Normal Subjects," *International Journal of Neuroscience* 73 (1993): 195–201.

89. Antonio Sastre et al., "Human EEG Responses to Controlled Alterations of the Earth's Magnetic Field," *Clinical Neurophysiology* 113 (2002): 1382–90.

90. Wiltschko and Wiltschko, *Magnetic Orientation in Animals*, 71–75.

91. *Der Ursprung des Kunstwerkes* (Stuttgart: Reclam, 1960), 45ff, 70, passim.

92. Stanley H. Ambrose, "Paleolithic Technology and Human Evolution," *Science* 291 (2 March 2001): 1748–53, at 1750.

Hertz speculated that the body had implicit cosmic coordinates: "The axis which divides the world into two halves, the one radiant and the other dark, also cuts through the human body and divides it between the empire of light and that of darkness. Right and Left extend beyond the limits of our body to embrace the universe."[93] Hertz thought we carried around the earth's relation to the sky in our bilaterally symmetrical bodies. The meridian not only divides the sky; it also splits us into two. Of course, the night sky is no more symmetrical—everything rises in the east, sets in the west, and rotates around the pole—than our bodies and nervous systems are. Indeed, there does not seem to exist in nature or culture any polarity that is perfectly symmetrical. Proteins, bacteria, winding plants, and snail shells all express themselves in non-mirrorable asymmetries.[94]

Hertz's theory is one hypothesis for the origins of handedness. No one really knows what kinds of evolutionary advantages it could have offered, or its possible relationship to the location of the language center in the left hemisphere of the brain. If we face east—literally, if we are *orient*ed—our left hand is to the north, the place where there is no sun; if we face north, our left hand is to the west, where the sun dies every day. In just this way, many languages use the same words for the sides of the body and the cardinal points, with right being east or south and left being north or west. Like the left hand, the north is dangerous in many cultures; Hebrew has a saying that evil comes from the north (cf. Isaiah 14:13), and in Genesis, a direction is given as "the left hand [north] of Damascus." Ursula K. Le Guin's novel *The Left Hand of Darkness* plays on such imagery. Millennia of astronomical mimicry enforced by cultural discipline might have reinforced a preference for the right among northern hemispheric humans as they stared at the sky, the spin of the stars, the rise and set of the sun, and the tides of the moon. Perhaps the lateralization of our central nervous system is some remote reflection of our bond to the sky and of the old mystical belief that the microcosm and macro-

93. Robert Hertz, "The Preeminence of the Right Hand" (1909), *Death and the Right Hand*, trans. Rodney and Claudia Needham (Aberdeen: University Press, 1960), 89–113, 155–60, at 102.

94. Roger A. Hegstrom and Dilip K. Kondepudi, "The Handedness of the Universe," *Scientific American* 262, no. 1 (15 January 1990): 108–15.

cosm, the body and the universe, are somehow aligned. Perhaps it is not. In either case, Hertz reinforces the conjecture that even the body is a sky medium, embodying purity and danger along the sagittal axis, like Queequeg in *Moby-Dick*, who "had written out on his body a complete theory of the heavens and the earth."[95]

95. Melville, *Moby-Dick*, 399.

Chapter 5

The Times and the Seasons: Sky Media II (*Kairos*)

> "But of the times and the seasons [*peri de tōn khronōn kai tōn kairōn*], brethren, ye have no need that I write unto you."—1 Thessalonians 5:1 (KJV)

Clocks and Calendars

Clocks, whose full media history is yet to be written despite rich scholarship and museum collections, are different from calendars in that they notate not the span of days but the now. Clocks raise the question "What is to be done?" in a more intense way than do calendars. To a large degree, they deal in time as *kairos* (opportunity) in contrast to *chronos* (duration). The ten-thousand year "Clock of the Long Now," under construction with funding from Amazon.com's Jeff Bezos, is a clock rather than a calendar precisely because of its message of urgency—urgency to think about deep time.

Though the year is astronomically more complicated than the day, the clock is harder to define than the calendar. A calendar is a grid, but a clock is a pointer. Calendars can suspend time—declare a holiday, a time out—but clocks never stop ticking. Calendars store and extrapolate past and future, but the intelligence of clocks is both used up and refreshed every moment. Curious automata, strange little personae with their "faces" and "hands," clocks say the same thing over and over, and yet the information they provide—where the "now" falls—is always current. (Hence Yogi Berra's supposed retort to someone who asked him the

time: "You mean right now?")[1] Their message is both always empty and evergreen. Baudelaire heard the whispered command of the second hand 3,600 times per hour—"Remember!" ("*Souviens-toi!*")—and we will soon see how charged clocks are with existential suggestion.[2] Clocks do for time what sextants, astrolabes, and GPS devices do for space: specify the "You are here" spot. As compass is to map, clock is to calendar. A clock is a compass whose second hand points to the now instead of the north, though the hour hand always has some relation, however attenuated, to solar position. The clock's *Umwelt* is the sky.[3]

We may think of the clock face as an arbitrary human construction, but nature speaks stubbornly in the direction of its spin and circular shape—as does history (Northern Hemispheric dominance). Clocks show an origin in the nonpolar regions of the planet—that is, nonextreme latitudes. At the poles, clocks do not work as we would expect. First, time zones lose their meaning at the poles, where all longitude lines converge. You have your pick of time zones: twenty-four possible frames of reference. Second, the zeitgebers that demarcate the bounds of the day and the usual indicators of cardinal direction—sunrise and sunset—are absent. At the poles the day, as a single cycle of light and darkness, coincides with the year. Daylight lasts six months and at the equinox suddenly gives way to a night of six months. Norwegian explorer Roald Amundsen claimed to have reached the South Pole at 11 a.m. on 17 December 1911, but how he decided the time in a spot without night or longitude is unclear.[4] Media bear traces of the real, and natural "secondness," as Peirce calls it, infests elemental media at every level.

The clock is thus also a compass: twelve is north, three is east, six is south, and nine is west. The clock indicates the north: point the hour hand at the sun and bisect the angle between the hour hand and the twelve,

1. See Erving Goffman's discussion of diverse answers to the question "Do you have the time?" in *Forms of Talk* (Philadelphia: University of Pennsylvania Press, 1981), 68–70.

2. Charles Baudelaire, "L'horloge."

3. Martin Heidegger, *Sein und Zeit* (1927; Tübingen: Niemeyer, 1993), 71: "In den Uhren ist je einer bestimmten Konstellation im Weltsystem Rechnung getragen." See also Joan González Guardiola, *Heidegger y los relojes: Fenomenología genética de la medición del tiempo* (Madrid: Encuentro, 2008).

4. Espen Ytreberg, "The 1911 South Pole Conquest as Historical Media Event and Media Ensemble," *Media History* 20, no. 2 (2014): 167–81.

and the north-south axis will fall more or less on that line (again in the Northern Hemisphere). The affinity of clocks and compasses is found in the practice of using the clock face to indicate direction, a usage apparently originating with pilots. A target ninety degrees left from the direction of motion is at nine o'clock, and so on. In the other direction, the medieval compass rose was used by sailors as both a wind-reading guide and as a clock.[5] The noon hour, we should note, also splits the heavens into two halves, east and west on the meridian.[6] The abbreviation *a.m.* stands for "ante meridiem," and *p.m.* means "post meridiem"; our division of the day corresponds to east and west. The term *dial* preserves a link to the daily round of the sun, and seems to enter English from the medieval Latin phrase "*rota dialis*," the wheel of the day. Jean Froissart, the fourteenth-century chronicler, observed that a clockwork's dial is "the daily wheel [*roe journal*] which makes a revolution once in a day, even as the sun makes a single turn round the earth in a natural day."[7] The root of all dials is the twelve-hour day; industrialism brought a plethora of dials and gauges, including the telephone "dial," whose digital twelve-button format restores the duodecimal status quo after the lapse into the decimal rotary dial. (That new media revive old ones was one of McLuhan's "laws of media.")

So clocks iconically mimic the sky, while calendars use symbolic means. A simpler contrast between calendars and clocks is that of magnitude and direction: a calendar deals with temporal units from the day on up; a clock deals with units smaller than the day, most fundamentally the hour. (In several languages the word for clock derives from the word for hour, as in the German *Uhr* or the French *horloge*.) Calendar systems model time on an expanding scale, aggregating days upward to weeks, months, seasons, years, decades, centuries, and indefinitely larger units; the Hindu and Buddhist "kalpa," perhaps the largest cycle in human calendars, takes 4,320,000,000 years. The vector of clocks, in contrast, contracts from hours, minutes, and seconds and then switches from sexagesimal to decimal notation for tenths, hundredths, and milliseconds on

5. Charles O. Frake, "Cognitive Maps of Time and Tide among Medieval Seafarers," *Man* 20, no. 2 (1985): 254–70, at 262–66. See also Bernhard Siegert, *Passagiere und Papiere* (Munich: Fink, 2006), 11.

6. The French word for noon, *midi*, is related to *medium*—the middle of the day.

7. *Oxford English Dictionary*, "dial," etymology.

down to increasingly smaller units (a "yoctosecond," for instance, is one septillionth of a second, or 10^{-24} s). Most computer processes operate between millisecond (10^{-3} s) and nanosecond (10^{-9} s) speeds, and laser research is exploring the realm of the attosecond (10^{-18} s), a time span during which light travels a bit farther than the width of a water molecule.[8] There is lots of room at the bottom, as George Dyson quips, and time's real estate is being increasingly subdivided by insatiable scientific appetites.[9] Cosmologists are fascinated by minute temporal slices of the Big Bang, especially the first 10^{-36} to 10^{-32} second "epoch" when "inflation" is hypothesized to have taken place. (Clocks can span ten thousand years, and epochs can be minute.)

Eventually our subdivisions will run into Planck's constant, beyond which the fineness of units of time and matter cannot go. There does not seem to be any such limit on the upper end, though the finite age and size of the universe imply physical (not theoretical) limits. Why do resources run out in the microscopy of time and not its macroscopy? Why do we hit rock bottom at the small and not the large end of things? Inversely, why do maps within maps retain isomorphic identity at every level while expanding maps quickly turn into white noise? The universe is not equally scalable in both directions, and nothing in heaven or earth, as we have seen, is purely symmetrical.[10]

Unlike calendars, clocks are run by continuous processes such as the slow motion of the heavenly bodies or the pressure of a spring, but some clocks take advantage of timing processes that have nothing to do with the sky. Water clocks are very old and diverse—used in Egypt and Babylon as early as 1600 BCE, in ancient Greece and Rome, and in ancient and medieval China. The law courts of classical antiquity were outfitted with ceramic containers that, when filled with water, would drain for a known period; in court, a lawyer would be assigned so many "pots" or "waters" to make his case. They were called *clepsydrae*, from the Greek

8. Hartmut Winkler, "Was tut ein Prozessor? Raum und Zeit auf der Mikroebene der Chips," paper in progress, Universität Paderborn.

9. George Dyson, *Darwin among the Machines* (Reading, MA: Addison-Wesley, 1997), chapter 10.

10. Please see my "'Resemblance Made Absolutely Exact': Borges and Royce on Maps and Media," *Variaciones Borges* 25 (2008): 1–23. Available at www.borges.pitt.edu/documents/2501.pdf.

for water-stealer. Chinese water clocks operated sometimes like the drip clepsydrae of the Greeks and Romans, but more mechanically complex astronomical clocks used water not as the indicator of the lapse of time but rather as a source of motive power. They had a distinct disadvantage in wintertime—they froze—so sometimes sand was used instead.[11]

We owe one paragraph to noncelestial timekeepers. In Europe, sand was used in hourglasses, or more accurately sandglasses, which have had diverse uses since the fourteenth century.[12] They came in multiple intervals: one hour (for sermons), two and a half minutes (for cooking eggs), and fourteen seconds (for measuring a ship's speed: the glass was turned over as a knotted rope was thrown overboard, and a sailor counted the number of knots that passed through his hands until the sand ran out—which is why ship speed is still given in "knots"). Today the sandglass is mostly used in board games (it is a nice model of a filter, with its single pinch-point) and as a symbol of time's passage: "Like sands through the hourglass, so are the days of our lives." The other key terrestrial timer is fire. King Alfred used candles of equal length as timekeepers, a lavish royal expenditure. ("The candle's flame is an hourglass that flows upwards," said Bachelard.[13]) We saw in chapter 3 that a candle was used forensically to estimate the time of Romeo's death. In China and Japan incense was used for time measurement, a fact that greatly interested McLuhan, who contrasted olfactory time with modern mechanical time.[14] Fuses are fire timers: anyone who lights a firecracker needs to know how long till it explodes, and a cigarette is said to make a decent seven-minute fuse. Mechanical clocks, of course, later did service as fuses for bombs, to be supplanted by mobile phones. These timers are necessarily full of kairos.

The latest shift away from celestial observables toward earthly flows is the atomic clock. For thousands of years, astronomers set the time (often

11. Joseph Needham, Wang Ling, and Derek J. de Solla Price, *Heavenly Clockwork: The Great Astronomical Clocks of Medieval China* (Cambridge: Cambridge University Press, 1960), 85–94, 154–61, passim.

12. Arthur F. Finney, *Shakespeare's Webs: Networks of Meaning in Renaissance Drama* (New York: Routledge, 2004), 80–81, discusses hourglass imagery in the Bard.

13. Gaston Bachelard, *La flamme d'une chandelle* (Paris: Presses universitaires de France, 1962), 24: "La flamme est un sablier qui coule vers le haut."

14. Silvio A. Bedini, "The Scent of Time: A Study of the Use of Fire and Incense for Time Measurement in Oriental Countries," *Transactions of the American Philosophical Society* 53, no. 5 (1963): 1–51; *Understanding Media*, 136.

in collaboration with astrologers and priests). In the mid-twentieth century, timekeeping duties shifted to physicists. The creation of absolute standards for weights and measures began in the French Revolution, but history had to wait more than a century and a half for absolute standards in units of time: in 1967, the second was defined as 9,192,631,770 oscillations of the cesium atom.[15] This was no zeitgeber accessible to the naked human senses. Seneca the Younger complained that you could expect more agreement among philosophers in Rome than among clocks.[16] Our world, in contrast, takes for granted agreement in clocks, but thankfully not among philosophers.

The Mechanical Clock

The modern European clock has traveled a long journey from the turrets of cathedrals, moving inside to walls and tables, then shrinking to personal accessories worn around the neck, in the pocket, or on the wrist, and finally spreading into the guts of machines. Clocks moved from towers and ships into radios, ovens, televisions, cars, computers, and every kind of digital device. Portability and miniaturization in both the size of clocks and the units of time they measure are hallmarks of the story, as is the relaxation of the tie between the sun and the clock. But clocks have always been tied to the variables of the sky and to the need to take action.

The clock's origins in Europe were largely religious: the need of monks to observe the canonical hours of prayer.[17] In eleventh-century China, in contrast, where horology was much more advanced than in Europe and the first mechanical (water-powered) clocks were developed, the main motive for timekeeping was political, as the emperor was to regu-

15. Tony Jones, *Splitting the Second: The Story of Atomic Time* (Bristol: Institute of Physics, 2000).

16. Seneca, *Apocolocyntosis divi Claudii*, 1.2: "Facilius inter philosophos quam inter horologia conveniet." The term "horologia" does not specify the kind of clock, whether sundial, clepsydra, or other type.

17. Wolfgang Ernst, "Ticking Clock, Vibrating String: How Time Sense Oscillates between Religion and Machine," *Deus in Machina*, ed. Jeremy Stolow (New York: Fordham University Press, 2012), 43–60.

late times according to the "mandate of heaven." The first clock drive, as developed by the engineer Su Song (苏颂) in the late eleventh century, moved an armillary sphere to match the slow movement of the heavens, and was thus at once an observatory and a clock.[18] For debated historical reasons, advancements in Chinese clock technology stagnated, and Europe became the world leader in clock technology from the late thirteenth century onward.[19]

The earliest mechanical clocks in Europe were mechanized astrolabes. The astrolabe was "the prototype clock face," and the earliest mechanical clocks in thirteenth-century Europe seem to have been motivated by the "desire to represent the moving heavens in material form."[20] The astrolabe was a sky medium par excellence. Its name means "star-taker" in Greek, and in both appearance and function it was a kind of cosmographic mirror. An astrolabe could correlate the position of the stars with the time, figure horoscopes, survey the heights of towers and depth of wells, calculate latitude, and declare the Muslim times of prayer; it was the most important astronomical instrument of the Middle Ages and it found wide use in Islamic science and technics, which, as we've seen, invested strongly in astronomical knowledge, following statements in the Qur'an that Allah gave the stars as signs for human guidance.[21]

Early clocks were directly tied to the heavens. "Most of the first clocks [in fourteenth-century Europe] were less chronometers than exhibitions of the pattern of the cosmos."[22] The clock, in the memorable phrase of Derek de Solla Price, is "a fallen angel" from the world of astronomical measurement.[23] The thirteenth and fourteenth centuries were crazy for wheels in millworks, gears, and the multiplying spheres of Ptolemaic astronomy. Fantastic designs for perpetual motion machines helped lay the ground for the fine gearwork of clocks. (Dante's *Inferno* speaks to an

18. Needham et al, *Heavenly Clockwork*, 53, passim.
19. David Landes, *Revolution in Time: Clocks and the Making of the Modern World* (Cambridge, MA: Harvard University Press, 1983, 2000).
20. John North, *Cosmos: An Illustrated History of Astronomy and Cosmology* (Chicago: University of Chicago Press, 2008), 133, 262–64.
21. Qur'an 6:97, 16:16.
22. Lynn T. White, Jr., *Medieval Technology and Social Change* (Oxford, UK: Oxford University Press, 1962), 122.
23. Derek J. de Solla Price, "On the Origin of Clockwork, Perpetual Motion Machines, and the Compass" (1959), https://archive.org/stream/ontheoriginofclo30001gut/30001.txt.

age obsessed with wheels within wheels.) Some early clocks provided calendar indications as well. Clock-driven celestial globes were made in Europe and China in the sixteenth century and some clocks of the same era were calendars in their indication of the position of sun, moon, and zodiac, and even of ecclesiastical holidays, eclipses, tides, and the varying duration of night and day throughout the year. Henry VIII had a huge astronomical clock at Hampton Court, showing the hours, minutes (grouped into intervals of five), phases of the moon, months, and zodiac. One beautiful Geneva-made silver watch from about 1650 in the British Museum tells the months, days, seasons, signs of the zodiac, and phases of the moon in addition to hours and minutes.[24] Some clocks featured little angels that proclaimed the time, presenting the device as an agent of annunciation.

The close tie of the mechanical clock to the sun did not last. With a sundial, noon was by definition the point of the shortest shadow. But cloudy weather makes sundials erratic suppliers of heavenly news, and in the high Middle Ages, court time slowly started to be set to the clock and not to the sun. King Charles V of France ordered all the clocks of Paris in 1370 to follow the palace time "whether the sun shines or not" (luise le soleil ou non). The medieval chronicler Jean Froissart similarly praised mechanical clocks for telling time "even in the absence of the sun."[25] This is the origin of our term *o'clock*, which means that the relevant time is the artificial standard. The sundial directly models natural facts, yielding stretchy days and hours that expand and contract as the earth makes its elliptical way around the sun, but the clock is a solar mood stabilizer, soothing the sun's annual swings into twenty-four-hour average units and ticking away regardless of sun or cloud. The disconnection of timing systems from natural cycles is thus not uniquely modern; even in ancient Greece and Rome, comic authors mocked those who waited to eat until the sundial's shadow had reached a certain length.[26] Nature and artifice have been conspiring together for a long time.

24. British Museum, P&E 1888,1201.229.

25. Carlo Cipolla, *Clocks and Culture: 1300–1700* (London: Collins, 1967), 41–42.

26. Gerhard Dohrn-van Rossum, *Die Geschichte der Stunde* (1992; Cologne: Anaconda, 2007), 28, 32.

Time Coordination

As we have seen, part of the drama of modern timekeeping lies in fitting bodies to artificial time grids. E. P. Thompson made famous the idea that the industrial era marked a sea change in people's work habits. Before the clock, timekeeping was loosely integrated with tasks to be done, as already noted in the case of the Nuer. Thompson noted ways in which short intervals have been defined in diverse cultures in terms of "task orientation": the time it takes to cook rice (half an hour), maize (fifteen minutes), or a locust (an instant), or to recite an "Ave Maria" or "Pater Noster." The medieval English span "a pissing while" was, he observed, "a somewhat arbitrary measurement." (Thompson was well into middle age when he wrote this essay.) All of these concrete measures, taking advantage of natural time spans like drip clepsydras, showed early timekeeping's embedment in a work to be done—a stark contrast to the emerging world of industrial production in which people had to learn to work to a clock that was only formally linked to natural cycles. Thompson shows that churches collaborated with capitalist interests by making punctuality a Christian virtue; thus his preindustrial workers had to synch their biorhythms to a device with celestial origins in order to become fully secular.[27] In a similar way, Lewis Mumford, playing Weber to Thompson's Marx, saw the clock as the key technological invention of industrial society—even more than the steam engine. He saw the clock as a power machine that coordinated the collective actions of people, creating the public grid for their common world.[28] Both calendar and clock imply discipline, but the discipline of the clock is much more pointed.

Social impact depended partly on technical innovation: if clocks weren't small, cheap, and accurate enough, they would not have proliferated. Well before our attoseconds and yoctoseconds, mechanical clocks had to learn to track minutes and seconds. The minute hand, which appeared in the sixteenth century, only became practical after Huygens perfected the pendulum around 1656, and the second hand followed hard

27. Edward Palmer Thompson, "Time, Work-Discipline, and Industrial Capitalism," *Past and Present*, No. 38 (1967): 56–97, at 58.

28. Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace, Jovanovich, 1934), 12–18. In *Being and Time*, 411, 416, Heidegger makes much of the clock's *Öffentlichkeit* or publicness.

upon. The pendulum enabled a huge step forward in accuracy; as late as the late seventeenth century, most were happy with a clock that lost less than one hour per day.[29] In 1870s Paris, slop of fifteen seconds was considered tolerable, as it took that long for a signal from the centralized master clock over a network of pneumatic tubes to reach the slave clocks. But within a decade it was seen as far too loose.[30] The gap continues to close. It is difficult for most moderns to imagine a world without minute or second hands, except on vacation. In Olympic swimming and track events, hundredths of seconds routinely separate gold and silver medalists, and our science and technique, as noted, depends on ever finer slicings of time.

The modern clock's chief motive has been neither religious nor political, but economic: in Ben Franklin's words, "time is money." Time was also power, especially sea power. By the mid-eighteenth century, the best clocks were chronometers used at sea and were accurate up to a second or less per day, though such precision was not the societal norm. British and French sea power helped create the integrated grid for global transportation and communication. Especially important was the problem of calculating longitude at sea: British clockmaker John Harrison, by creating a chronometer so accurate that one could know the precise time in Greenwich even in the middle of the Atlantic, made it possible to reckon one's precise location on an east-west axis.[31] The modern clock is the highest engineering achievement of the era of global sea trade and it carries a debt to navigation and astronomy; as Norbert Wiener put it, "The clock is nothing but a pocket orrery."[32] ("Minutes" and "seconds," of course, are not only intervals of time, but angular measurements.) The need for a standard time shared between distant places first emerged at sea, well before the telegraph made it possible and the railroad made it necessary.

Prior to the railroad and telegraph, every town (away from the court) set its noon hour by the shortest shadow. The sundial set the time: nature still ruled. It once did not matter if, for instance, Dover, Brighton, Ports-

29. Cipolla, *Clocks and Culture*, 58–59, 138–39n2.
30. Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: Norton, 2003), 93.
31. Dava Sobel, *Longitude* (New York: Walker, 1995).
32. Wiener, *Cybernetics*, 38.

mouth, Plymouth, and Penzance, stretching from east to west along the southern coast of England, each had a successively later noon. But by the mid-nineteenth century, the crazy quilt of local times in industrializing countries such as England and the United States was causing serious, sometimes catastrophic problems in railroad traffic.[33] At the Greenwich Observatory in 1833, a leather ball dropped down a pole at 1:00 p.m. served as a visual signal to ships on the River Thames to set their watches to Greenwich Mean Time (GMT). GMT was first distributed by telegraph within the nation in 1852, and by the late 1850s England was covered with a network of time balls, cannons, bells, and needles to spread the news of when exactly 1:00 p.m. was (GMT did not become the official national time until 1880).[34] One of the key motives for coordinated time via telegraph was weather reporting.[35] By 1848 Charles Dickens observed a drift away from natural zeitgebers: "There was even railway time observed in clocks, as if the sun itself had given in." He could have said something similar about clock time in the courts of the High Middle Ages.

The international grid of time zones centered on Greenwich, established in 1884, divides the globe into twenty-four time zones of more or less fifteen degrees each, though the precise boundaries are always political first and longitudinal second. Time zones, as rough averages, extend the trend loosening sky and time. Depending on your location in a time zone, the point of the shortest shadow can be more than an hour off from the official noon, and daylight saving time can widen the gap even more.

Centering the world time-zone system on Greenwich was certainly an index of empire, but more telling is the International Date Line in the Pacific—located as far away from Europe as possible. Establishing a world clock was easier than establishing a world calendar—which still does not exist de jure, though world business operates on Gregorian time—but there are still small pockets of resistance. The Ayatollah Khomeini complained about being captive to a European time standard. China, a country with a huge east-west spread, has a single time zone;

33. See James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, MA: Harvard University Press, 1986); Galison, *Einstein's Clocks*, chapter 3; Carey, "Ideology and Technology," 213, 223ff, passim.
34. Derek Howse, *Greenwich Time* (London: Oxford, 1980).
35. Paul N. Edwards, *A Vast Machine* (Cambridge, MA: MIT Press, 2010), chapter 2.

today Newfoundland, Iran, Afghanistan, India, and Burma start on the half hour and Nepal on the three-quarter hour. In 2007 President Hugo Chávez of Venezuela shifted his country's time zone by thirty minutes, treating sunlight as yet one more commodity subject to socialist redistribution. Standard time is a sine qua non for international capitalism—perhaps one reason why Chávez opted out. For decades since the late nineteenth century, the Netherlands operated on a national time grid based in Amsterdam, with the clock set nineteen minutes and thirty-two seconds ahead of Greenwich, an interval eventually rounded to twenty minutes for ease in international reckoning. Only in 1940, when the Germans invaded the Netherlands, did the last European exception fall into conformity with the rest.[36] All of the United States now observes daylight saving time except for Arizona, but even there we see resistance: Navajo Nation territories in Arizona do observe daylight saving time so as to stay in sync with other Navajo lands in New Mexico and Utah. Timekeeping is always a question of identity and affiliation.

There's still lots of shaking going on. Time zones are subject to conflict as much as anything else to do with timekeeping. In the United States, daylight saving time was tweaked in 2005, pushing the change earlier into spring and later in fall, supposedly with the aim of saving energy. (Catholic bishops and conservative Jews predictably opposed the legislation.)[37] In 2010, Russian president Dmitri Medvedev shrank Russia's time zones from eleven to nine in an attempt to make communication across Russia's gigantic share of the Eurasian landmass more manageable. Another recent case of calendrical tinkering for the sake of identity is found in Samoa. In the early days of the International Date Line, the American authorities persuaded the Samoan king to shift the line to the west of the island group, so as to be on the same day as California. This was achieved by celebrating two Fourths of July in 1892. In the years after that, Samoa's trade and migration shifted westward to New Zealand and Australia. Wanting to share the day with them and its immediate neighbors, in 2011 Samoa went straight from Thursday the twenty-ninth to Saturday the

36. Goudsblom, *Het regime van de tijd*, 33–34.

37. On daylight saving time, see Siamak Movahedi, "Cultural Preconceptions of Time: Can We Use Operational Time to Meddle in God's Time?" *Comparative Studies in Society and History* 27, no. 3 (1985): 385–400.

thirty-first of December; Friday 30 December 2011 never existed (though workers still got paid for it). Samoa was thus the first rather than the last nation to welcome the new year in 2012.[38] Time zones, like holidays, signal belonging.

Like the calendar and the time-zone grid, the clock has gotten lots of resistance, though of a more diffuse and morose kind. Critics of industrial capitalism from Karl Marx to Charlie Chaplin have seen the clock's strict time discipline as a cruel distortion of human existence. There is probably not a clock puncher in the history of labor that has not lollygagged or otherwise defied the clock. Deists in the eighteenth century found in the clock's indifferent but constant mechanism a model for the universe: God had wound it up in the beginning and now was letting it run down without further supervision—an image played for comfort and desolation. The watch is a prime symbol of modernity, a time bomb marking our Faustian mortgage of ourselves to things we did not actively choose but will not give up.[39] "The clock tintinnabulum" (Cowper) contrasts with the behavioral arrhythmias of modern time discipline.[40] The clock is the paradigm case of a medium which we embraced at great advantage and great cost but without ever signing consent.

Poets, like psychiatrists and their patients, often get the existential vibe of media best. Robert Frost found something melancholy in a clock tower:

> And further still at an unearthly height
> One luminary clock against the sky
> Proclaimed the time was neither wrong nor right.
> I have been one acquainted with the night.

The watch has also been a particular target for existential inquiries and complaints. (Even its name suggests the vigils of the night.) Frances Cornford, Darwin's granddaughter, woke one night to hear her watch ticking under her pillow (read it aloud):

38. Keni Lesa, "Samoa Skips Friday in Leap across International Dateline," *Christian Science Monitor*, 30 December 2011.

39. Peter L. Berger, Brigitte Berger, and Hansfried Kellner, *The Homeless Mind: Modernization and Consciousness* (New York: Vintage, 1974), 145.

40. Josetxo Beriain, *Aceleración y tiranía del presente* (Barcelona: Anthropos, 2008).

I thought it said in every tick:
I am so sick, so sick, so sick.
O death, come quick, come quick, come quick,
Come quick, come quick, come quick, come quick![41]

The British Museum has a small German-made silver watch in the shape of a skull from the 1660s bearing the Latin motto "Incertita hora"—the hour (of death) is uncertain (perhaps also a comment on the timepiece's accuracy).[42] The time of death or birth or labor is always nigh: this is the message watches have been sending for centuries. (*Une montre est un monstre*.)

A watch is a counter, a pointer, a stargazer, a body technique, and a pet. Julio Cortázar brilliantly caught its mixed status. When they give you a watch, he wrote, they give you a fragile and precarious piece of yourself, something that is you but is not your body, but is attached to your wrist like a desperate small additional limb. A host of duties and anxieties come with the watch, such as constantly being on the lookout for the correct time, worrying about losing or dropping it, comparing it with your peers' watches, and winding it so that it "continues to be a watch." In the end, it is not the watch that is given to you; you are given to the watch for its birthday.[43] A clock, like the Internet, is boosted by network effects: the more people have one, the more people need one. As we did with e-mail, our ancestors assented to the clock in a fit of absentmindedness. Fire's lesson again: New media make us freer—and more dependent.

Bells

The word *clock* derives from the Latin *cloca* (source of the French *cloche* and the German *Glocke*), all of which mean *bell*. Bells were once the main means of telling and tolling the time in medieval and early mod-

41. "The Watch," lines 7–10.
42. Item P&E 1874,0718.41.
43. "Preámbulo a las instrucciones para dar cuerda al reloj." Thanks to Pablo Rodriguez Balbontín.

ern Europe. Johan Huizinga dramatically begins his classic study of the Late Middle Ages with the sound of the bells, calming and alarming, calling and dispersing, benign spirits hovering over the sonic tumult of the time.[44] The time sounded from European clock towers, starting in the very late twelfth century but taking firm hold throughout the fourteenth, founding a long acoustic line of time-tellers that includes cuckoo clocks, chimes, music boxes, organs, and alarms. Bells show the primal unity of sound and time. Bells were not mere timekeepers; they were among the central media of religious and civic life.[45]

The point that declaring the time is an act of power is certainly echoed in the history of custody battles between church, state, and market over bells in France, as told by Jacques Le Goff, who shows the contrast between the sacred time of the church, which marked festivals, and the quotidian time of the market that enframed urban life in fourteenth-century France. Humanists and merchants in cities started to wrest timekeeping functions from the monasteries and instituted a day regularly subdivided into twenty-four hours delivered by mechanical clocks, unreliable and fussy though they were, culminating in the aforementioned power grab by Charles V in 1370 setting all the clocks of Paris to palace time.[46] In European history from that point forth, bells were under the joint custody of church and town, with much friction. Early mechanical bell clocks often required full-time tech support and were very expensive to build, but cost was also a kind of conspicuous consumption: clocks were matters of fierce municipal pride. Rather like the water towers that dot the great plains of the United States today, clock towers were focal points of local urban identity in Europe: every town of note had to have one. The aim was less chronometric accuracy than bling, a motive that continues to inspire the building of clocks and other urban landmarks up to the gigantic Mecca Royal Hotel Clock Tower today.[47]

Bells were key proclaimers of the Christian calendar of Easter, Christ-

44. Johan Huizinga, *Herfsttij der Middeleeuwen* (1919; Haarlem: Tjeenk Willink, 1957), 6.
45. Jacques Le Goff, *The Birth of Purgatory*, trans. Arthur Goldhammer (Chicago: University of Chicago Press, 1984). 290–95, passim.
46. Jacques Le Goff, "Le temps du travail dans la 'crise' du XIVe siècle: Du temps médiéval au temps moderne," *Pour un autre moyen age* (Paris: Gallimard, 1977), 66–79.
47. White, *Medieval Technology*, 124.

mas, and other holidays. In nineteenth-century rural France, as Alain Corbin explains, bells shaped the day by summoning people to mass, weddings, funerals, emergencies, assembly, or battle, and often rang with a dialect distinctive to each village, and similar practices took place throughout Europe.[48] One function of bells is to mobilize bodies into assembly—Christian soldiers to battle or to church. Indeed, bells in Europe are a specifically Christian institution, and Longfellow's phrase about "the belfries of all Christendom" has sound comparative religious footing. In the Philippines and Mexico, the Spanish conquistadores ceremonially placed native peoples "bajo las campanas"—under the bells. Once people could hear the church bells, they were Spanish subjects. Sound defined the space of the crown's and church's dominions. To hear the bells was to acknowledge Spanish sovereignty. Audition was assent—or at least conscription. (Here is the ancient link of hearing and hearkening, listening and obedience.) As ordering devices, bells stand out when off: Hamlet compares Ophelia in her madness to "sweet bells jangled, out of time and harsh" (III.i.158).

Buddhists and Chinese rituals since the Shang have used bells, but they were largely absent in Judaism and Islam. Judaism has no tradition of bell ringing for religious or chronometric purposes: Amos Oz reports that his Aunt Sonia, growing up in Poland in the early twentieth century, found the sound of church bells scary, the signal of a pogrom.[49] Jews, instead, use the *shofar* or ram's horn, which Menahem Blondheim calls "God's veteran woodwind instrument," as a ceremonial marker of time-outs. The shofar announces the new year and is often sounded from atop a mount or tower, sometimes with mythically devastating military results (the so-called trumpets that brought down the walls of Jericho in the sixth chapter of Joshua were *shofarot*). The shofar was traditionally used as a summons or alarm, for marking states of emergency. It was sounded at Spinoza's excommunication, and one of its main purposes is to incite terror: as Amos 3:6 asks rhetorically, shall a shofar be blown in the city and the people not be afraid? An instrument that asks both the people

48. Alain Corbin, *Village Bells*, trans. Martin Thom (New York: Columbia University Press, 1998).

49. Amos Oz, *A Tale of Love and Darkness*, trans. Nicholas de Lange (New York: Harcourt, 2004), 191.

and God to remember, the shofar is another logistical medium with resonant overtones.[50]

Muslims, too, had alternatives to bells. The Ottomans, for instance, prohibited the ringing of church bells in Greece, properly recognizing the great communicative and mobilizing force these media can hold for Christians. In Islam the analogous role is played by *muezzin* (criers) who sing the call to prayer five times per day. Their tenor voices, broadcast from the thin minaret towers attached to mosques, summon the populace to pray (with limited success, in my experience of cosmopolitan cities such as Cairo, Istanbul, and Jerusalem), and lack of strict clock coordination means that one can hear contrapuntal calls ricocheting over the city like a Muslim beehive. It is hard to know which voice to obey, but there is no question about which religion saturates the air at that moment. The word *minaret* comes from an Arabic term meaning light tower and, according to early Islamic traditions, it was inspired by the *shofar*; it may hearken back to the ziggurat, the template for the Tower of Babel story, and could even have inspired Christian bell towers.[51]

Sound marks space. US troops in Afghanistan working with troops from other parts of the country faced a problem: the locals thought the Afghan troops were not even Muslims. Lieutenant Commander Nathan Solomon (whose name honors two biblical figures known for wisdom) proposed that loudspeakers be installed at the bases to broadcast the daily five calls to prayer. One local reported: "We didn't know they pray like we do. It makes us trust them more, knowing we all share the same faith."[52] Soundmarks establish solidarity and identity, and bells are key media for demarcating local identity, allegiance, and belonging. To be a true Cockney, as the old saying goes, one must be born within the sound of the bells in St. Mary-le-Bow church in London's East End. In Italian,

50. Aschoff, *Geschichte der Nachrichtentechnik*, vol. 1, chapter 12; Theodor Reik, "The Shofar," *Ritual: Psycho-Analytic Studies*, trans. Douglas Bryan (1919; New York: Farrar, Straus and Company, 1946), 221–361; Jacques Lacan, "La voix de Jahvé," *L'angoisse* (1963; Paris: Seuil, 2004), 281–95.

51. R. J. H. Gottheil, "The Origin and History of the Minaret," *Journal of the American Oriental Society* 30:2 (March 1910): 132–54.

52. Brian Mockenhaupt, "Enlisting Allah: To Thwart the Taliban, Marines in Helmand Province are Teaching the Locals to Read the Koran," *Atlantic*, September 2011, 28, 30—a fine example of how multiculturalism and imperial reach can go hand in hand.

campanilismo (literally, "bell-tower-ism") means parochialism, as does the French term *de clocher*. Bells signify rootedness to place. The BBC's signature sound for decades was the chimes of Big Ben—one sign that radio, as a general timekeeping medium, was the twentieth-century successor to bells. Lord Reith wanted "the clock which beats the time over the houses of Parliament, in the centre of the empire, [to be] heard echoing in the loneliest cottage in the land." Parliament-cottage, center-periphery, empire-village, urban-rural—the sound of Big Ben was to the British Empire what the local clock tower was to a village, its pulse of common life. Bells, like fireworks, are public displays that collectively mark local space and time as festivals and holidays. They hail us as political or religious subjects.

Bells, since they operated also at night, were once held to play a magical role in controlling the weather, fighting fires, and banishing evil spirits. Sacred sounds could cut through the darkness. The medieval and early modern night was a time for sonic exorcism, when the air was especially thick with demons and vapors. Bells not only brought news but also dispelled danger—the secularized gap between symbol and physics had yet to be imposed. Judging from the Latin mottoes that adorned them—in both Europe and China, bells were key surfaces for writing—they awoke or mourned the dead, married the living, banished the lightning, guided the winds, and punished the cruel. One motto read:

> *Funera plango, fulgura frango, Sabbato pango*
> *Excito lentos, dissipo ventos, paco cruentos.*

"I wail for funerals, break the lightning, celebrate the Sabbath, rouse the lazy, scatter the winds, and subdue the cruel." As media that proclaimed the *tempus*, bells governed the air, its spirits and weather. In medieval and early modern Europe, "bells were credited with the power to drive away thunder, thunderstorms, and tempests, and cleanse the air of every infernal presence."[53] They not only announced bad weather; they changed the composition of the air. Bells are thus a good example of a medium that operates both in signs and ontology. We may think of the air now as

53. Corbin, *Village Bells*, 102.

empty and open, but it was once possessed with spirits and pestilences. People were once quite literally saved by the bell. In modern times, however, people awoke from dreams about church bells to the sound of their alarm clocks.[54]

To get a sense of their force, we'd have to compare bells to tornado or air raid sirens, sounds that have robbed bells of their messaging function. In Israel on Yom HaShoah, the Holocaust memorial day, a commemorative siren sounds. The BBC had similar sacramental echoing gravitas. In 1924 it started its six-pips signal on the hour, followed in 1936 by a speaking clock service and the tolling of Big Ben. Reith believed that the BBC should build in breaks between programs in spans of up to fifteen minutes to give his noise-inundated audiences a chance to digest the programs. Rather than broadcasting dead air, the BBC used the sound of a studio clock ticking to assure listeners that the radio signal had not gone out. A 1933 critic complained that the "sinister thumping of the silence signal" would be heard by people as "an unpleasant reminder that the seconds of their lives are beating away."[55] Siren or clock: both can pack the kairos.

As bells were displaced by other sources of sound and community news, the one meaning they retained was a sacral one: the sound of deep time, death, and the echo of history. As bells "gradually stopped being signs, portents, or talismans," Corbin notes, they were left with the role of "anchoring the gnawing sense of *nevermore*."[56] One can detect this change already in poems of Coleridge, Keats, and Tennyson, for instance, where bells toll a deeply forlorn sense of what once was or, more rarely, what is to come. Bells take you back to times when the dead were yet among the living, or call out the hope of continuity of time. Perhaps the ultimate in superannuated resonance is the Philadelphia Liberty Bell, whose centrality in the American imagination it owes precisely to its being cracked. Ritual objects are neutralized, says Julian Huxley: the normal function is removed. The Liberty Bell takes the logic of the bell

54. Sigmund Freud, *Introductory Lectures on Psycho-Analysis* (New York: Norton, 1966), 112–15.

55. Kate Lacey, *Listening Publics: The Politics and Experience of Listening in the Media Age* (Cambridge: Polity, 2013), 82.

56. Corbin, *Village Bells*, 307, 290.

to another level, playing sounds so lost and mysterious that no one can hear them. The bell will sound no more. Old media never die; they just take on rare or sacred functions.

Bells are secret twins with cannons: round, metallic sound-producing devices in which a projectile of some sort (ball or clapper) does its ballistic business to clear the earth of bodies or the air of demons. Cannons, like bells, are punctual: they tell you what to do now. The cannon's time is not what Benjamin called the empty and homogeneous time of the calendar, but the emergency time of life or death. Deborah Lubken has shown the interconvertibility of bells and cannon in the nineteenth-century United States. The bells that chimed ecclesiastical ordinances were also melted into military ordnance. The same "death metal" that killed people could become a bell to mourn them, and vice versa. Indeed, cannons are acoustic media. Some of the most important early modern studies of the propagation of sound were made in timing the thunderclaps of cannons on the battlefield.[57] Cannons mourn the dead and summon attention, like the twenty-one-gun salute at a military burial or the royal fanfare announcing the drinking of King Claudius in *Hamlet*. (Collective drinking coordinated by cannonades was practiced in some states during presidential visits by George Washington.) In some Muslim countries a cannon shot signals the end of the daily fast during Ramadan. Like clocks and metal type for the printing press, cannons and bells were made by the same craftspeople—blacksmiths, locksmiths, and gun founders. One fifteenth-century Swiss craftsman was known as *magister bombardarum et horologiorum*, the master of cannonballs and clocks.[58] Cannons and bells are paired like swords and plowshares.

57. Deborah Lubken, "Death Metal: American Bell Metal in War and its Aftermath," presentation to International Comm. Association, Boston, 2011; Friedrich Kittler, "Lightning and Series—Event and Thunder," trans. Geoffrey Winthrop-Young, *Theory, Culture and Society* 23 (2006): 63–74, esp. 65–69; Bernhard Siegert, "'Erzklang' oder 'Missing Fundamental': Kulturgeschichte als Signalanalyse," in *Medias in res: Medienkulturwissenschaftliche Positionen*, ed. Till A. Heilmann, Anne von der Heiden, and Anna Tuschling (Bielefeld: Transcript, 2011), 231–45.

58. Cipolla, *Clocks and Culture*, 39, 50.

Towers

Like calendars and clocks, towers mediate between heaven and earth: they point upward to the sky, but thereby gain more advantage over the earth's surface. Towers are uniquely associated with divine and secular power. They proclaim the times and the seasons by sound and sight. From the Tower of Babel to the Twin Towers toppled on 11 September 2001, they have been symbols of communication or its failure, and targets of resentment (by God in the first case, and by al-Qaeda in the second). Like temples and other "high places," towers mark the binding point of heaven and earth, the *axis mundi*, and the spot where lightning is most likely to strike.[59] (Lightning in many cultures is considered the deed of the gods.) Like many logistical media, they declare a point about which everything revolves. Towers are artificial mountains, often built on top of preexisting heights, and they serve as observatories of the sky, the earth, and the things in between. By day their shadows sweep the earth, and by night they have a privileged look at the stars.

The key fact about towers is leverage. Towers provide an Archimedean point, both optically and acoustically. They can be seen and heard from great distances, and they can also see and sound at great distances. Every unit of increase on the vertical axis enormously multiplies the reach of the horizontal axis, thanks to both the principles of trigonometry and the curvature of the earth. Carillons, minarets, pulpits, lifeguard stands, and radio and television antennas all show that a small vertical investment yields circumferential dividends. Even a stump is often height enough for a speech. The "Babel complex" that fires our ambition to scale the heavens has a sideways, earthly payoff.[60] A tower is a fulcrum, providing mechanical advantage for the eye and favorable acoustics for the ear, and is thus a power technology par excellence. The leverage towers offer is threefold: being heard, seeing, and being seen.

Aztec temples, like broadcasting towers before the fact, illustrate these three functions. In their battles with the Spanish, the Aztecs used their

59. Marija Gimbutas, "Ancient Slavic Religion: A Synopsis," in *To Honor Roman Jakobson* (The Hague: Netherlands: Mouton, 1967), 738–59, at 742–46.
60. Roland Barthes, "La Tour Eiffel" (1964), *Oeuvres Complètes*, ed. Éric Marty (Paris: Seuil, 1993), 1:1379–1400, at 1385.

temples to great military advantage. The temples afforded vista points and strategic lookouts to survey the Spaniards' movement, and they were command posts that were very hard to capture. (In an earlier, more peaceful moment, Montezuma had showed Hernán Cortés and his men the amazing sight of the city of Tenochtitlán from the Templo Mayor, a panoramic 360-degree view.) The Spanish, in turn, were eager once the fighting began to occupy the temples and to replace the deities with their own insignia. The Aztec elites used the temples as agents of spectacle and intimidation for their own people and neighbors as well, since they amplified the visibility of human sacrifices. Spectators on the ground had a cinematic view of mutilated victims being cast down from the altar. But the priests also used the temples as a center point for transmitting sound. Bernal Diaz, in his chronicle of the conquest of Mexico, reports that the large Aztec drum could be heard for two leagues from the temple, accompanied by conch shells, horns, and trumpets. He detested its sound and thought it an instrument from hell, a thought surely reinforced by the knowledge that it was heralding the sacrificial offering of some of his comrades.[61] Aztec temples were not only places of religious sacrifice but centers of political and optical-acoustic control. The Spaniards recognized their importance at once, installing "*cruz y campana*" (cross and bell) like revolutionaries taking over the television network.

Let us take each function one by one. First, towers enhance the propagation of sound, marking time and space, as we have seen with bells, minarets, and Aztec drums. They have always been used for proclamations and decrees.[62] Radio, television, and cell phone towers perpetuate the tradition of sound from artificial heights, and satellites, the most recent spawn in a long lineage of sky media, with their "footprint" of continental reach from a celestial location, may be the ultimate tower.[63]

Second, towers extend the eye's range of vision and the horizon, as machines for the suppression of space. Eyes on towers have a natural telescopic advantage and enjoy what Barthes called "the euphoria of an aerial vision." Towers are privileged lookouts from which to observe hap-

61. Bernal Díaz del Castillo, *Historia Verdadera de la Conquista de la Nueva España* (Mexico City: Porrúa, 2004), 174.

62. See woodcut in Athanasius Kircher, *Phonurgia nova* (1673), facing 114.

63. See Lisa Parks and James Schwoch, eds., *Down to Earth: Satellite Technologies, Industries, and Cultures* (New Brunswick, NJ: Rutgers University Press, 2012).

penings both above and below, whether they are approaching hosts or storms. Each tower is its own north star, a celestial pivot. Indeed, like Greek and Roman temples, they are observatories for auguring celestial and terrestrial signs, places for *contemplation* and *consideration* in the original senses: to contemplate is to view the sky (looking for omens such as birds and clouds) from the temple; to consider is to look into the stars (*con* = with + *sidera* = stars). You go to the *templum* to discern the *tempus* (both time and weather.) Towers set the time and date. It is atop a turret in the castle that Hamlet discerns that "the time is out of joint."

Towers retain a potent hold on the religious imagination. On a tower one waits for the new moon or star to appear. According to Vitruvius, the Roman architectural theorist, temples to the gods who protect the city, such as Jupiter, Juno, or Minerva, should be built at the highest point possible, so as to oversee the city. In the Greek and Roman worlds, such temples linked worship, civic festivals, and military reconnaissance. The Athenian acropolis, for instance, was at once an awe-arousing device, an instrument of tax collection, and a fortification. The Bible expresses similar views: "The name of the Lord is a strong tower," says Proverbs 18:10. Yet two biblical towers are also symbols of futility: the aforementioned Tower of Babel and the tower whose cost you must count in advance, lest you start to build and can't finish (Luke 14:28). The Jehovah's Witnesses publish *The Watchtower*, a name evoking biblical imagery of military surveillance, evangelical warning, and millennial expectation.

The tower is the fundamental medium of surveillance (Bentham's panopticon had a tower at its center) and has a long military history as a post for sentinels and guards and a launch pad for projectile weaponry. The discovery of the vanishing point in fifteenth-century painting in Italy and Flanders might owe something to the views rendered by towers and ramparts. Albrecht Dürer's last work was a treatise on fortresses, the *Befestigungslehre* (1527), which tied together ballistics, early modern optics, Renaissance art, and military surveillance. Renaissance perspective and artillery both arose in the fifteenth century; both depended on the analysis of straight sight lines from a central point.[64] In Peter Apian's *Instrument Buch* (1533), a section shows how to measure buildings by the stars

64. Friedrich Kittler, *Optical Media: Berlin Lectures*, trans. Anthony Enns (Cambridge: Polity, 2010).

and stars by buildings; early Renaissance architecture and astronomy went together.[65] A 1440 tract claimed British control over the English Channel as far as a ship's sail could be sighted and recognized in fair weather—a distance of about twenty-one kilometers.[66] To see is to draw is to design is to aim is to fire: this sense of armed vision continues in ordinary talk of *shooting* pictures today. (A look can be a projectile.) Orhan Pamuk attributes a similar revolution in Muslim miniature painting to the view afforded by a tower: Ibn Shakir, the legendary calligrapher in Baghdad, witnessed the city's destruction by the Mongols in 1258 while hidden in the top of a minaret. He drew the city while he could, leading to a new depiction of the horizon line from "an elevated Godlike position."[67]

Third, towers not only allow seeing at a distance but are also easily seen from a distance. Standing above the trees, they preside over the landscape and provide marks for orientation. They are often among the most visible objects on any horizon, and shoreline towers have long served as points of navigation for boats and ships. In 1583 an English theorist of navigation exhorted students of the art "diligently to mark what buildings, castles, towers, churches, hills, downes, windmills and other marks are standing upon the land."[68] A city that is set on a hill cannot be hidden. *Oedipus at Colonus* starts with Antigone sighting the tower of a distant city, and church towers are often designed with cross, clock, and weathervane to show all the layers of time. Towers, like other conspicuous sights, establish lines of connection between distant points. They are seen to be seeing, and are often exercises in conspicuous expenditure. (The phallic dimension is too obvious to dwell on.) The tallest building in any city—the point at which all sightlines converge—usually announces the city's character, an urban synecdoche. In Kiev the Rodina Mat, a socialist-realist monstrosity that looks like a metallic Green Giantess, was supposedly designed to be just slightly shorter than the top of the Lavra monastery, which sits behind it on a hill and marks the symbolically laden birthplace of Russian Orthodoxy.

65. Peter Apian, *Instrument Buch* (1533; Leipzig: Reprintverlag, 1990).
66. Michel Mollat du Jardin, *Europe and the Sea*, trans. Teresa Lavender Fagan (Oxford, UK: Blackwell, 1993), 113.
67. Orhan Pamuk, *My Name Is Red*, trans. Erdağ M. Göknar (New York: Vintage, 2001), 70.
68. John Naish, *Seamarks: Their History and Development* (London: Stanford Maritime, 1985), 11, 14.

Modernity's most important tower, the Eiffel Tower, is certainly symbolic of its city, and every film set in Paris needs at least one shot of it.[69] Its designer, Gustave Eiffel, defended it against charges of frivolity in 1887: "From a military point of view, the tower will provide an invaluable observatory . . . it enables, whether by direct vision or optical telegraphy, the establishing of communications that do not yet exist."[70] It would be hard to synthesize more succinctly the functions of towers: as observatories for stars and weather (linking heaven and earth and providing a military advantage), platforms for direct vision or for distant sighting, and nodes for new networks. Towers signal not only civic identity but convey military intelligence, news, weather, and above all, the time. Guy de Maupassant, who detested the Eiffel Tower, liked to breakfast at a restaurant at its base—since, said he, it was the only place in Paris you didn't have to look at it. It has long been a platform for publicity and advertising, decorated at times with a large clock (of course) and as a giant thermometer. It began its career as a timekeeper in 1910, transmitting French standard time by radio wave for the entire empire, and using signal-based synchronization technology that foreshadowed GPS satellites.[71] It was once hung with lights that spelled CITROEN; the Nazis in 1940, with a less developed eye for line, hung a horizontal banner on it announcing: "Deutschland siegt auf allen Fronten." The Eiffel Tower served as a beacon of the countdown to the year 2000 with a huge digital readout announcing the time remaining in the millennium, down to the second.

These two sorts of leverage—vision and visibility—work together. Roland Barthes calls the Eiffel Tower "an object that sees, and a gaze that is seen." It transgresses "the ordinary divorce of seeing and being seen. It achieves a sovereign traffic between the two functions: it is a complete object which unites, if one may put it thus, the two sexes of the gaze."[72] Uniting "masculine" looking with "feminine" being-looked-at is of course

69. In 2012 Paris police arrested a family for trafficking in unusual contraband: "Police Seize 13 Tonnes of Miniature Eiffel Towers," *Guardian,* 14 April 2012, 26.

70. Gustave Eiffel, in Jean des Cars and Jean-Paul Caracelle, *La Tour Eiffel: Un siècle d'audace et de génie* (Paris: Denoël, 1989), 59. "Enfin au point de vue militaire, la Tour fournira un observatoire précieux . . . elle permet, soit par la vision direct, soit par la télégraphie optique, d'établir des communications qui n'existent pas encore."

71. Galison, *Einstein's Clocks*, 275–90.

72. Barthes, "La Tour Eiffel," 1384.

not unique to the Eiffel Tower; it is characteristic of all towers. The Eiffel Tower also had an acoustic side, as the "cradle of French broadcasting."[73] It was central to the conquest of the airwaves, the first great transmitter. In 1899 Marconi succeeded in sending a radiotelegraph "wire" from the tower across the English Channel. Airplanes guarding Paris during World War I were directed from the tower, and in 1915 it was the vehicle of transatlantic contact. In World War II it was an important military target, enough for Adolf Hitler to pose sentimentally before it, a conqueror awed by the object of his conquest. In the late 1940s it served as the first transmitter for Télévision Française. Barthes rightly notes that the Eiffel Tower is a symbol of communication—but it is also a channel of communication, its top still bristling with transmitting and intercepting devices. It is perhaps the first and greatest of a long series of broadcast temples, the headquarters of media corporations whose architecture reflects their mission between heaven and earth.[74] As magnets for public attention and the center points on logistical grids, towers dictate, to at least some degree, public space and time.

This ease of sending and reception makes towers essential media for line-of-sight communication, such as signal fires in antiquity and modern optical telegraphy. (Light signals, like stars, prefer night as a backdrop: the sunlight obscures them.) Aeschylus's *Agamemnon* famously begins with a primal scene of communication at a distance, Queen Clytemnestra divining the fall of Troy via a system of signal fires linking Troy to Argos—every historically minded media theorist rightly mentions it. The play opens with a bored night watchman on a tower, tired of waiting for a signal to appear, who jubilantly, at long last, spots a flickering light on the horizon. The question he has to resolve is whether the light is an illusion or not, intentional or not, a star ascending or a signal fire. (The mind plays tricks on those who watch for too long.) The ancient Greeks did use hilltop signal pyres, and the one described by Aeschylus is possible but unlikely, as its bonfires would have had to be more than twenty-four meters high to be seen at the distances mentioned.[75] The signal must be

73. Charles Braibant, *Histoire de la Tour Eiffel* (Paris: Plon, 1964).

74. Staffan Ericsson and Kristina Riegert, eds., *Media Houses: Architecture, Media, and the Production of Centrality* (New York: Peter Lang, 2010).

75. Volker Aschoff, *Geschichte der Nachrichtentechnik*, vol. 1 (Berlin: Springer, 1989), chapter 3.

unambiguously a signal: "For a lighthouse to fulfill the reason of its existence, it must not only be seen, it must be recognised when seen."[76] The message has to show that it is a message. Optical telegraphs developed in late eighteenth-century France carried on this lineage, as do cities with a "beacon hill." Paul Revere's legendary lantern in Boston's Old North Church is another example. Towers, as Gustave Eiffel said, always establish lines of communication, real or symbolic, that otherwise would not exist.

L'appel du vide

As spots from which the news will come, and places at which gravity works most pitilessly, towers are catastrophic places of danger, emergency, and death. The tower may be the architectural precondition for the sublime, which, in its original formulation by Longinus, simply meant "height" (*ὕψος*); the sea, in contrast, provided the corresponding register of "bathos" or depth.[77] Lighthouses—with their searchlights, foghorns, and radio communication—unite the three functions of the tower and share the same vibe of lonely exposure to the cosmos. Towers are classic places for captivity, since a tower's visibility makes it an easily watched prison—for Rapunzel or the modern self in T. S. Eliot's *Waste Land*. In *Hamlet*—like *Agamemnon*, a play about adulterous parents and avenging children that opens with uncanny sightings atop a watchtower—Horatio warns Hamlet with an acrophobic description of the edge of the tower's platform:

> The very place puts toys of desperation,
> Without more motive, into every brain
> That looks so many fathoms to the sea
> And hears it roar beneath . . .
> (*Hamlet*, I.iv.75–78.)

76. William Thomson, Lord Kelvin, "On Lighthouse Characteristics," in *Lectures on National Architecture and Engineering* (Glasgow: William Collins, 1881), 89–106, at 89.
77. Thanks to Jim Porter for this observation.

The beginnings of *Agamemnon* and *Hamlet* both announce a theme: the tendency of watchmen inadvertently to fabricate. Is that faint light really a signal of victory at Troy, and did the ghost really appear? Phantasms proliferate for the lonely watchman just as repetitive tasks start to proliferate into perceptual multiples. Under a constant gaze, the object breaks apart.

Towers put the fear (or allure) of death into us all. The Eiffel Tower was the world's premier destination for suicides before protective railings were put up. Its cousin the Golden Gate Bridge, "a threshold that presides over the end of the continent and a gangway to the void beyond," has since assumed that dubious distinction; and it is curious to see how deep public resistance is to putting up a guard rail despite abundant evidence that it would save at least a score of lives every year.[78] The French call the temptation to throw oneself from high places *l'appel du vide*, the call of the void. Empedocles is the great symbol of this urge. In one of the three temptations, Satan takes Christ to the pinnacle of the temple and invites him to throw himself down (Matthew 4:5–7). Fyodor Dostoyevsky famously read this invitation as the temptation of "miracle," a stunt to impress onlookers with supernatural powers, but the text does not mention any audience present to enjoy the show. The temptation is more primal—to jump from a high place for the heck of it, the temptation of nihilism at its purest, a pointless empty hankering that everyone briefly, shiveringly has felt while looking down from a high place.[79]

Towers enable a rendezvous of the living and the dead. Like bells, they signal between the mundane and the urgent, height and expanse, the sacred and the secular. All timekeeping devices implicate questions of time and eternity. Their message is the degradation of cosmic order, the toll of irreversibility. Whatever else time is, it is the thermodynamic fact that events only run in one direction and that a fruitful void keeps opening before us. If we took towers, sundials, and clocks as media of communication, as they undoubtedly are, we would have to think freshly about where meaning comes from.

78. Tad Friend, "Jumpers: The Fatal Grandeur of the Golden Gate Bridge," *New Yorker*, 13 October 2003, 48–59.

79. See F. W. J. Schelling, *Über das Wesen der menschlichen Freiheit* (1809; Frankfurt: Suhrkamp, 1975), 74, on "die Lust zum Creatürlichen"; and E. T. A. Hoffmann, "Der Sandmann."

Heidegger the Weatherman

Heidegger spent much time in his youth in the tower of the church where his father worked as a sexton, enjoying the views of Messkirch, his own thoughts, and the company of the bats. He also perched in a military observation tower during World War I, reading the winds. Heidegger was a weatherman. He served in the end of World War I as a military meteorologist on the western front, northeast of Verdun, France, in the Ersatz-Bataillon Infanterie-Regiment 113, Frontwetterwarte 414, from late August until November or December 1918, following an eight-week training course at the Heimat-Wetter-Warte-Kommando in Charlottenburg, Berlin. In letters he wrote to his wife Elfriede in July after arriving in Berlin, Heidegger said that he expected to learn a great deal in the next weeks, and mentioned his desire to acquire a scientific book on meteorology. He told her that his job would be to provide "observations of temp., barometer, wind, etc. expertly and systematically for artillery and pilots," and later sent her a picture of his quarters in the field, which showed a small observation tower where he must have sat on duty. It is not clear exactly what he did as a meteorologist, but a glimpse comes in a September letter home written after he had arrived in the field: up early in the morning, Heidegger "sits at the telephone and gives a copious amount of numbers to artillery, air ship troopers, gas offic., etc." The rumor that he helped to plan gas attacks against the Americans turns out to be unsubstantiated, but he clearly was involved in gathering essential data about wind speed and direction for war in the air; weather was always a critical part of warfare, but gas warfare requires predictions about wind direction (lest the gassers be poisoned themselves). Heidegger's rank was *Luftschiffer*—literally, captain of the air—and he had a front-row seat before one of the twentieth century's most distinctive atmospheres: the cloud of poison gas.[80]

80. See Gertrud Heidegger, ed., *'Mein Liebes Seelchen': Briefe Martin Heideggers an seine Frau Elfriede, 1915–1970* (Munich: Deutsche Verlags-Anstalt, 2005), 69, 71, picture on 81; Thomas Sheehan, "Heidegger's Early Years: Fragments for a Philosophical Biography," in *Heidegger: The Man and the Thinker*, ed. Thomas Sheehan (Chicago: Precedent Publishing, 1981), 3–19; Hugo Ott, *Martin Heidegger: A Political Life*, trans. Allan Blunden (1989; New York: Basic, 1993), 104–5; and Georg Paul Neumann, *Die deutschen Luftstreitkräfte im Weltkriege* (Berlin: E. S. Mittler und Sohn, 1920), 286–97 (on the weather service). On the poison gas cloud, see

It is clear that the war had a decisive experience on Heidegger's subsequent thought, and especially on his magnum opus, *Being and Time* (1927).[81] Immediately after the war, he discovered "kairological time" in the epistles of Paul, but he had perhaps already discovered it watching the kairos of the weather from his tower. (His 1919 lectures documenting this turn are written on the back of unused military weather reports; paper was scarce during the "Kriegsnotsemester.")[82] When Paul wrote to the Thessalonians, "About the times and the seasons you have no need that I should write you," he probably meant that they were already well instructed in doctrine, but he could just as well have been referring to the futility of writing about weather at a distance. Time here is *chronos*, and season is *kairos*, and Heidegger made this epistle one of his key texts. The Thessalonians were waiting for the coming of Christ—the *parousia*, a term Heidegger translated as *Ereignis* (event)—and thus were in a state of watchfulness. Heidegger was fascinated with the duty of *Wachsein*, of being awake or vigilant, a notion with deep roots in Christian theology. Jesus commanded his disciples to watch because no one knew the time when he would return "in the clouds of heaven" (Matthew 24:42, 30). The disciple was to watch the sky for the sign of the parousia, the right moment, a task that unites the boring, one-thing-after-the-other sense of time spent waiting with the ecstatic time of the event or emergency. Heidegger translated *kairos* as *Augenblick*, literally, the glance or blink of an eye, an ordinary German term for "moment" that took on increasing resonance in his thought.[83]

Watching the weather gives a new, historically specific cast to Heideggerian tropes of vigilance, *hüten* (guarding or watching), kairos, and observance. Time, as Heidegger's central preoccupation, shows up as

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Peter Sloterdijk, *Schäume, Plurale Sphärologie* (Frankfurt: Suhrkamp, 2004), 89–153 and passim.

81. William H. F. Altman, *Martin Heidegger and the First World War:* Being and Time *as Funeral Oration* (Lanham, MD: Lexington Books, 2012).

82. Theodore Kisiel, "Das Kriegsnotsemester 1919: Heideggers Durchbruch zur hermeneutischen Phänomenologie," *Philosophisches Jahrbuch* 99 (1992), 105–22. The meteorological paper was reported to me by Prof. Kisiel.

83. Martin Heidegger, *Phänomenologie des religiösen Lebens*, *Gesamtausgabe* vol. 60 (1920–21; Frankfurt: Klostermann, 1995), 149–51.

weather.[84] It is not hard to imagine a meteorological inspiration for the fourfold—*das Geviert*—as Heidegger peered from his perch between heaven and earth toward the western front a few kilometers away where mortals died in trenches and gods, maybe, looked on. Somehow the twentieth-century notion of vigilance as a paramount ethical duty has something to do with those sublime objects in the sky such as vapor trails, weather maps, air raid alarms, wireless signals, and smoke from ovens. Every time in Heidegger that we read of watchfulness, shepherding being, or the event (*Ereignis*), we should think of weather, and remember that he was reading the winds to carry weather balloons, airplanes, ordnance, and poison gas. Marvelous insights from a compromised context are not unusual for this thinker. (Harold Innis, László Moholy-Nagy, Norbert Wiener, and Ludwig Wittgenstein all worked artillery in World War I; ballistics is also a key source for media theory.) Given our current climatological mess, it is fitting that our weatherman philosopher was watching heaven and earth in order to assay the mix of gases in the atmosphere. The sky, like the sea and earth, becomes a medium in emergencies. It is still our task to watch the sky and reckon the time, now that we have passed four hundred parts per million of carbon dioxide in the atmosphere, a concentration not seen on earth in three million years. If we try to be Luftschiffer, the very view puts toys of desperation into every brain that looks so many fathoms to the sky.

Weather and the Gods

Kairos rivals *logos* as one of the richest words in ancient Greek, with applications in medicine, warfare, archery, ethics, aesthetics, and rhetoric. It is often translated as *window of opportunity* or *good timing*, but another rendering puts it directly into the context of sky media—as *weather*. Indeed, in modern Greek, *kairos* means exactly that, and every evening on

84. If we translate *Sein und Zeit* into English by its cognates, we get *Sin and Tide*. If we translate it into French, we get *L'être et le temps*, which we can then translate into English as *Being and Weather*—or, using the homophone, *Letter and Weather*. All of these word plays have resonance for Heidegger's thought.

Greek television, glamorous presenters give an overview of the *kairos*. Events in the sky—*meteōra* in Greek, whence *meteorology*—are always temporal. The link between weather and timing is not peculiar to Greek; it is pervasive. In Latin, *tempus* means weather and time, giving English such words as *temporal* and *tempest*, and French *le temps* and Spanish *el tiempo*, both of which mean both time and weather; the Spanish *al tiempo* means both "in season" (of fruits) or "at room temperature" (of drinks). Terms such as *temperature*, *tempering*, *tempo*, and *temperament* show shared semantic fields across heat, harmony, rhythm, and mood. Humans have always vigilantly watched the sky for signs of the times, and the worry about climate change continues the historical norm of reading our fate in the atmosphere. Disasters—a term that means "bad star"—happen in the sky first. Time and tide, chance and fortune, an opportunity that opens and shuts, a brief moment in which to take action—this cluster of meanings shows weather and climate to be critical sky-based fields in which to ponder urgent action.[85] (It's not surprising that chaos theory is the child of meteorology.) Kairos suggests time that is ripe and urgent—or messianic time, as Walter Benjamin called it.

"Wir können niemals scheiden, was Wetter und was Götter sind," said Kittler.[86] We can never separate the weather and the gods. The weather, with its intermittent reinforcement and irregular patterns of blessing and bane, behaves like gods and parents—one reason why we are so emotionally attached to it. As much as the stars, the weather can seem the direct action of the deities. For sailing cultures such as the ancient Greeks or Vikings, wind and good fortune were intimately related. Winds are gifts from the gods—or curses; Poseidon is always messing things up for Odysseus. The gods spoke through winds, waves, and clouds. The ancient Greek word used for fair weather, εὐδία (*eudia*) is from "*eu* + *dios*," meaning Zeus's favor.[87] Moses praises the Lord for his breath that parted the Red Sea; and in the Book of Job, the Lord appears in the whirlwind.

85. Richard Broxton Onians, *The Origins of European Thought: About the Body, the Mind, the Soul, the World, Time, and Fate* (Cambridge: Cambridge University Press, 1954), 343–48, and Napier Shaw, *The Drama of Weather*, 2nd ed. (Cambridge: Cambridge University Press, 1939), chapter 1. Note that the kairotic term *window*, from "wind eye" preserves an etymological link to weather.

86. Friedrich Kittler, *Musik und Mathematik*, 1:1 (Munich: Fink, 2006), 79.

87. Shaw, *Drama of Weather*, 51. This term is used by Jesus in Matt. 16:2; see below.

Jesus tells Nicodemus to consider the wind (perhaps troping on the Hebrew *ruach*, meaning wind, breath, or spirit), and his calming of a storm on the sea of Galilee proves his divinity, leaving his amazed disciples to make the axiomatic statement that winds and waves obey no mortals. In Japanese, *kamikaze* means divine wind, but the term almost seems redundant. Feng shui, literally "wind-water," is the Chinese art of orienting harmoniously to the environment, and it descends from ancient ideas about climate and meteorology. Even *inclement weather* hides a moral shading, as clemency is mercy. Zephyrs and breezes are forest spirits. With respect to weather—like all things that happen in the sky—humans were until very recently like dolphins: handicapped materially.

If weather was once a stage for the drama of extraordinarily moody celestial beings full of whims and antics, the notion of a purely physical atmosphere is relatively recent, though many have called for it. Speaking with Heidegger, weather was once *Götterschau*, the theater of the gods.[88] Less personifying, the Chinese term for weather, *tian qi* (天气), means sky energy. People look to the sky, listen to the winds, thunder, and rustling of leaves, and watch for comets, eclipses, lightning, and clouds, and surely there is a rich history of the diverse anthropological understandings of weather to be written to go with the booming research on climate history. Many people have seen the air not as an empty and homogeneous transparency but as a medium thickly inhabited by creatures and substances that affected mood and health (which, as we have seen, bells could control.) Hamlet complained that "this most excellent canopy, the air" seemed nothing but "a foul and pestilential congregation of vapors," a description that nicely captures how some saw the air before modern understandings of infectious disease. Settlers and doctors in nineteenth-century America, for instance, had rich notions of contagious miasmas, disease agents, and vitalizing elements in the air.[89] Even in the late 1930s and 1940s, my father as a child slept in a bedroom with an open window even in the coldest winter, because my grandmother was convinced of the health benefits of fresh air.

It would be tempting to define modernity as the exorcism of the atmo-

88. Friedrich Kittler, *Musik und Mathematik* 1:2 (Munich: Fink, 2009), 40.

89. See Conevery Bolton Valencius, *The Health of the Country* (New York: Basic Books, 2002), 109–32.

sphere. But efforts at a secular vision of weather and a disenchanted sky are very old, just as weather animism persists robustly into our own time. Aristophanes made fun of the idea that the clouds communicate in *The Clouds*, though he gave them some very nice speeches; and he mocked Socrates for having his head in them. Lucretius, in *The Nature of Things*, argued that we should read storm clouds not as faces or images but as tiny bodies buffeted through the air. "Come on"—*Nunc age*—he pled, with those who read the sky metaphysically. Pliny praised philosophers such as Thales, who explained eclipses and thus liberated people from crippling fear about celestial portents, and he himself explained that a shooting star was not a sign that someone had died but rather a natural process, like the sputtering of an oil lamp.[90] There were plenty of efforts to demystify the sky in the ancient world, a project whose vigor hints at how robust were notions of celestial influence and atmospheric disturbance. Enlighteners first take aim at the sky.

You wouldn't expect a lot of indulgence of the idea that the sky is a theater of the gods from a comic playwright, atheist, and naturalist, of course; but Biblical writings do not offer a straightforward endorsement of reading the heavens either. Genesis says the heavenly bodies are given as signs for timekeeping, the rainbow marks God's promise not to flood the earth again, and YHWH is often described as a storm god who lives in the cloud; but the Hebrew prophets condemned reading the sky for omens, as too close observance of the heavenly bodies could verge on idolatry. The King James Version renders this sin as "observing times" in Leviticus 19:26 and Deuteronomy 18:10, but the Hebrew in both verses implies "reading the clouds" or "predicting the weather," and thus getting involved in the dangerous game of speculating on the future.[91] The cloud hides the divine presence on Mount Sinai, but by hiding, it also discloses by displacement, and the pillar of cloud leads the Israelites through the wilderness. The theology of clouds in the Hebrew Bible is a complex matter,[92] but we should not expect any unambiguous endorsement of the idea that God's will is readable in the sky. Indeed, the prophets and

90. Lucretius, *De Rerum Natura*, book 4, lines 166ff; Pliny, *Naturalis historia*, book 2, chapters 6, 9.

91. Thanks to Menahem Blondheim for help.

92. See J. Luzarraga, *Las tradiciones de la nube en la biblia y en el judaismo primitivo* (Rome: Biblical Institute Press, 1973).

Lucretius pretty much agree on that. Disenchantment, as Hegel pointed out, is not the enemy of monotheistic religion, but its result.

Though Christ is said to return in the clouds with a sign that will fill the heavens, the Jesus of the canonical gospels was also impatient with a prurient interest in reading the sky. The Gospel of Matthew records that Jesus was once asked for a wonder (or sign) from heaven (or the sky); *σημεῖον* (*sēmeion*) means both miracle and sign in New Testament Greek, like the Hebrew *ot*, and *οὐρανός* (*ouranos*) can be the physical sky or the metaphysical heavens. In a rather sarcastic reply to his questioners, Jesus started talking about meteorology. "When the evening comes, you say, fair weather! because the sky is red. And in the morning, you say, today will be stormy, because the sky is red and gloomy." (This is a version of the nautical saying "Red sky at night, sailor's delight; red sky at morning, sailor take warning.") His questioners wanted a miracle, but he gave them ordinary natural sequence; they read s*ēmeion* as "wonder", but Jesus read it as "sign"; they read *ouranos* as "heaven," but Jesus read it as "sky." He finished with a rebuke: "You know how to discern the face of the sky but cannot discern the signs of the times [*sēmeia tōn kairōn*]," hinting darkly toward a weather of history (Matthew 16:2–3). Here Jesus was not interested in spectacular events in the sky, offering the obvious as the miracle in a classic infrastructural gesture; he did not encourage us to find camels, weasels, and whales there. For his part, Paul warned the Galatians against paying too much heed to the celestial signs of months, times, and years.[93] (Later popular Christianity did not abide by these strictures.)

If intellectual leaders among the ancient Greeks, Romans, Jews, and Christians resisted reading the sky as the site of divine doings, moderns cannot quite resist the opposite reading. Weather's desacralization is uneven. Though Ben Franklin took the lightning from the hands of Zeus and Thor, the idea that adverse weather can reflect superhuman disapproval is alive and well. In August 2011, US Congressional Representative Michele Bachmann, at the time a Republican presidential candidate, suggested that Hurricane Irene, which had just killed forty people and caused billions of dollars of damage to the Caribbean and the East coast of the United States, was God's wake-up call to the Obama administration. Many mocked her for this claim, but environmentalist Bill McKib-

93. Gal. 4:10, which echoes Lev. 19:26 and Deut. 18:10.

ben similarly took advantage of Irene as a wake-up call, though without theistic backing, to make a point; and the idea that "the earth is fighting back" (James Lovelock) against an overweening humanity is ubiquitous in ecocritical discourse.

And after a meteor exploded over Siberia in February 2013, a Russian orthodox cleric stated: "We know from the scriptures that the Lord often sends people signs and warnings via natural forces. . . . the meteorite is a reminder that we live in a fragile and unpredictable world."[94] The idea that the meteor was a sign from God was instantly controversial, but note how he backs off: the meteor is a "reminder" of an incontestable fact, rather than a specific message. The interpreting is left up to us. But who, even the most secular, on a beautiful day can resist the thought that some divine benevolence is smiling on us? The weather is still one of our most ready lexicons for the mystery of blessing and bane. Television weathercasters like to take on shamanistic personae, as if responsible for the weather: "Tomorrow I hope to bring you some sun."[95] McLuhan liked a joke about a caller to a radio station: "Are you the station that gives twice as much weather? Well, turn it off. I'm drowning."[96] Messengers always get mixed up with the message, and with the weather it is always hard to tell which is which.

Weather and Modernity

Weather is an interesting object for media studies because it seems, on the one hand, to be immune to any human fashioning, and yet on the other is one of the most heavily constructed objects we know—constructed by talk, measuring instruments, journalism, and now geoengineering, the possibility of direct and aggressive alteration of atmospheric chemistry. We need a good history of weather's *Aufschreibesysteme*, including the natural ones being richly exploited by climate history. Probably

94. "Russian Cleric: Meteorite was Lord's Message," *Rianovisti*, 15 February 2013, en.ria.ru/russia/20130215/179493189.html, accessed 15 February 2013.
95. Bruce E. Gronbeck, "Tradition and Technology in Local Newscasts," *Sociological Quarterly* 38, no. 2 (1997): 361–74.
96. McLuhan, *Understanding Media*, 66.

more distinctive of modernity than a disenchanted sky is the idea that weather is a normal, routine affair susceptible to daily reporting. Since Noah, spectacular weather was a subject for storytelling; indeed, weather has an affinity with drama.[97] Shakespeare made great use of weather: the witches control it in *Macbeth*; a storm humbles Lear in *King Lear*; the sky is full of weather portents in many plays, notably *Hamlet*; and *The Tempest* concerns a storm staged as a theatrical spectacle. Floods, droughts, typhoons, windstorms, tsunamis, hail, raining frogs, and other signs and wonders between heaven and earth have been sung far and wide, up to the Weather Channel today. The Renaissance polymath Robert Burton wrote of the flood of information arriving daily at his door: "I hear new news every day, and those ordinary rumours of war, plagues, fires, inundations, thefts, murders, massacres, meteors, comets, spectrums, prodigies, apparitions, of towns taken, cities besieged in France, Germany, Turkey, Persia, Poland, &c. daily musters and preparations, and such like, which these tempestuous times afford, battles fought, so many men slain, monomachies, shipwrecks, piracies, and sea-fights, peace, leagues, stratagems, and fresh alarms."[98] The only weather events Burton mentions are extreme ones: meteors, comets, floods. He has no concept of routine weather.

Weather as an essential human interest has always been a fundamental part of news in all forms, but a weather report given daily, regardless of drama, is a symptom of a modern telecommunications infrastructure. (Note the tie to time: *tidings* is cognate with the German term for newspaper, *Zeitung*, and "the times" as the title of a newspaper goes back to shipping and the "tides.") It would be fruitless to publish local weather reports in eighteenth-century newsletters that took weeks to circulate. Only weather oddities and wonders had legs. (Almanacs are another story.) Weather is so fickle that broadcasting it only makes sense when you have a quick and refreshable system of distribution that transcends local horizons; nothing ages so fast as a weather report. (Almost everywhere, people chuckle in self-congratulation as they tell visitors, "If you

97. See Shaw, *Drama of Weather*.

98. *The Anatomy of Melancholy*, quoted in James Gleick, *The Information* (New York: Pantheon, 2011), 401–2.

don't like the weather, just wait ten minutes," as if it were a local peculiarity.) Weather reporting, like a genuinely predictive science of meteorology, presupposes high-speed space-time integration.

Everybody talks about the weather, but no one does anything about it, as Mark Twain supposedly said, and which is also repeated too many times to count: the weather is a fierce producer of banality. Benjamin says a new "epidemic of boredom" broke out in 1840s Paris when routine weather was invented as a topic of talk; weather and boredom, he thought, have a deep, inner connection.[99] (As I type, a foggy drizzle has descended on the December air, cloaking the mood in dullsville.) In Britain and the United States, it was not until the 1860s and 1870s that weather became an object of journalistic and scientific reporting and took on—like being itself—the privilege of being ordinary, but maybe Benjamin's flâneurs got there first. The weather has "the capacity to be both tremendously mundane and spectacularly dramatic."[100] It partakes of the bright urgency of the now and of sameness—the two faces of the sky and of time as well. I hope someone will write a comparative social history of weather that will tell us if it has always been a default conversational topic or if such reflects modern conditions.

Telegraphy was a constituent element in forming the chronic, noneventful conception of weather. Historians agree on the decisive role of the electrical telegraph, which, from the 1850s, helped to promote a "God's eye view" of weather, though there had been weather maps before.[101] The United Kingdom established its national Meteorological Office in 1854, and other countries followed apace. Starting in 1856, the Smithsonian displayed an updatable weather map of the United States in its great hall, with reports received at least daily by telegram from points around the country (except on Sundays); maps and other graphic displays, as Mark Monmonier has shown, are another crucial medium in

99. *Das Passagen-Werk*, vol. 1, 156–65. His most famous concept, "aura," has an atmospheric vibe.

100. Marita Sturken, "Desiring the Weather: El Niño, the Media, and California Identity," *Public Culture* 13, no. 2 (2001): 161–89, at 162.

101. Paul N. Edwards, "Meteorology as Infrastructural Globalism," 4. See James Rodger Fleming, *Meteorology in America, 1800–1870* (Baltimore: Johns Hopkins University Press, 1990), chapter 7, and Mark Monmonier, *Air Apparent: How Meteorologists Learned to Map, Predict, and Dramatize Weather* (Chicago: University of Chicago Press, 1999), chapter 3.

the history of making weather through visual data. "The telegraph enabled people to think of weather as a widespread and connected affair, rather than an assortment of local surprises."[102] Networks of observers linked by wire "made it possible to combine on a map within an hour observations from a sufficient number of stations to make the idea of a general view of the play of the wind and weather possible."[103] Ironically, the telegraph system was itself vulnerable to electrical storms and other forms of extreme weather. In the United States, the national weather-reporting infrastructure was a peace dividend as the Army Signal Corps repurposed its mission and hardware after the Civil War to perform reconnaissance of another enemy that was always rich in threat.[104] (Vilhelm Bjerknes, a founder of modern forecasting, had the military sense in mind when he coined the term *front*.)

Another key technique for managing—constituting—the weather was statistics. Along with crime and suicide, the weather was statistically normalized in the nineteenth century. Like forecasting, statistics presupposes a telecommunications infrastructure that can unite the findings of dispersed observers into aggregates, such as populations, markets, or weather systems, that would defy individual sensory perception. There is no enterprise so data-hungry as meteorology, and as a probabilistic science it inspired many quantitative innovations later used for social and economic phenomena. Important mathematical thinkers such as the Marquis de Laplace, Adolphe Quetelet, and Charles Babbage were fascinated by problems of meteorological data gathering.[105]

John Ruskin articulated the imperative of nonlocal coordination in a 1839 speech at the Meteorological Society of London that has become a landmark for weather historians. Ruskin saw the new field as distinguished by its great utility and beauty: "It is a science of the pure air, and the bright heaven . . . . He, whose kingdom is the heaven, can never meet with an uninteresting space . . . . the meteorologist . . . rejoices

102. Gleick, *The Information*, 147.

103. Shaw, *Drama of Weather*, 48, 70.

104. Richard R. John, *Network Nation: Inventing American Telecommunications* (Cambridge, MA: Harvard University Press, 2010), 123–24. I thank him, John Nerone, and Cambridge Ridley Lynch for help on the history of American news and weather.

105. Stephen M. Stigler, *Statistics on the Table* (Cambridge, MA: Harvard University Press, 1999), chapter 2.

in the kingdoms of the air." Meteorology was distinct as a science, he claimed, because it could never be the work of a lone genius. An individual's "observations are useless; for they are made upon a point, while the speculations to be derived from them must be on space." Instead, "it was necessary that the individuals should think, observe, and act simultaneously, though separated from each other, by distances, on the greatness of which depended the utility of their observations." He dreamed of "a vast machine . . . omnipresent over the globe, so that it may be able to know, at any given instant, the state of the atmosphere at every point on its surface."[106] His dream of global omnipresence awaited not only the telegraph but also softer political and intellectual infrastructures. The key point here is that modern weather was already an abstraction, something that local experience could not be trusted to observe.

Ruskin supplies the title to Paul Edwards's excellent study of the emergence of a global weather infrastructure in the twentieth century, *A Vast Machine*. The history of modern meteorology and climate science is full of media in the semiotic (telegraphs, journalism, radio, television, and satellites) and ontological senses (devices for measuring, monitoring, and constituting things). Satellites were important, but equally so was the forging of worldwide standards of meteorological measurement and reporting; as usual, the problem was not the channels for moving information, but the standards (formats) for packaging and reading it. Weather forecasting was arguably the first world wide web, Edwards argues: a global network for the exchange of data, not only in creating a genuinely global project, but also in terms of computer technology. Next to simulating nuclear explosions, meteorology is the most important motive in the rise of supercomputing. John von Neumann, a mastermind of the postwar computing infrastructure, is well known for designing computers to model the bomb and its effects, but he was an equally fierce advocate of computational meteorology. Weather forecasting has an insatiable appetite for data, and one of meteorology's central narratives, Edwards shows, is the insufficiency of computing resources.[107] Without

106. "Remarks on the Present State of Meteorological Science," *Transactions of the Meteorological Society* 1 (London: Smith, Elder, and Co., 1839), 56–59, quotes from 57 and 59.
107. Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010), 137, 173–74, passim.

satellites and computers there is no global weather, but without the need for global weather, we might not have the satellites or computers we do. In this pairing we can find a more literal origin for the idea that "the cloud" is a public computing resource.

There are many reasons for the global appetite for weather reporting, such as aviation and fishing—one reason why Norway has been a leader in meteorology. A deeper understanding of weather has invented entire professions in the twentieth century and deeply changed the ways that we conceive and manage danger; not only seacraft and aircraft, but risk itself became modernized.[108] And of course war was one of the most important pushes. Weather forecasting was another "abuse of military equipment." In the 1950s, the need to track the atmospheric effects of nuclear testing, especially the spread of fallout, spurred the development of upper air meteorology. Intercontinental ballistic missiles needed global weather intelligence, as did high-altitude reconnaissance pilots, whose cameras only worked when there was no cloud cover. Since the utility of spy planes depended on clear weather, espionage was networked with meteorology, another form of reconnaissance. Clouds cloaked targets for aerial photography, and learning to read the clouds was a spin-off of the urgent need for assessing nuclear arms stockpiles. (Media pop up where there is noise to be filtered.) Both Eisenhower and Kennedy used weather prediction as a public justification for militarizing the sky.[109]

Weather is not climate. One is *kairos* and the other is *chronos*. Nobody talks about yesterday's weather, but climate consists of long-term averages that can reach back decades, centuries, millennia, and more. Part of the rhetorical problem is analogous to a statistical t-test for comparing two means. The fluctuations in a single day's weather range so much more broadly than the slight but potentially catastrophic rises in global temperature over decades and centuries that experience of the air seems to overpower the much subtler long-run facts. Edwards shows how our knowledge of the climate crisis rests upon the constitution of weather and climate as globally visible and manageable objects through data

108. Narve Fulsås, "What Did the Weather Forecast Do to Fishermen and What Did Fishermen Do to the Weather Forecast?" trans. Mary Katherine Jones, *Acta Borealia: A Nordic Journal of Circumpolar Societies* 24 (2007): 59–83. Thanks to Espen Ytreberg.
109. Edwards, *A Vast Machine*, 222 ff.

models, even though climate scientists chafe under having to make do with the leftovers of forecasting data instead of having data designed to assess climate.[110] The challenge with climate change is to make *chronos* as urgent as *kairos*. But we should not forget that much of the modern experience of weather is already an abstraction: moderns are people who would sooner check the weather report than stick their heads out the window. The lesson they have learned—that direct experience of the atmosphere is not to be trusted—might be applied to climate.

Clouds

Of things that paint the sky, clouds are preeminent and also deserve a full media history. The idea that they could be media is a test of the limits of the concept.[111] Indeed, clouds are often thought of as the thing par excellence without inherent meaning. Aristophanes was not the only one to treat communicating with the clouds as a ridiculous project; up to "cloud bubbles" in cartoons, which reveal what characters are thinking but not saying, clouds have had a long association with the giddy ephemerality of private thoughts. Hamlet toys with Polonius by suggesting several different animal shapes in a single cloud, making Polonius look idiotically agreeable, pliable as the clouds themselves.

> Hamlet: Do you see yonder cloud that's almost in the shape of a camel?
> Polonius: By th' mass and 'tis, like a camel indeed.
> Hamlet: Methinks it is like a weasel.
> Polonius: It is backed like a weasel.
> Hamlet: Or like a whale.
> Polonius: Very like a whale.
> (*Hamlet*, III.ii. 361–67)

The British Cloud Appreciation Society published a coffee table book called *Clouds That Look Like Things* (2005), which is full of gently droll photographs but always positions the reader as projector rather than

110. Edwards, *A Vast Machine*, 189–90, 222–24, 301, passim.
111. Thanks to Kristina Scharp for asking whether clouds are media.

discerner of nebular intention. (The society's website has many more such pictures.) If we see shapes in clouds, we are expected to know that they are nothing but figments in the eye of the beholder. Apollonius of Tyana spelled out the terms for the last two millennia. Refuting the idea that God is a cloud painter who amuses himself by drawing centaurs, stags, and wolves in the sky, Apollonius explained that "these figures flit through the heaven not only without meaning, but, so far as providence is concerned, by mere chance; while we who by nature are prone to imitation rearrange and create them in these regular figures."[112] Random clouds, imaginative viewer: nothing quite divides subject and object like clouds. There are few reading practices that are as rigorously policed to expunge projections as looking at clouds.

What would it mean to ask if clouds have meaning? Are clouds media? They are the ultimate test of the idea that there could be natural media. But first, clearly clouds are full of meaning—ask any farmer, pilot, or sailor. Aristotle was not above finding lessons about interpretation in the sky, and he noted the apparent banality in the *Rhetoric* that "if it is cloudy, it will probably rain."[113] Smoke is the classic "index" of fire, and the mushroom cloud, one of the most important facts and symbols of the postwar era, ought to silence the idea that clouds lack historicity or meaning. Whales make bubble clouds, and squids make ink clouds for art, deception, hunting, or courtship. People can stimulate clouds by seeding them, and it is against international law to use clouds (e.g., for rain or drought) in warfare. Humans also make clouds for art: Japanese artist Fujiko Nakaya makes fog and mist installations, and Dutch artist Berndnaut Smilde produces short-lived surrealist clouds *inside* of buildings. Smilde's artistic medium is as much photography as vapor, since the works vanish almost instantly (art, of course, need not be durable, as our hypothetical dolphins show us). If clouds were once solely for distant viewing, untouchable things in the sky, they are now molded and shaped by humans. Nakaya and Smilde make art fit for an age of poison gas, cloud seeding, and geoengineering. Like many other phenomena thought to be natural, clouds have become encompassed by artifice.

The meaning of clouds is the problem that art historian Hubert Dam-

112. Philostratus, *Life of Apollonius of Tyana*, trans. F. C. Conybeare, book 2, chapter 22.
113. Aristotle, *Rhetoric*, 1393a.

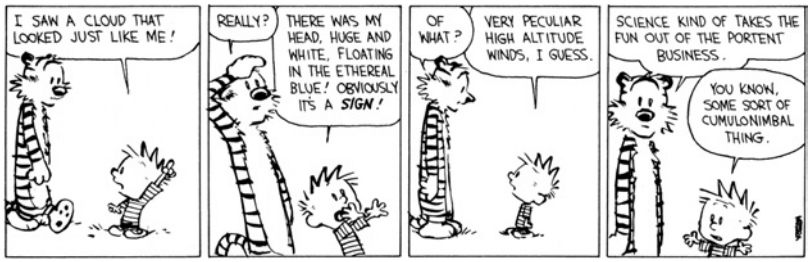

Figure 5. The meaning of clouds. Cartoon by Bill Watterson. (CALVIN AND HOBBES © 1992 Watterson. Reprinted with permission of UNIVERSAL UCLICK. All rights reserved.)

isch pursues in his wonderful *Théorie du nuage* (1972). Clouds pose peculiar problems for painting, not only because of their fleetingness and the consequent difficulty of rendering them, but because they lack edges and thus challenge the geometrical discipline of point, line, and plane introduced by Renaissance perspective. Clouds are "bodies without surfaces"—a concept Damisch takes from the notebooks of Leonardo da Vinci, who argued that painting should include such elusive objects as burning ash, mud, and clouds.[114] Damisch's task is to explain the florid ubiquity of clouds in painting since the sixteenth century; neither matter nor form, their vapory being tests the outer limits of representation. You can't specify their forms in terms of surfaces, and clouds raise the old philosophical problem of the heap—it is impossible to say where the boundary lies. Clouds exist as much in color (as Aristotle pointed out) as in shape. Their voluminous colorful shapes defy the rules of perspective, and yet clouds obsessively haunt five centuries of European painting, illustrating the psychoanalytic maxim that there is nothing so productive as a law to transgress. Their atmospheric logic defies the grid logic, and some of the most brilliant cloud paintings, such as the Ruisdael in the frontispiece of this book, combine both logics. Clouds are the goad to painterly ingenuity, a test of the ability to paint what apparently cannot be painted. China, in contrast, as Damisch notes, has a robust tradition of cloud painting, but with less anxiety or transcendence than the Euro-

114. The concept productively anticipates Deleuze and Guattari's "body without organs" (CsO).

pean; clouds exist much more in harmony with the mountain and the sea than above them.[115]

Cloud painting breaks the ancient ban on finding pictures in the sky. Wise people since Lucretius and Apollonius have taught there are no images in the clouds, and yet painters break that *Bilderverbot* (ban on images) by rendering clouds as images in all their shimmering glory. What kind of images are these? Clouds in painting can be extraordinarily beautiful, as they can be in the sky. They do not need to look like things to bear significance. They are neither icon, index, nor symbol. Gloriously, clouds pose the problem of the unrepresentable. In seventeenth-century Dutch painting, which produced some of the most marvelous of all cloud art, clouds flourish not only because they are paired with the seascape, so essential to Dutch economy and national self-consciousness, but because they do not represent any concrete images at all. Calvinism, so decisive for Dutch culture, is iconoclastic in opposing the idolatry of the image, but it also favors observation of the world in all its humble empirical detail, down to light and shadow playing on cumulus. Because of their abstraction, clouds were safe subjects for painters who sought God's touch in the least of things but did not want to risk making reifications in the sky. A clear vision of what exists in all its plainness could fully show the glory of creation.[116] Here were no heavenly hosts riding ostentatiously on pillowy clouds, as in Baroque painting—only the clouds in all their humble radiance, and that was enough.[117]

There was no more central theme in nineteenth-century British, French, and German literature, science, and art than clouds.[118] A recent

115. Hubert Damisch, *Théorie du nuage: Pour une histoire de la peinture* (Paris: Seuil, 1972), 51–52, 170–71, 180, 201, 214, 227, and passim.

116. The integrity of Ruisdael's meteorological observation has been argued in Franz Ossing, "Haarlem's Crown of Clouds: Meteorology in the Paintings of Jacob van Ruisdael," trans. Kari Odermann, http://bib.gfz-potsdam.de/pub/wegezurkunst/haarlem_ruisdael_en.pdf (accessed 3 May 2014).

117. Werner Busch, "Wolken zwischen Kunst und Wissenschaft," *Wolken: Welt des Flüchtigen*, ed. Tobias G. Natter and Franz Smola (Ostfildern, Germany: Hatje Cantz Verlag, 2013), 16–26.

118. Kurt Badt, *Wolkenbilder und Wolkengedichte der Romantik* (Berlin: De Gruyter, 1960); André Weber, *Wolkenkodierungen bei Hugo, Baudelaire, und Maupassant im Spiegel des sich wandelnden Wissenshorizontes von der Aufklärung bis zur Chaostheorie* (Berlin: Frank und Timme, 2012).

exhibit on clouds in Vienna starts in 1800, premised on the idea that 1800 marks a rough historical break when clouds became secular; and it is tempting to say that clouds stood in for the disappearance of God, but we have already seen how mixed sky motives are.[119] Nonetheless, something did happen around this moment, most notably the establishment of a scientific nomenclature for clouds by Luke Howard in London in 1802.[120] Goethe was fascinated by Howard's work and devoted much time to studying the atmosphere, assuring himself that even if he didn't learn anything certain, the sky's study provided abundant lessons in how to think. His several poems on clouds include the perfect lines: "Ich muß das alles mit Augen fassen, / Will sich aber nicht recht denken lassen" (I must take it all in with eyes / Though it does not let itself be thought). A cloud, says Mary Jacobus, is a quintessential "romantic thing" whose ephemerality and mutability embody the moodiness that romantics celebrated.[121] For Percy Bysshe Shelley, "the cloud" represented the creative nihilism at the heart of natural cycles of birth and death.

> I silently laugh at my own cenotaph,
> And out of the caverns of rain,
> Like a child from the womb, like a ghost from tomb,
> I arise and unbuild it again.

For John Constable, often considered the greatest painter of cloudscapes in the nineteenth century, clouds were gorgeous studies of color, mood, light and wind, meticulously documented by date and hour, contingent portraits of the sky's whims and emotions. These floaty aerosols are saturated with water and with meaning that humans never put there. But also with meanings that they did: J. M. W. Turner and Claude Monet painted natural water vapors mixed with smoke produced by the railroad, anticipating the mix of nature and culture that would be so dominant in the twentieth-century cloudscape.

119. Tobias G. Natter, "'I change, but I cannot die': Eine Wolkenentdeckungsreise," *Wolken*, 6–13, at 8.

120. See Richard Hamblyn, *The Invention of Clouds* (London: Picador, 2001).

121. Mary Jacobus, "Cloud Studies: The Visible Invisible," *Gramma* 14 (2006), 219–47. For romantic cloud themes, see Hermann Hesse, *Peter Camenzind* (1904). Thanks to Kourtney Lambert Peters.

Ruskin, who saw modern painting as "the service of clouds," defined a cloud as a mixture of something and nothing, and in this he named the heart of media.[122] Kittler saw nineteenth-century analog media as the conquest of white noise (*Rauschen*, as he called it) by mathematics in Fourier, Helmholtz, and Cantor, and by graphic inscription devices such as photography, phonography, and film. Writing ceased to be the domain of "the symbolic" (i.e., letters), and the kingdom of the recordable expanded to include traces of natural processes such as sound, bodies, and clouds—something painters had already been doing with the continuum of the real. Clouds were thus among the first abstract objects to be depicted, and in this they are a critical step in the prehistory of recording media. Clouds, like coastlines and cauliflowers, are fractal beings that defy the straight line and benefit from the modern ability to reckon with indefinites. Together with flowing water, they are the hardest thing to render convincingly in animation. The science of fluid dynamics has cast much light since Howard on the formation of clouds.

Clouds were a problem not only for painting but for photography as well. Indeed, early efforts to photograph clouds failed because the clouds did not sit still long enough to register on the plate; daguerreotypy's long exposure times wiped the clouds from the sky in the same way that they wiped people from the Paris streets. To avoid a flat and white sky emptied of figures, early photographers had to shoot landscape and skyscape separately.[123] In the mid-1920s, when he launched a stunning series of cloud photographs called "Equivalents," Alfred Stieglitz flattered himself that he was the first to liberate photography from concrete subject matter, a tale that some historians have perpetuated. But as Damisch points out, the problem of abstraction—of portraying an object without definite surface or shape—was there from the beginning of Renaissance cloud painting, and there was already a long history of cloud photography by the time Stieglitz started shooting. (Simultaneous with his Equivalents was the heyday of the cloud chamber to discover subatomic particles, which produced images of equally fascinating abstraction, though with a different kind of clouds.) In fact, it is better to place Stieglitz at the end of a long line of scientific cloud photographers who collected images for a

122. John Ruskin, *Modern Painters*, vol. 5 (Sunnyside, UK: George Allen, 1888), 108.
123. Thanks to Margarida Medeiros. Lucretius might approve of this expurgation.

series of late-nineteenth-century international cloud atlases; the visual affinity, as Herta Wolf shows, is quite overpowering.[124] These scientific cloud photographers were trying to make atlases of cloud types, a project with an in-built frustration. Clouds resist ontology.[125]

Some of the most remarkable images over the past half century involve clouds. Seen from outer space, the most obvious thing about the earth is that it is covered with clouds—a sharp departure from the conventions of aerial photography, which, as we have seen, usually presupposes cloudless skies. Robin Kelsey places two famous NASA photographs of the earth in the longer history of landscape painting, and argues that the prominent clouds were "discomfiting" because they stood in the place of the expected geophysical grid of latitude and longitude and thus transcended the geometric and atmospheric logics that Damisch sees as having been in tension since the Renaissance.[126] With space exploration and satellites it has become routine to see clouds, as Joni Mitchell says, from "both sides now," and they look different from space than they do from earth, as from the vertigo of a tower looking down. At first it was difficult, as Edwards points out, to make the data of satellite photography of clouds intelligible, and an art and science of reading clouds from above has developed to go with the older one of reading them from below.[127] Meteorologists have discovered what they call "Hokusai" phenomena, for instance, in satellite images of the atmosphere that resemble his woodcuts of waves. It is strange to be looking down at clouds and weather patterns from a position that defies traditional embodied experience, but perhaps even stranger to hear science, the bastion of demystifying rationality, discovering artful images in the clouds after two millennia of proscription. This is some kind of crucial historical mutation: not only is it legitimate to look for images in the clouds, but it has become urgent. Our survival may depend on knowing how to read the signs in the atmosphere.

124. Herta Wolf, "Wolken: Zum Beispiel," *Wolken*, 42–53.

125. Lorraine Daston has very exciting work in progress on the science of clouds and the limits of representation.

126. Robin Kelsey, "Reverse Shot: Earthrise and Blue Marble in the American Imagination," in *New Geographies 4: Scales of the Earth*, ed. El Hadi Jazairy (Cambridge, MA: Harvard University Press, 2011), 10–16. Thanks to Kyle Stine.

127. Chris Russill, "Forecast Earth: Hole, Index, Alert," *Canadian Journal of Communication* 38 (2013): 421–42.

Chapter 6

The Face and the Book (Inscription Media)

Language and Writing

It is human nature, I have argued, to stand on two feet, play with fire, manipulate nature (including ourselves), make graves for our kin, watch the sky, and make something out of nothing, a capacity for which language is essential. Language, an astonishing gift acquired by genus *Homo* many tens of millennia ago, must have come after fire control and cooperative social life. It gave us the ability to spin worlds with syntax and grammar, phonemes and morphemes, poetics and pragmatics, and it enabled new adventures in association and joint activity. An excruciatingly difficult subject to define, language is heterogeneous, pervasive in human affairs, an aspect of all fields of study—at once physical, physiological, psychological, social, and logical.[1] A small library has been devoted to its history, families, deep structure, sound shape, and social role. Language has enlarged the circle of sociability among humans and stimulated not only human rationality but also our distinctive higher madness, such as the ability to recite epics, synthesize anthrax, and hunt whales; to call things into being that don't (yet) exist, such as wind tunnels, unicorns, and empires; to live in the future and the past, in the optative and the subjunctive modes; and to say "if" and "not." If there is an ocean all humans swim in,

1. Ferdinand de Saussure, *Cours de linguistique générale* (1916; Paris: Payot, 1995), 25, re: *langage*, not *langue*.

it is language. It is a primal element that bathes, nourishes, connects, and sometimes betrays us.

Whether oral language should be counted as a medium is as difficult a question as whether the sea should be so counted. And my answer will be similar to that given in chapter 2: Writing is the ship that makes the sea of speech navigable. Speech is unquestionably material: speech animates the body and face, calls on the breath and brain, mouth and ears, eyes and hands. The tongue and vocal tract of an infant are like potter's clay before the phonemes of the mother tongue, and after a few years of habituation the mouth's musculature is so set that some sounds can no longer be produced. Speech is bodily, unquestionably a cultural technique, one that in principle could be possessed by other brainy beings. But its lack of durability keeps unsupplemented speech on the side of technique rather than technology.

The ability to mummify language changes the game once again. The fixing of words is as radical a transformation as the movement of sea creatures onto land. The ability to fix language in external form—writing—creates an altogether new habitat of material vessels authorized to carry human memory, mind, and history. We have outsourced much of our precious cargo to stone, wood, and silica. In Milton's striking image, "a good Booke is the pretious life-blood of a master spirit, imbalm'd and treasur'd up on purpose to a life beyond life."[2] What does this external custodianship of mind mean—our zombie fellowship with matter? How did mind take on solid states, "life beyond life?" Our speech, labor, and experience flee but our artifacts and documents endure, and this double life specifies much of our natural history and ongoing existence. Of the five elements, earth best fits this chapter, with its interest in the price of solidity.

Writing, broadly understood, is a medium that extends memory, governs transactions, empowers states, and alters the three fronts of civilization: relations within the self, between people, and between people and nature. Documents are an environment that needs management just as much as sea, earth, or sky. Writing, records, libraries, and databases can be as immersive to us as the sea is to its life-forms. "The world of artifacts, texts, media (and even cultural practices and institutions) may be for us

2. John Milton, *Areopagitica* (1644), 6:5.

what the actively created whorls and vortices are for the tuna," writes Andy Clark. [3] Symbol-laden artifacts are just as important environments for human habitation as farming or celestial navigation. The ability to sail, burn through, and constellate written words comprise some of our most important cultural techniques.

Writing provides an excellent way to consider our embedment in matter and media. Speech enables action, the changing of the political world, but writing enables work, the changing of the physical world.[4] Literate humans are amphibians who live both in the fluid of speech and, more rarely, the terra firma of writing. Spoken words are sounds, among other things, and sounds disappear. As Hegel famously put it, sound disappears by being.[5] Indeed, the voice would be unintelligible if the previously articulated sounds did not vanish to make way for the new ones; music would quickly turn into a soup of brown noise if sound did not instantly dissipate. Homer spoke of the "winged words" of speech, a natural concern for both an epic poet and for whoever wrote down the *Iliad* and the *Odyssey* in the newly fashioned Greek vowel alphabet. Speech vanishes unless it is somehow trapped. Sound is one of our greatest opening voids, one of the richest and most perishable of all things, and this doubleness helps us clarify the fashionable term *material*. Sound, as pressure traveling through a medium (air, water, earth) is material but not durable, and as we've seen with dolphins, material and durable are not the same thing. The world of writing mixes the animate and inanimate, flow and fixity.

In their enormous diversity, practices of inscription are the matrix of all other human media. Humans etched meaning into matter—in tombs and temples, drawings and rituals—long before the crucial externalization of language as phonetic writing around 5,400 years ago in the Fertile Crescent (and perhaps also Egypt). The written word is the great technical medium in its ability to convert time to space and space to time, and

3. Andy Clark, "Embodiment: From Fish to Fantasy" (1999), 14; available at www.philosophy.ed.ac.uk/people/clark/pubs/TICSEmbodiment.pdf.

4. Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958).

5. For discussion, see Josef Simon, *Das Problem der Sprache bei Hegel* (Stuttgart: Kohlhammer, 1966), 68–79, 120–23; Friedrich Kittler, "Real Time Analysis, Time Axis Manipulation," in *Draculas Vermächtnis: Technische Schriften* (Leipzig: Reclam, 1993), 182ff; and Alexander Rehding, "The Discovery of Slowness in Music," *Liminal Auralities*, ed. Sander van der Maas and Kiene Brillenburg-Wurth (New York: Fordham University Press, forthcoming).

sound to sight and sight to sound, and to do so in external material. All other symbolic media sail in its wake. Writing has equal or greater leverage on our being as shipping, burning, celestial orientation, or weather forecasting. Time reckoning stems from the sky, but time binding stems from the ability to fabricate and interpret durable arts that survive time.

The human stakes of writing as a form of communication is a topic beloved of media theorists, and this chapter revisits it in light of the resurgence of writing as a means of everyday interaction in the digital era. The written word is one of the clearest historical continuities between early civilization and the latest innovations. Writing has roared back to the center of everyday communication practices. A total of 7.8 trillion text messages were sent in 2011, more than a thousand for every living human, and that ratio will be much greater by the time you read these lines, though the genre will probably decline in popularity at some point. According to some sources, the average American spends twenty-three hours per week online (a figure that must have a large standard deviation). Writing, the ancient technology of the crypt, now fills everyday interactions. Writing, of course, has been at the heart of social interaction for traders, scholars, and distant lovers for ages, but digital media, whatever else they are, are machines that convert everyone into writers.

Assessing writing's world-historical place is not an easy thing. I have much sympathy for Jorge Luis Borges's saying that paradise would be a kind of library, so my story will express little nostalgia for the oral past beloved by media historians who, working in McLuhan's wake, believe with him that literacy brought "a train of maladjustments."[6] But the written word is indeed hazardous, like all forms of leverage and shipping. Writing is a chief craft that our species sails in; it moves us across the seas of time and puts us at risk of wreckage. "There is no Frigate like a Book," said Emily Dickinson. When someone had been reading aloud at great length, Diogenes the Cynic stood and announced, "Cheer up, men, there's land in sight," pointing to the blank space at the scroll's end.[7]

Whatever is meant to remain has to be written in some way. Writing saves. It creates strange alternate universes parallel to and sometimes

6. Marshall McLuhan, "The Later Innis," *Queen's Quarterly* 60 (1953): 385–394, at 387.
7. Diogenes Laertius, *Lives of Eminent Philosophers*, trans. R. D. Hicks (Cambridge, MA: Harvard University Press, 1925), 38.

more real than whatever other worlds we live in. Writing is portable, addictive, expensive, labor-intensive, never mastered, shunned, marvelous, and treacherous. In the end I do not think the text is the same as the universe, but it's awfully close. Yet if you subtract texts from the universe, something remains, just as the sea does without the ship. Almost all humans speak, many write, but all live in a world governed by writing. Writing is preeminent among "advantages so dearly bought" (Thoreau). Our lives unite flesh and word, spirit and letter, and the marriage has not been easy.

Writing was perhaps the primal form of disembodied communication among people. How to simulate the feeling of presence (sometimes called telepresence) has been of interest for digital designers for at least two decades, but scramblings of body and text have been part of our logistical complexities for millennia. Interaction at a distance is perhaps coterminous with the human condition. We shouldn't pretend that it has cropped up only since the appearance of letters, the telephone, text messages, or Skype. Graves, some of the first signs of behavioral modernity, are material investments for extending time between past and present. Emperors have bragged of their might in stone, or sealed their tombs with curses, addressing unknown future generations, claiming the attention of the future. The apostrophe—addressing the king, loved one, God, the lady—is one of the oldest poetic devices. (Lyric poets usually address absent objects.)[8] One of history's great love affairs, that of Abelard and Heloise, was conducted mostly by letter. New social media take us back to the beginnings of distant interaction, to the grave and all its mysteries.

Mediated communication blurs "live" and recorded contact. In stored meaning-machines such as writing, the living and the dead can impersonate each other, as Socrates complained. It is utterly routine to read words from people who are dead; much of the uncanniness of that act has rubbed off, though the voice calling from the beyond can still take us by surprise. Recording blurs the status of the living and the dead. This is the key point. Any medium of recording used for interaction creates uncanny possibilities not fully present in face-to-face talk. Such leverage appeared first in writing and later in the analog media of the nineteenth

8. See Jonathan Culler, "Apostrophe," *The Pursuit of Signs* (Ithaca, NY: Cornell University Press, 1981), 135–54.

century. As I have argued in an earlier book, faces and voices, thanks to new analog audiovisual media, took on a new lightness and volatility. In photography or cinema, in sound recording or the telephone, effigies of personal identity only loosely tethered to the body could circulate in a new spirit world. Voices propagated by wire or air; faces were held by screen or paper. When we traveled—moved our bodies across space—we could sometimes catch up with the phantasms that had gone before us by letter, telegram, phone, or photo. My great-grandparents first "met" each other in the early 1890s via an exchange of photos brokered by a third party. An exchange of letters followed, and finally they met in person. This is the world that our ancestors around 1900 learned to live in, the human presence enhanced by diverse audiovisual doubles; spiritualists made great use of the picturing and sounding powers of analog media, but schizophrenics took literally thoughts flying through the air, vibrations reorganizing our bodies and minds, and tokens of selfhood going apart from ourselves. The troubles of flesh and word, presence and absence, that are so salient a part of social media today have a longer history, which this chapter tries to outline. Let's start with the flesh.

The Body as Medium

The body, a mix of sea, fire, earth, and sky, is our most fundamental infrastructural medium. Humans, like all mammals, emerge from a history of life billions of years old. Our bodies feature ancient clocklike subsystems in our brains, extinct viruses in our DNA, bacteria in our guts, and endosymbiotic mitochondria in every cell. "We are a commonwealth," says Geoffrey Bowker. And the human organism is composed of many internal environments. Our neurological function is inseparable from the skin, musculoskeletal system, and sensory organs. Our brains are worn throughout our bodies, and our retinas are the brain's outposts in our eyes. Our body is composed of overlapping ecosystems and is an environment of environments. The boundary between organism and environment does not lie only at the skin.[9] This is true for all the body, but especially the brain. Mind is to brain as ship is to sea: the set of arts that

9. John Dewey recognized this in *Art as Experience* (1934; New York: Perigree, 1980), 59.

manage and make habitable the mysterious, chaotic, never fully fathomed natural element.

If media theory is in part the question of what it means to be in a body, then there is no better guide than André Leroi-Gourhan. Evolutionary history is a kind of massive biomechanical experiment, "an extraordinary paleontological adventure," that starts with the anterior field (*champ antérieur*) as the main mode of orientation and interaction with the world.[10] Leroi-Gourhan is the master thinker of the constraints in bodily shape; for him the history of evolution looks like an animated film full of elastic bodies. There is a parallel history, he shows, of organic and inorganic life: one we call evolution, the other we call technics, but with humans the two rivers have flowed together. For Leroi-Gourhan, artificiality and artifactuality do not begin where our bodies end. Despite external banks, vessels, and archives for storing our minds, we should not think of our bodies as completely natural, or of technology as completely external. Much work inspired by Michel Foucault makes this point, but its exposé of the body's historical saturation tends to stay at the level of phenomenology—that is, of the ways in which bodies experience and desire. But even more radically, though on a much longer historical scale than Foucault worked on, our bodies and minds are technical and cultural in their anatomy and physiology. They have evolved to flourish in artificial habitats in which we can burn meanings from plants, animals, the earth, and ourselves. We carry symbolic architecture in our bodies from heel to head. Our essence roots in certain givens—terrestrial residence, two-footedness and upright posture, small teeth, large brain, and the dual fields of face and hand—that emerge from a technically pressured environmental history.[11] Our bodily infrastructures—skulls, teeth, and feet—are historical, cultural, and technical in shape and function.

This is especially true for the face and hand. Almost all organisms, starting from protozoa, lead with the mouth (sponges are an exception). The heads of fish combine ingestion, sensation, and prehension—functions later differentiated for other animals. Most fish, birds, and ungulates have

10. *Gesture and Speech*, 25, 19, chapter 2 passim; *Le geste et la parole*, 1:34, 41; trans. modified.
11. For another media theorist interested in bodily symmetry; see Vilém Flusser and Louis Bec, *Vampyroteuthis Infernalis*, trans. Valentine A. Pakis (Minneapolis: University of Minnesota Press, 2012).

only a facial mode. If most fish want to eat or grasp something, they have only one option. The only way in which a horse can mold matter (besides trampling) is with its head and mouth, and it has a set of teeth that allow for diverse kinds of interactions with the material world (a good indicator of a horse's age and health history). An elephant has the most advanced of all facial apparatuses. Other animals have a manual mode as well: fish with short limbs, raptors, bears, primates. Facially-oriented animals tend to live on food that is abundant and relatively easy to obtain, such as grass for horses and cows. "Bipolars," endowed with both facial and manual modes, eat more energy-packed food that requires hunting and manipulation (fruits, nuts, etc.). A rabbit, having only a facial field, is a herbivore, while its cousin the rat, having manual dexterity, is an omnivore. All graspers possess the potential for technicity. Humans are unique among bipolars in having forelimbs liberated from locomotive contact with the ground, which frees the hands for technics—and for communication. The hand makes, gestures, and caresses, and it played a role equal in importance to that of the face in the evolution of communication among humans.

To define the human, Leroi-Gourhan does not point to intelligence, sociability, or fire, but—quite infrastructurally—to the feet. Humanity starts with the feet.[12] The key definers of humanity are posture on two feet, free hands, and a short face. Our feet both enable dance and poetry (whose basic unit is the foot) and drive evolutionary change. For fish, water supported the weight of the head, but the transition to land brought new mechanical stresses. The human brain may be a triumph of evolution, but it's a passive passenger shaped as a by-product of running and walking.[13] Being precedes consciousness: "The development of the nervous system follows in the wake of that of the body structure."[14] The shape and volume of the cranium are set not by the size of the brain, but by the stresses of jaw and neck. Chewing shapes the human body by im-

12. *Gesture and Speech*, 149; *Le geste et la parole*, 1:211: "L'humanisation commence par les pieds."

13. For a more recent case made for the biomechanical payoffs of upright posture for our brains, see Daniel Lieberman, *The Evolution of the Human Head* (Cambridge, MA: Harvard University Press, 2011).

14. *Gesture and Speech*, 50; *Le geste et la parole*, 1:75: "L'aménagement nerveux suit celui de la machine corporelle."

posing stresses on the cranial dome. Differentiated teeth (heterodonty) and shrinking jaws allow the human skull to balloon, suspended behind the face on the neck. The two canines and molars are the pillars on which the face is constructed. Our teeth are a kind of evolutionary archive. Incisors, canines, and molars equip us with varied tools for catching, tearing, and mashing. Our hands, in allowing us to find and prepare food apart from our face, helped liberate our mouths from toothiness, and thus freed the skull to grow a large brain. The short roots of our canines, in other words, allow us to think about and notice such things.

Our facial shape and brain size are thus results of both biological and technical evolution, due in part to the liberation of the brain from the teeth by fire and cooking. The human form suggests technical shaping at its core. "Human technicity," Leroi-Gourhan suggests, is "a simple zoological fact." Human zoology, in turn, is also a technical fact. The architecture of the body and brain witnesses to the history of its pressures and adaptations, and our brains and bodies retain remnants of every step in evolution since the sea. Our sociability, adds Leroi-Gourhan, is motivated by a relatively short digestive tract that cannot digest cellulose (grass). We could never be lone ruminants on the plains, eating an infinity of abundant grass. Most living biological matter, in fact, is indigestible by humans.[15] (That doesn't mean we won't eat it.) The nature of our bowels required us to live in groups in which we could share rare "fleshy foods" (*aliments charnus*) high in calories, protein, and fat. Technical externalities and physiological constraints are part of our species history.[16] Natural history is the open book of media theory.

The body is strange and inaccessible indeed. The insides of bodies are hidden from view, but the outsides are also hidden, and not only by culture. An odd, brilliant story by David Foster Wallace reports the case of a boy who conceived the ambition to touch his lips to every square inch of his body. Mastering contortionist poses to the point of injury, he manages an ever increasing conquest of his own epidermis over the course of several years. Yet some parts remain forever inaccessible—the neck, the bottom of the chin, and the lips themselves. "We are all of us self-inaccessible," notes the narrator, "and can, for example, touch parts of

15. Diamond, *Guns, Germs, and Steel*, 88.
16. Leroi-Gourhan, *Gesture and Speech*, 149–50, *Le geste et la parole*, 211–12.

one another in ways that we could not even dream of touching our own bodies . . ."[17] There is no parity between the facial and manual systems in self-knowledge. With the possible exception of a spot in the middle of the upper back, the hands can touch every part of the body; the face cannot. We cannot touch or see significant territories of our skin, cannot see our faces except as reversed in mirrors or mediated in photography, and have little understanding of the secret workings that go in inside of the body. When something goes wrong, we go to a medical expert in the same way we take our cars to a mechanic.[18] We should not assume that the individual has privileged access to either the physical or psychical self.

Gesture, Speech, and Writing

Writing is an embodied practice, but there are more direct bodily modes. Our modes of social interaction have long been wildly diverse, and the nonequivalence of verbal and nonverbal modes is basic to the ways we interpret each other. The so-called nonverbal cannot survive translation into words without loss. A handshake says "This is not a fist," but also much more. Showing up to visit the sick says more than sending a note. (A handwritten note, in turn, would mean more than an e-mail, because it performs sincerity by showing a greater investment of time.) "What can be shown," said Wittgenstein, "cannot be said." Apes and otters, as Gregory Bateson noted in the 1950s, have no way to say "This is play," but they can perform it, turning a normal action into a signal by suspending its normal consequences. The only way to prove that a nip is not a bite or that a tickle is not an assault is to not follow through with the nip or tickle. Without words to mark the suspension of the norm, it must be shown. Showing, because it is so vague, is less stable than saying. Playful nipping can turn into serious biting in an instant.[19] This is the deep well

17. David Foster Wallace, "Backbone," *New Yorker*, 7 March 2011, 69; an excerpt from *The Pale King*.

18. Paddy Scannell, *Television and the Meaning of* Live: *An Inquiry into the Human Situation* (Cambridge: Polity, 2014), 64, 232n5.

19. See Gregory Bateson, "Why Do Frenchmen" and "A Theory of Play and Fantasy," in *Steps to an Ecology of Mind* (1972; Chicago: University of Chicago Press, 2000), 9–13, 177–93.

of meaning in the nonverbal, rather like the powerful and vague meanings we have seen in fire.

Physically co-present communication has deep biological foundations. For primatologist Frans de Waal, the physical choreography of conspecifics has an ethical import. Embracing the tie between biology and politics that has existed since Aristotle, he joins the battle with colleagues such as Richard Dawkins. Seeing moral feeling as a thin crust artificially superimposed on a supposedly animalistic, brutal, and selfish mode of life does wrong, de Waal argues, not only to humans but to animals. De Waal views neo-Hobbesians such as Dawkins as not only politically tendentious but scientifically wrong, since a sense of justice is deeply rooted in, and evolutionarily selected for within, gregarious animals. Bodily mimesis builds emotional ties in many species: birds and humpback whales learn songs from each other, and dolphins and primates are famously avid copiers. Mice are capable of "pain contagion" or alarm for hurt fellow mice if they can see them. Dogs and wolves engage in consoling behavior to comfort the losers of fights and rebuild the bonds of the group. Elephants weep, and seem among the most empathetic of animals. (On the whole, apes are more empathetic than monkeys, and women more empathetic than men.) Body-to-body care has a long evolutionary heritage.[20]

People get a charge out of being together with other people, and clearly take pleasure in bodily synchronization.[21] Clapping, yawning, laughing, dancing, marching, and subtler forms of motor mimicry lie at the core of social life. Body mapping starts early in infancy, and from then on, we map our internal feelings of our bodies onto others and thereby strengthen our emotional bonds with them by physically doing what they do. (Mirror neurons have been suggested as playing a key role.)

What is called, rather diminishingly, nonverbal communication is clearly older than language. The best proof is the perpetuation of the species, the unbroken chain of generations, which suggests some kind of history of emotional and sexual interaction. Sexual pair bonding is nearly

20. Frans de Waal, *The Age of Empathy: Nature's Lessons for a Kinder Society* (New York: Broadway Book, 2010).

21. William H. McNeill, *Keeping Together in Time: Dance and Drill in Human History* (Cambridge, MA: Harvard University Press, 1995).

two million years old among genus *Homo*. To sustain lifelong attachments before language, a rich repertoire of meaningful signs and gestures must have developed. The basic facial expressions for fear, joy, anger, and surprise, for instance, seem more or less universal among humans. So much is said by sigh, moan, and motion. There is an eloquence no words can catch in rivals wrestling, lovers nestling, or mother nursing child. Indeed, all sign languages, despite their great diversity, share some basic semantic content, since the meaning of some gestures and facial expressions seems inherent. This is in stark contrast to spoken languages, where the match of phonology to semantics is almost entirely arbitrary. The voice is infinitely full of nuance and meaning. Something is said by pupil size, posture, the tilt of a hat, or a haircut, but it's hard to say what. Actors, vocalists, and stylists own this vast realm of nonlinguistic expression. A great actor can put years into a single glance. A face can change your life: one look at Anna Karenina, and Vronsky is lost.

Language completely remodeled meaningful presence. The emotional infrastructure of our interpersonal relations was perhaps forged in the Pliocene, though it has been renovated many times since. Some popular evolutionary psychologists write as if humans had not been radically remade by the crafts of fire, language, civilization, and writing. It is true that vast deposits of ancient emotions may fuel our later engines, but our natural history is dynamic. The way in which gestures work, for instance, has been changed by language.[22] The boundary of language and gesture is vague, as Austin's theory of speech acts shows. A nod can stand in for "yes." In Greece, sticking out one's chin and raising the eyebrows is the same as saying *όχι* (*okhi*) or "no." A signature is a famous example: not simply linguistic, as legibility is not required, it is a name, icon, gesture, act, and utterance all at once, a work of the hand backed by the entire body.[23]

For Leroi-Gourhan, language was always audiovisual and in the joint custody of face and hand. The hand was the main medium of gesture, and the face the main medium of vocalization: there was a language of sight

22. David McNeill, *Hand and Mind: What Gestures Reveal about Thought* (Chicago: University of Chicago Press, 1992).

23. Béatrice Fraenkel, *La signature: Genèse d'un signe* (Paris: Gallimard, 1992). Thanks to Ben Kafka.

and a language of hearing. Many of the hand's first gestures were technical operations with tools. Tools for the hand and language for the face, the manual making of things and the facial expression of emotion—this was the human arrangement until drawing and writing scrambled everything, putting language into the hand and breaking the monopoly of the face.[24] The stuff of meaning became worldly, as Arendt says—subject to endurance. We have seen that marine intelligences could in principle be capable of what Arendt calls "action," the ability to transform relationships within the polity forever, something that all entities with developed "facial" systems could achieve. We too are facial animals, and most of what we do vanishes forever, just as fluidly as dolphin doings do. But writing involves what Arendt calls "work," a permanent world of things capable of bearing meanings outside of anyone's body or brain. Before writing or drawing, language existed only in gaseous or fluid, never solid, states, although its effects could be lasting. The brain sits in a skull, but mind can sit in reified forms of all kinds. Mind is the ship that sails through the ocean of the brain.

Telepresence and Presence

Interacting in the flesh is ethologically rich: so much data on so many channels. That it is also dangerous was the great theme of Erving Goffman and of fellow students of civility from Freud to Norbert Elias. There is so much, primarily embarrassment, at stake when you meet another person. So many decisions! Should we shake hands, kiss one cheek or two, and is my breath fresh? In face-to-face interaction, split-second timing is fraught with significance—small pauses are data-rich ways to interpret affect, and never are fully under voluntary control. The face's microexpressions give off involuntary attitudinal clues. In real time, people always give themselves away. Text messaging, Twitter, and Facebook, like earlier forms of writing, suspend the risks of real time. Even a split second of "time out" helps manage self-presentation; in face-to-face communication, the clock never stops. The ability to stall time is the most potent of all tools. In online posts and comments, for instance, people have a few

24. *Gesture and Speech*, chapter 6, esp. 149–50; *Le geste et la parole*, esp. 270, 272.

moments to polish their witty repartee in a way only the most gifted conversationalists could manage in real time. Like quantum computing, the medium of writing allows a sideways step into a parallel world that is unreachable in the relentlessly serial universe of face-to-face talk. As Plato complained, writing can serve as a performance-enhancing drug; you always get a second chance. On Facebook, everybody gets to be Oscar Wilde.

Online interaction also mitigates the risks of body, spine, and feet. In cyberspace we need not worry about a growly stomach, an errant sneeze droplet, or a postprandial dental remnant. We don't get to see how tall others are, what their feet are doing, or whether their legs are crossed. A neglected zipper or the postural effects of high heels play no role. A keyboard can negate a stutter or mask an unpleasant voice. Computer-mediated communication pushes many of the ancient information-laden sources of sizing each other up to the background. If humanization starts with the feet, what does the footlessness of cyberspace mean? Having our feet in the same place as those of others matters in some way. Everyone knows that the best indicator of a person's class or attitude is their shoes. Online it is hard to know where you stand, or to put yourself in someone else's shoes. How will you put your best foot forward? Online, as at sea, it can be hard to find your footing. Who will invent the app to provide pictures and status updates about the feet of kith and kin? Will they call it Footbook?

In 1999 Bill Gates asked: "What is it about sitting face to face that we need to capture? We need software that makes it possible to hold a meeting with distributed participants—a meeting with interactivity and feeling, such that, in the future, people will prefer being telepresent."[25] The information technology business has always wanted to wean people from physical presence; the project of designing interactive environments preferable to "being there" has already succeeded beyond Gates's wildest dreams, but with a twist. People prefer being telepresent via Facebook, Twitter, and text messaging not because the software provides the "feeling" of "sitting face to face," but rather because it doesn't provide it at all. Text-only communication lightens social anxieties. Telephone talk

25. "Gates sees personal data, telepresence as future software issues," *MIT News*, 14 April 1999, web.mit.edu/newsoffice/1999/gates2–0414.html, accessed 21 March 2013.

is not as fraught with body perils as is a face-to-face meeting, but you still have to negotiate openings, identification, and exit strategies—none of which are required in texting.[26] In the story that began chapter 1 of this book, Amos Oz's parents found nonverbal richness in the oral medium of the telephone. Texting, in contrast, provides relief from that barrage of data and can be so exceedingly minimal that texters have developed ways to signal mood by the speed of response, diacritical marks, nonstandard spelling, and each person's style and dialect. (Intimates can read a crucial difference between "Hi" and "Hiiii!" and the period is often read as a mark of anger.) Hunting for minute cues happens, of course, in every communicative setting; but meeting face-to-face at least guarantees a setting people have been using, if only somewhat successfully, for hundreds of thousands of years.

Online interaction reduces what my colleague Andy High calls "emotional bandwidth." In text messages, you don't have to decide whether to identify yourself, know how to greet the recipient, or ask how they are doing. Compared with a telephone conversation, a text message is decapitated and legless: no beginning, no end, only body. The meeting of two members of the same species has always brought special problems of violence or alliance, sexual threat or friendship. Online interaction changes the recipe by seemingly taking the body out of the equation and scrambling the rules of animal behavior. Could Hegel's master-slave dialectic take place on Twitter? He figured it as a primal face-off between two men struggling for recognition, and physical presence was essential to the way he imagined it. But battles to the death for the sake of honor do in fact crop up with exceeding regularity in the gratuitous combativeness of talk online. The implicit social contract that governs everyday talk seems attenuated online. So-called "trolls" and other self-appointed harassers can get away with sociopathic behaviors online that would be hard to do elsewhere. The online world breeds styles of maliciousness that seem perversely fitted to the narcissism and solitude of the act of writing, something that obeys laws very different from those of orality. Writing takes its revenge in the age of digital media.

We should beware of any platform of communication that pretends

26. Robert Hopper, *Telephone Conversation* (Bloomington: Indiana University Press, 1992), 13ff, passim.

there is no difference between interaction online and face to face. Facebook pretends to be a forum for sociability, when everything that takes place on Facebook is logged and registered somewhere, allowing both for a collection of data and a preservation of ghosts that doesn't happen in speech. Recording, again, blurs the living and the dead, and online it is harder to tell whether or not your conversation partner is a zombie; social media are a new habitat for the dead.[27] Life, like fire, means stuff burning into the air, like the smoke of speech. Such vanishing is the great sign of life. The face and the book are two very ancient modes of communication and power, and you can't just smash them together and expect everything to go happily. To pretend that the medium of writing can handle the material of everyday social relations, as so many digital media applications do, is indeed a recipe for a train of maladjustments.

Social media are an interesting mutation in the history of communication that reveals older patterns, such as the great utility of reduced bandwidth. The old oral world of face-to-face interaction is not necessarily more real or vital than artificially mediated ones. Presence, of course, is a medium too.[28] Writing brought my great-grandparents together and, in ways the rest of this chapter will show, has been the chief medium for manipulating time and space. But in defending mediation, I do not want to imply that the longing for real-time presence is some kind of metaphysical mistake. The metaphysics of presence, as Jacques Derrida called it, might be a harmful philosophical confusion—but the erotics of presence, while also confusing for different reasons, is a species requirement. People long to be with their dear ones not because they harbor the illusion that presence and voice yield privileged access to the other's soul that writing cannot afford. If it's mind you want, and many do, then writing is better. But we also want and need each other's bodies and presence, and not only in a sexual way. Live presence will never lose its pull or charm. Some recent research suggests that being with other people

27. See Alice Marwick and Nicole B. Ellison, "'There Isn't Wifi in Heaven!' Negotiating Visibility on Facebook Memorial Pages," *Journal of Broadcasting and Electronic Media* 56, no. 3 (2012): 378–400.

28. Ilana Gershon, *The Breakup 2.0: Disconnecting over New Media* (Ithaca, NY: Cornell University Press, 2010), 93–101, shows how explicitly college students have started to see co-present communication as a media choice.

encourages physical health, specifically vagal tone: the robustness of the vagus nerve that connects brain and heart.[29] This kind of finding is hard to interpret, but the evidence that people actively seek presence to build trust and bonds is everywhere. The right of assembly, notes Todd Gitlin, is one of the most underrated parts of the First Amendment; we still gather according to ancient underrated modes of interpersonal mimicry.

What is at stake in all this is the status of the body in cyberspace, a subset of the question about the body in any medium. At first, with the emergence of the World Wide Web in the early 1990s, a rhetoric of happy neoplatonic bodiliness popped up: the online world was an immaterial realm where we could leave the body behind and take on new identities regardless of our skin, weight, or gender.[30] "On the Internet," in Peter Steiner's famous 1993 cartoon, "nobody knows you're a dog." Today hardly anyone believes that cyberspace offers up a cloud heaven of mind-only communication. It became obvious almost at once that fixed identities, rivalries, and domination crop up there as fast as in any other human domain. The Internet may be full of plastic morphing bodies like the cephalopods that Jaron Lanier and Vilém Flusser adore, perhaps especially on dating sites,[31] but it is also full of much less malleable material—naked pictures, blackmail, and what the Russians call "*kompromat*"—that has caused the misery, ruin, and suicides of many; the bodies—Tyler Clemente, Amanda Todd, James Arnt Aune, to name two famous suicide victims and one I knew—will continue tragically to pile up offline. The Internet is a breeding ground for fantasy bodies, "one big orgy, an endless informational bacchanal" for memes, spam, porn, and their human hosts—a destructive, volatile zone not at all the safe, happy place that the Internet companies paint it to be.[32] In this way, it is like an older habitat, writing.

29. Barbara L. Fredrickson, "Your Phone vs. Your Heart," *New York Times Sunday Review*, 23 March 2013.

30. Ken Hillis, *Online a Lot of the Time: Ritual, Fetish, Sign* (Durham, NC: Duke University Press, 2009); Imar O. de Vries, *Tantalisingly Close: An Archaeology of Communication Desires in Discourses of Mobile Wireless Media* (Amsterdam: Amsterdam University Press, 2012).

31. That dating sites are the natural home of Lanier's morphing cephalopods I owe to two papers in my spring 2013 undergraduate class by Norah Bushman and Amanda Smith.

32. Jack M. Balkin, "Information Power: The Information Society from an Antihumanist Perspective," papers.ssrn.com/sol3/papers.cfm?abstract_id=1648624, accessed 12 April 2013, p. 4.

Writing as a Power Technology

Next to the domestication of fire, plants, animals, and of humans themselves, the invention of writing constitutes probably the greatest technical transformation in human history (unless we count upright posture or language as technical inventions, which we have good reason to do). Like fire, writing has terrible powers. Its ability to preserve meanings makes it explosive and dangerous. Like all other domesticates, writing has never been fully tamed, and can occasionally run amuck. (We have all been burned by fine print.) Things in writing can come back to haunt us—or rescue us. Every document is a "little sorcerer's apprentice."[33] Written words have an oracular quality, like zombies from the realm of the dead. They keep on saying the same thing over and over again, as Socrates complained in Plato's *Phaedrus*, and depict creatures as if they were alive though they are dead; Socrates almost makes writing sound like a display of mounted animals (zoographia).[34] Writing can determine our fates ("the writing on the wall") and decide between life and death. "If only not to know how to write," lamented conquistador Hernán Cortés, "so as not to have to sign death sentences."[35] Writing, as a medium that allows voice and mind to transcend the grave, has a long-standing association with death and death-dealing men.[36]

Whenever one takes pen in hand, even in the most ordinary situations, one opens unforeseeable chains of events, large or small. The taxidermy of words changes their force enormously. Speech and writing play by very different rules. Writing's incendiary quality is one reason why so-called social media will never be like face-to-face speech. The introduction of the medium of writing in its diverse forms and practices has had enormous consequences. Whatever group has possessed it has invariably outwitted those that did not. Writing is not simply a storage device for words and data; it is also, like all media, a power technology. Its

33. David Michael Levy, *Scrolling Forward: Making Sense of Documents in the Digital Age* (New York: Arcade, 2001), 38.
34. Plato, *Phaedrus*, 275d.
35. Bernal Díaz del Castillo, *Historia Verdadera de la Conquista de la Nueva España* (Mexico City: Porrúa, 2004), 97. "¡Oh, quién no supiera escribir, por no firmar muertes de hombre!"
36. Walter J. Ong, *Orality and Literacy: The Technologizing of the Word* (London: Routledge, 1982), 81.

raw power is less its content than its leverage. It is a key part of civilization that goes together with such lasting facts as the division of labor, bureaucracy, and male supremacy. (The history of writing is also the history of domination.) The need to make an inventory of goods, record labor or debts, immortalize the doings of kings, or check the accuracy of a genealogy go only with a certain kind of society. "To put it crudely, early writing presupposes a powerful state—which over most of human history has meant some form of kingship."[37] Writing enables remote control over people and goods, but also over time and space. The Christmas story in Luke 2 begins with Caesar Augustus doing what emperors always do: decreeing not that "the whole world should be taxed," as the King James Version puts it, but that the empire should be inscribed—into a database. (The Greek term used, *ἀπογράφεσθαι* [*apographesthai*], is the precise forerunner of Kittler's *Aufschreibesystem*.)[38] States feed on documents as steam engines feed on coal. A written contract binds the future, an archive preserves the past, and writing has always been the best means of managing events, agents, and inventories at a distance.

"Writing," says Barry Powell, "is magical, mysterious, aggressive, dangerous, not to be trifled with."[39] Its long use by the market, the palace, and the temple has given it enormous, sometimes violent power. Poststructuralist writers like to point out that German verb to write, *schreiben*, contains *Schrei* (scream), just as the French noun *l'écrit* suggests *le cri* (the cry). Writing has exaggerated and amplified effects over communication, politics, and history. The prudent man gets it down in writing. Signatures can send some to their deaths, and a few well-placed zeroes can make others enormously rich. People expect a real signature, a bit of blank ink squirted from a living hand, in exchange for death. A scandal broke in 2004 when it was discovered that Donald Rumsfeld, George W. Bush's secretary of defense, had used a signature machine to sign condolence letters to the families of soldiers who died in Iraq. The blood of one body did not even merit the ink of another. We all understand Woody

37. Michael Cook, *A Brief History of the Human Race* (New York: Norton, 2003), 47.
38. Cornelia Vismann, *Files*, trans. Geoffrey Winthrop-Young (Stanford, CA: Stanford University Press, 2008), 5.
39. Barry Powell, *Writing: History and Theory of the Technology of Civilization* (Malden, MA: Wiley-Blackwell, 2009), 11.

Guthrie's point that some men will rob you with a six-gun and some with a fountain pen.

For millennia, writing was the sole option for sending culture across the expanses of time (recording) and space (transmission). What was not written disappeared into the air or took root in the fickle soil of memory. Indeed, oral memory seems to last a few centuries at best.[40] Writing was as radical a change as sea animals taking to land: both required adaptations to a world of fixity. Such fixity enables spatiotemporal enlargement in the radius of communication. Postal and messenger systems kept people in touch at geographical distances, and writing in all its formats—monuments, scrolls, codices, scripture, libraries, and archives—kept people in touch across the wide prairies of time. Writing was the sole means of cultural storage in Kittler's famous Innis-like concept of the *Schriftmonopol*, or monopoly of writing.[41] Inscription was once the only way to store up anything for future generations—whether poetry, law, religion, history, genealogy, property rights, or even music, dance, and cuisine. (I count notation systems—such as musical scores, mathematics, chemical formulas, and architectural plans—as forms of writing.) Incessant scribbling was the only bulwark against the mischief that time plays with memory. Writing may seal our fate forever, but it also gives us a shield against time's arrow. Like squids, the modern bourgeoisie secretes streams of black ink, making pseudomorphs to fend off our enemies such as death.

Like every topic treated in this book, writing and its history could take a lifetime's study. About it there is much to be said—and so much that has been said. A history of writing would have to be self-reflexive, inasmuch as it would be a history of history itself. Writing is the bias through which we read history, and our access to the history of writing—and the history of almost anything else—comes from writing. There are so many things such a macrohistory should treat. We could discuss the history, for instance, of the traditional gender division of labor between text and textile; of the prestige and beauty of calligraphy among Chinese scholars or Islamic clerics; of writing implements such as chisel and calamus, quill and typewriter; of the Jewish scroll and the Christian codex; of the print-

40. Cook, *A Brief History of the Human Race*, 142.
41. Friedrich A. Kittler, *Gramophon Film Typewriter* (Berlin: Brinkmann and Bose, 1986), 12.

ing press and its shaping of national languages and identities; of double-entry bookkeeping and modern capitalism; of paper's role in money and mathematics; of writing's religious role as scripture and guardian of memory; of its epistemic role as database of learning or its devious use as a tool of subjugation and resistance; of literature in all its varieties; of archives stretching from the library of Alexandria to Google; of memory; of literacy and the rise of the modern self or modern novel; of the arts of typography; or of the discipline of eye, ear, throat, hand, spine, and even derriere in writing. (*Sitzfleisch*, as it is sometimes known, is a key part of the writer's tool kit.) The particularities of the medium of writing have long given different actors and operators chances to swing things their way.

My focus here is on writing as a medium rather than as an array of practices. Some will object to my talk of "writing" in general, correctly noting the dazzling variety of work people have done with writing in history. As with fire and sky media, I do not mean to slight the great variety of practices and modes of power that writing affords. To use a distinction that the English term *writing* does not make, I focus more on *l'écrit* or *Schrift* (nouns) than *écrire* or *schreiben* (verbs)—more on a set of possibilities or a medium than on a history of activities. Despite its world-changing powers, writing has become so integrated into our lives that it can be hard to fully appreciate its historic and lasting importance. Like other taken-for-granteds such as walking on two feet, finding north, living at a settled address, or telling the time, writing invites infrastructural neglect, but is full of wonder and mystery if we start to grasp the worlds it enables.

The Most Momentous Technical Innovation

Imagine a new cultural technique. People would sit together in each other's company, completely ignoring each other, and absorbed in their devices with impunity. Lovers would retreat to the privacy of their rooms, preferring it over face-to-face presence. It would capture people's private thoughts and memories as if in a holographic form, making the inner contents of minds accessible to self and others, to whoever came within range and knew how to use the technology. Learning to use it would take

years of people's lives, often with incomplete mastery. People could not imagine life without it. Whole arts and sciences would develop that were completely dependent on it, as would bureaus of state, trade, medicine, insurance, accounting, and the census. A society that possessed it would invariably have power over others that didn't. People would spend hours and hours immobilized using it, and critics would grow hoarse complaining about their pleasurable self-absorption. Dogs would stare at their masters, wondering why they had retreated to vacancy.[42] People would damage their eyes and strain their backs. This strange medium would take people away from their immediate social and sensory worlds, and subject their heart's desires to mysterious logics that came from afar. It would make culture into something so big and vast that nobody could oversee it. Religious people might even say that they loved it more than God.

This technology is obviously writing (and not the Internet). As one would expect with everything humans do—our species, like nature, sports gratuitously—reading practices are enormously various.[43] Today we tend to have a reverent attitude toward the written word. But our high estimate of the cultural worth of reading and writing is not universal in history. New media are criticized and old media are cherished, says Mitchell Stephens.[44] Writing has long been ferociously criticized for its association with death and fixity or with social isolation and solipsism. In the eighteenth and nineteenth centuries it was not unusual for alarmed critics to complain that writing isolated people into private, even illicit pleasures. Readers got lost in an ungrounded fantasy world, out of touch with real human beings and objects.[45] To read these critics, you could imagine that they were talking about Internet pornography or Facebook. In a way, perhaps they were.

Writing is unquestionably the most "momentous" of all *technical* inno-

42. William James, "On a Certain Blindness in Human Beings," in *The Writings of William James*, ed. John J. McDermott (Chicago: University of Chicago Press, 1977), 629–45, at 630.

43. A nice review is Leah Price, "Reading: The State of the Discipline," *Book History* 7 (2004): 303–20.

44. Mitchell Stephens, "Which Communications Revolution Is It, Anyway?" *Journalism Quarterly* 75 (1998): 9–13.

45. Leah Price, "You Are What You Read," *New York Times*, section 7, 23 December 2007.

vations in human history.[46] In contrast to spoken language, which seems "hardwired" into the human equipment, writing is a software package that requires installation and constant updates. A toddler with something to say will not ask for pen and paper but will use gesture, facial expression, and the interactive array of oral language. As Darwin notes, "Man has an instinctive tendency to speak, as we see in the babble of our young children; whilst no child has an instinctive tendency to brew, bake, or write."[47] In contrast to speech, writing is difficult, unnatural, and even painful, and anyone who teaches university students knows that fifteen or sixteen years of intense training in the art are usually not enough to master it. Speech is a more or less "natural" endowment of all humans; writing is a technical accomplishment that requires a long apprenticeship. (And, unlike writing, talking is something almost everybody enjoys.) Of course, defining "natural" is a vexed business for beings whose nature it is to be artificial. Everyone who writes knows that it can be an intensely physical process involving sore backs, bitten fingernails, headaches, and pulled hair. Books are both literally and figuratively bound in human skin.[48] Writing is labor. It exacts a fierce bodily and cognitive discipline. It has a crucial biomechanical dimension, requiring integration of multiple skills such as eye tracking, vocalization, auditory perception, manual dexterity, posture, and mental exertion.[49] It costs our bodies a lot to incise meaning.

Writing is not only bodily; it is also always material and worldly. Though speech can have enduring consequences, its medium of record—memory and lived practice—is comparatively ephemeral and immaterial. Plato used the metaphor of writing in water for speech (something oddly applicable to squids or dolphins).[50] Writing takes advantage of available conditions and resources such as stone, clay, bones, tortoise shell, silk,

46. Ong, *Orality and Literacy*, 85.

47. Charles Darwin, *The Descent of Man* (New York: Appleton, 1871), 53.

48. Carolyn Marvin, "The Body of the Text: Literacy's Corporeal Constant," *Quarterly Journal of Speech* 80, no. 2 (May 1994): 129–49.

49. Lydia Liu, "Writing," *Critical Terms for Media Studies*, ed. W. J. T. Mitchell and Mark B. N. Hansen (Chicago: University of Chicago Press, 2010), 310–26.

50. Plato, *Phaedrus*, 276c, and Ernst Robert Curtius, *Europäische Literatur und lateinisches Mittelalter* (Bern: Francke, 1948), 306.

bamboo, jade, palm leaves, brass, wood, animal or human skin, papyrus, paper, chalk, and silicon chips. Even dust has been a writing material—*abacus* seems to descend from the Hebrew word for dust, which once covered tablets used for figuring. Oil vapor, the medium of skywriting, has a similarly evansescent quality. There may be speech without tools or tangible materials, but writing always requires both. Like all cultural techniques, writing blends materials and techniques. As Hartmut Winkler reminds us, writing is special among practices of "material depositing."[51] And it is *worldly* in the rich sense that Arendt gives that term—an archive of durable things. The history of writing tools, arts, and crafts has become a fascinating scholarly subspecialty of its own. An entire material-cultural infrastructure supports writing; it includes furniture and lighting, forestry, paper milling, education, and optometry.[52] Writing is always physical and technical, however automated or naturalized it may feel to its users.

Even the eyeballs need to be infrastructurally grooved. As you read, your eyes scan left to right. Your eyes come to a brief fermata with every period. A small point directs traffic at the gateway to the soul. They could move right to left as in Semitic languages, or up and down. In the 1950s Chinese writing shifted from top-to-bottom to left-to-right in a modernizing effort. You sit or possibly stand, thanks to a spine of vertebrae, holding the surface at a comfortable distance: a nice coordination of facial and manual systems. You take more than a dozen breaths every minute, drinking in the oxygen that keeps your body alive and your brain on its slow burn. The small organelles mitochondria, happy little parasites that have been living endosymbiotically inside other cells for about one billion years, inherited in vast chain along your mother's maternal line, do their work, invasive species hosted in every cell, keeping you warm. You digest and metabolize. Your life's experience is saved in a tangle of proteins as complex as the universe, whose history depends on the nucleosynthesis of supernovae. So much history is invested in metabolism. It takes a universe to read a word.

51. Hartmut Winkler, "Discourses, Schemata, Technology, Monuments: Outline for a Theory of Cultural Continuity," trans. Geoffrey Winthrop-Young and Michael Wutz, *Configurations* 10 (2002): 91–109.

52. For Heidegger on writing media (*Schreibzeug*)—curiously bodiless—see *Sein und Zeit* (1927; Tübingen: Niemeyer, 1993), 68.

Many theories of writing treat it as if it were a poor substitute for speech, a distancing and alienating shortcut that stands in for the warmth of the voice. This normative preference for orality was hotly contested by Jacques Derrida, surely the most influential philosophical thinker about writing in the last half century. His blockbuster book *De la grammatologie*, published in 1967, argued that Western thought's view of writing as secondary, as a mere means of recording speech by visible marks, had a number of deleterious effects. Though his arguments could be flamboyant, Derrida was very well informed about the history of writing. He took the term *grammatology* from I. J. Gelb, a University of Chicago Assyriologist whose book *A Study of Writing* (1952) was long regarded as the best theoretical treatment of the history of writing and also played a strong underground role in postwar French thought about signs and language.[53] (Gelb's book still has classic status but has since been criticized for its teleological narrative and its failure to recognize Mayan glyphs as writing.) Derrida's larger points about history, politics, and ethics—that writing's downgrading was in league with "the violence of Western metaphysics" and helped to foster the illusory belief that the voice was somehow more revealing of, or more "present" to, the self's interior than the text—were grounded in the solid philological truth that no script or writing system in history has ever fully captured the voice and that many writing practices, such as a signature, have no clear vocal counterpart. "A purely phonetic writing is impossible and has never finished reducing the nonphonetic."[54] Derrida showed that writing was more than a mere ancilla to speech, more than "the painting of the voice" (Voltaire) or "the art of speaking to the eyes."

Derrida helped diverse thinkers see the artful fertility of writing as a medium in its own right. For him, writing did not pervert the supposed purity of speech; rather, it intensified and revealed the symbolic structures inherent in language generally. (Speaking with Heidegger, as Derrida sometimes did, you could say that writing reveals language as the sails reveal the wind.) Phonetic writing based on the Greek alphabet is

53. On Gelb's influence in France, see Claudia de Moraes Rego, *Traço, letra, escrita: Freud, Lacan, Derrida* (Rio de Janeiro: 7Letras, 2006), chapter 2.

54. Jacques Derrida, *Of Grammatology*, trans. Gayatri Chakravorty Spivak (1967; Baltimore: Johns Hopkins University Press, 1976), 88.

not writing in general; it is a peculiar, historically specific form. "In its obsession with phonetic accuracy, the Greek alphabet was a great anomaly in the history of writing."[55] Derrida provides a crucial opening for media theory in showing that writing's distance from speech and presence is a gift, not a curse—a notion central to poststructuralist thought. Absence is writing's genius, and *all media to one degree or another trade in absence*. (Think of ships, fire, and clocks.) By criticizing the dream of immediacy, Derrida makes room for the medium of writing and also invites us to see media as variations on writing's logics. Writing can thus be understood as primary rather than derivative in our stock of media forms. This notion has been developed by several media theorists writing in German, who suggest that the changes brought by the analog media of telegraph, photograph, sound recording, and film from the nineteenth century should not be seen as making writing irrelevant, but rather as radicalizing and intensifying its role.[56] Each new medium paid tribute to the old in its name: tele*graphy*, photo*graphy*, phono*graphy*, cinemato*graphy*.[57] The media innovations of the late nineteenth century were writing at a distance, light writing, sound writing, and movement writing.

Modernity, then, means the spread and diversification of writing, not its obsolescence. Despite the sound and fury of audiovisual media, probably no century ever saw such a proliferation of letters, fonts, and calligraphies as the twentieth. The QWERTY keyboard remains one of the most pervasive communication devices. Despite prophecies of its extinction, paper continues to be used in great quantities (though decreasing, alas, for newspapers). Indeed, the supposedly digital age boasts the greatest abundance of writing material in history. Photography, television, cinema, and video did not simply displace writing: their technologies rested upon its deep logics (inscription, storage, editing, transmission) and their products were full of written materials (labels, captions, credits, subtitles, etc.). It is historically apt that you cannot buy a digital device without it coming wrapped in a package of paper covered with writing and accompanied by printed user manuals.

55. Barry B. Powell, "Homer and Writing," in *A New Companion to Homer*, ed. Ian Morris and Barry B. Powell (Leiden: Brill, 1997), 3–32, at 4.

56. For an excellent overview see Till A. Heilmann, *Textverarbeitung: Eine Mediengeschichte des Computers als Schreibmaschine* (Bielefeld: Transcript, 2012), 1–56, passim.

57. Hartmut Winkler, *Basiswissen Medien* (Frankfurt: Fischer, 2008), 235, 237.

Fixity and Erasure

Not only is writing a difficult practice to master; it is even harder to define. Its practices are so overwhelmingly diverse and technically complex as to defy a single overarching understanding. Gelb defines it generally as "a system of human intercommunication" or as "a device for expressing linguistic elements," in either case using "conventional visible marks."[58] Barry Powell's definition is similar: "a system of markings with a conventional reference that communicate information."[59] For both scholars, whose analysis I follow here, writing must have visual markings and be governed by systematic rules of decoding, but it need not necessarily stand directly for speech, though many forms more or less do. Gelb and Powell, like Derrida, warn against generalizing too glibly from the ancient Greek alphabetic system, in which discrete letters stand more or less exactly for phonemes (more exactly in Finnish and less exactly in English). A two-dimensional planar surface capable of receiving visual-spatial marks also seems definitive for almost all forms of writing. Words used for writing in many languages imply actions such as incising, scratching, or scraping—the Latin *scribere*, German *schreiben*, and French *écrire* are all cognates to the English *scribble*, and the English *engrave*, the Spanish *grabar* (to record or to tape), are related to *grave*, the first lasting shelter of meaning. (The Greek *γράφω* [*graphō*], to write, is no longer considered to be in the family, alas.)

Writing is often associated with lastingness. As Jan Assmann notes, the state is a mechanism not only for amassing power but also for assuring immortality. Its means include canons, temples, libraries, laws, and schools of reading. The cultural mnemotechnics favored by the Egyptians were temples, which served as memory books architecturally built in stone. The ancient Jews, in contrast, preferred sacred texts, which were much lighter and easier to carry. Indeed, much of the drama of the book of Exodus pits not only one way of life against another—the fleshpots, spectacle, and pharaohs of Egypt versus the burning bush, commandments, and priests of Sinai—but also one medium against another. (YHWH does briefly write in stone, but the tablets are soon smashed in a

58. Gelb, *A Study of Writing*, 12, 24.
59. Powell, *Writing*, 18.

fit of Mosaic rage.) Immortality was achieved not by lithic means, but by a continuity of exegetical tradition and ritual remembrance that persists to this day. Readers of the Torah are, in a lovely image of an active reader, to make bread of its wheat and cloth of its flax.[60] Reading here is not just receiving information but fabricating new materials. The Greeks, in turn, had an open canon of writings whose human as opposed to divine authorship gave them the status of literature instead of scripture, although both those types of writing exert strong claims to lasting value.[61]

Writing enables a metaphysics and political practice of inalterability. Kittler traces the history of trademarks back to the ancient curse of Hammurabi upon those who might alter his decree. The Book of Revelation seals itself on a similar note, threatening anyone who alters a single word of the text with the plagues it describes (Revelation 22:18).[62] John 10:35 reads, "The scripture cannot be broken," but the original Greek—"*Ou dynatai lythēnai hē graphē*"—is much more categorical: "The writing cannot be dissolved." A lovely expression of such a belief comes from the Mishnah, whose six sections or "orders," spelled out anagrammatically, yield ZMN NKT, which are the two roots for Hebrew words meaning "to hold time." Such is a precise description of the function of writing not only in Jewish culture but in sacred texts everywhere.

Permanence of record, though essential to its power, is not always a fail-safe definitional criterion of writing, given the crucial part played in the history of writing by erasable surfaces such as the wax tablet, the slate, the blotter, correctible typewriters, and the computer screen. The history of the pencil, for instance, shows a vast realm of experimental, erasable, and fruitfully nondurable writing—what Sybille Krämer calls "operative writing." First drafts, architectural drawings, mathematical calculations, and engineering plans require disposable writing. "Ink is the cosmetic that ideas will wear when they go out in public. Graphite is their dirty truth."[63] Not all writing, fortunately, is permanent—the humble eraser is one of many methods of deletion. Writing not only stores and transmits

60. Barry Holtz, ed., *Back to the Sources: Reading the Classic Jewish Texts* (1984; New York: Simon and Schuster, 2006), 28–29.

61. Jan Assmann, *Das kulturelle Gedächtnis* (Munich: Beck, 2007).

62. Friedrich Kittler, *Musik und Mathematik* 1:1 (Munich: Fink, 2006), 113–15.

63. Henry Petroski, *The Pencil* (New York: Knopf, 1989), 6.

meanings; it also turns them on and off. Like the abacus and tablet, the pencil shows that writing's revocability is an important counterweight to its fixity, without which the text keeps speaking irrevocably. The tyrant's writ could not be recalled without catastrophic cosmic consequences. Even the great Persian king Darius, according to the Book of Daniel, was unable to take back a decree once he signed it, even though he wanted to. Text trumped the king's will. But cancellation is also the prerogative of power.[64] Editing is a sign of majesty. Amnesty has long been figured as the blotting out of a written record. (So has excommunication.) Deletion is the genuine thermodynamic innovation.[65] Without deletion, we would be stuck with Pontius Pilate's dour bit of *Klartext*: "I have written what I have written" (John 19:22). The eraser is a small symbol of forgiveness. Only the hand that erases, said Meister Eckhart, can write the truth.

Writing was a tool of data processing well before it was a storage device for speech, let alone one for law or literature. According to Denise Schmandt-Besserat, the earliest kinds of writing consisted of tallies and lists in ancient Mesopotamia—markings on clay forms she calls "tokens."[66] Such tokens were forerunners of the Sumerian cuneiform writing that lasted for more than three thousand years and was the script for a succession of unrelated ruling languages (rather in the same way that English, Finnish, Guaraní, and Turkish—none of them kin—are all now written with Roman letters). Tokens were used to manage people and inventory. Their function was counting and accounting; they were data processing devices with no concern (or ability) at first to record syntax or designate linguistic sounds relevant to the ear, let alone to chronicle origin myths or royal histories. Writing has long been used for lists, tables, registers, rosters, censuses, charts, atlases, and maps. It was an essential ingredient in early astronomy for compiling star catalogs and reckoning time. The digital computer and Internet infrastructure extend writing's age-old role. Siegert notes two traditions of writing: one, working in time, to store words, and another, working in space, to diagram

64. Vismann, *Files*, 25–29.

65. James Gleick, *The Information: A History, a Theory, a Flood* (New York: Pantheon, 2011), chapter 13.

66. Denise Schmandt-Besserat, *How Writing Came About* (Austin: University of Texas Press, 1996).

data about collections, inventories, populations, etc.[67] The spreadsheet has a long prehistory.

Thus, Lev Manovich's overly dramatic claim that recent digital media shift the logic of media from the "narrative" form of novels and cinema to the "database" format of digital computers misses the long and mixed history of scribal media. In the current culture of keyword searches and configurable software, he argues, users make targeted forays into texts on demand. They are no longer in thrall to the linear unfolding of a story's plot, or captive to an A-B-C-D logic or someone else's schedule.[68] Manovich's generalization illuminates a lot about the current environment but it is shortsighted historically.[69] Stories and lists, with their respective preferences for temporal and spatial order, have always been competing and complementary principles in the history of recording media.[70] Writing has always been a database, since its invention in Mesopotamia, to account for such items as bread, beer, and labor time—a device of administration and computation as well as literary storage and transmission.[71]

Writing's processing power is clear in the early appearance of the list. In list writing, serial order loosens its hold. When one reads a novel, for instance, one typically reads in a straight line from first to last page. But even in novels, sequence does not always reign: the readers of romance novels studied by Janice Radway sometimes read the endings first, in order to assess the novels.[72] Readers have always hopscotched around, according to their needs. No one reads every word in almanacs, bibles, cookbooks, dictionaries, or encyclopedias. But this is not the fate only of reference books: no one reads the whole newspaper either. Alpha-to-

67. Bernhard Siegert, *Passage des Digitalen* (Berlin: Brinkmann und Bose, 2003), 33.

68. Lev Manovich, *The Language of New Media* (Cambridge, MA: MIT Press, 2001).

69. See Michael Schudson, "Political Observatories, Databases & News in the Emerging Ecology of Public Information," *Daedalus* 139, no. 2 (2010): 100–109.

70. Peter Stallybrass, "Against Thinking," *PMLA* 122, no. 5 (2007): 1580–87, at 1586.

71. Jöran Friberg, "Counting and Accounting in the Proto-Literate Middle East: Examples from Two New Volumes of Proto-Cuneiform Texts," *JCS* 51 (1999): 107–37. Thanks to Dan Emery. See also Vismann, *Files*, and Wolf Kittler, "Aphrodite gegen Ammon-Ra: Buchstaben im Garten des Adonis, nicht in Derridas Apotheke," in *Archiv für Mediengeschichte: Stadt—Land—Fluss*, ed. Lorenz Engell, Bernhard Siegert, and Joseph Vogl (Weimar: Verlag der Bauhaus-Universität, 2007), 207 ff.

72. Janice A. Radway, *Reading the Romance: Women, Patriarchy, and Popular Literature* (Chapel Hill: University of North Carolina Press, 1991), 199–200.

omega narratives are the minority form, however influential. The novel is a privileged exception in the history of reading. Writing does not consist essentially of integrated story lines: stories are one of the many kinds of data it holds. The historiography of writing has been biased toward literature and away from bureaucracy, toward pens and away from pencils. Books account for only a small portion of the vast piles of wood pulp used for printing in the twentieth century. Through accounts, ledgers, maps, logs, registers, catalogs, indexes, blueprints, schematics, and tables of all sorts, writing simulates inventories of objects without a front-to-back narrative structure. "The most original medium of every mnemotechnic is spatialization."[73] The beauty of such writing is that its "visual, spatial location" makes it "subject to possible rearrangement."[74] A chronological list of the kings of England can be rearranged by length of reign, by age of coronation or death, or in alphabetical order.[75] Writing enables data crunching.

"My pencil and I are more clever than I," Einstein supposedly said.[76] Krämer's "operative writing" uses graphic practices to figure, tally, and design: here writing is not just a storehouse of speech but a device of calculation. Mathematics depends on writing. What Bruno Latour calls "flat laboratories" (slate and abacus) enabled ancient Greek mathematics to emerge as a discipline: inscription systems sustained both social networks of mutual criticism and intellectual techniques of materializing and manipulating thought. Early modern mathematics, specifically analytic geometry and calculus, likewise made essential use of graphic practices such as tables, grids, and x–y coordinates, taking advantage of Hindu-Arabic numerals and the zero. Paper served as what Krämer calls "a symbolic machine" or an exterior mental tool. One of the wonders of modern mathematics is the ability to reckon with nonexistent entities such as zero. A sheet of paper can sustain a place-value logic,

73. Assmann, *Das kulturelle Gedächtnis*, 59, 215.

74. Jack Goody, *The Domestication of the Savage Mind* (Cambridge: Cambridge University Press, 1977), 104.

75. Joke: An elderly Jew has lost his prayer book and doesn't know the prayer by heart. He prays, improvising: "But I have a solution, Almighty One, and I hope it meets with Your approval: I will just call out all the letters in the alphabet, and You, please, put them together in the right way." Leo Rosten, *Hooray For Yiddish!* (New York: Touchstone, 1982), 95.

76. David Deutsch, *The Beginning of Infinity* (New York: Viking, 2011), 60.

which is essential in different ways for notation systems such as mathematics, maps, and musical scores. There is graph paper as well as lined paper. In operative writing the eye can move multidimensionally, as can the pencil. In a purely linear text, the spatial location of content is not important. Different editions of the same novel could have different pagination without anything important being lost. But in an equation, map, or table, spatial location is crucial. Where a decimal point or zero is placed can change the world.

Chalk is another medium of mathematical materialization. Since the early nineteenth century, chalk has been indispensable in mathematics pedagogy, discovery, and mythology. It springs to life in the mathematician's hand like an animate being. (When he is not playing the violin, riding his bike, or sticking out his tongue, Einstein iconically stands in front of a blackboard covered with abstruse symbols.) The aim of mathematics is to render intuitions intelligible via semiotic conventions, and chalkboards are a way to materialize objects of analysis. "There is no mathematical concept whose formal immediacy or self-evidence stands beyond media and mediation."[77] The chalk, slate, and pencil are like the vortices that a tuna's swim strokes create to make more strokes in. ("Kill some trees!" was the exhortation of one of my children's math teachers—i.e., show your work.) Revealing the materiality of mathematics has been crucially important for recent efforts to shake us from the image of science by which we used to be possessed. Figuring and scribbling means abandoning the ideas that mathematical entities were ideal and that writing was exclusively for finishing. In ancient Greek mathematics, Latour notes, diagrams "acted, effectively, as a substitute for ontology." Exactly: this is what media always are.[78]

77. Michael J. Barany and Donald MacKenzie, "Chalk: Materials and Concepts in Mathematics Research," August 2011, www.sps.ed.ac.uk/_data/assets/file/0020/60518/Chalk.pdf, accessed 20 March 2013.

78. Bruno Latour, "Review Essay: The Netz-Works of Greek Deductions," *Social Studies of Science* 38 (2008): 441–59, at 457. Heidegger anticipates the constitutive nature of writing: "Even the most 'abstract' working out of problems and recording of the results operates with writing materials. However 'uninteresting' and 'self-evident' such components of scientific research may be, they are by no means ontologically indifferent." *Sein und Zeit*, 358.

Landmarks in Writing's History

The history of writing is itself full of deletions. The preservation of written records (perhaps like that of all historical records) often depends on happenstance. Linear B, an ancient script that offered essential clues to the history of ancient Greek, was preserved by a palace fire in Knossos, Crete that baked clay tablets that otherwise would not have endured. Fire also preserved Ugaritic.[79] Vesuvius's hot ash killed Pompeii's lives but preserved its life, with typical creative destruction. Aramaic, the language used to administer the far-flung Persian empire, is best documented in Egypt not because Egypt was the geographic center of the language's use, but because a desert climate preserves documents best.[80] If the overall history of writing is patchy, the history of human communication is even more so. Humans have been writing for more than five thousand years, but drawing for even longer, speaking for even longer, and pairing up as lifelong sexual partners for even longer. Much of this history is still unclear, but archaeological and genetic research is adding pieces. "Prehistorians," writes Leroi-Gourhan, "must resign themselves to doing without the evidence that would have been most significant—gestures, sounds, arrangements [*agencements*] of objects . . . ."[81] Lithic artifacts and writing give us almost all of what little we have of the history of communication among humans (stone artifacts stretch back two and a half million years). Fortunately, it is possible to read things that were not written.

Images and writing obey different logics. Behaviorally modern humans seem to have been graphic artists from early on. They drew and painted to represent moons, people, and animals, and perhaps for the sheer exuberant joy of it. But language consists not in things and events but rather in sounds, syntax, and systems of meaning. Before writing, language existed only as a creature of sound, voice, and ears: it was never seen. The eye was a very important conduit for nonverbal communication via gesture, posture, and facial expression, but it was not a carrier of language. Early graphic forms capture meaning by pictures, but not

79. Barry B. Powell, *Writing and the Origins of Greek Literature* (Cambridge: Cambridge UP, 2002), 105.

80. Nicholas Ostler, *Empires of the Word: A Language History of the World* (New York: Harper, 2005), 78, 83, 131.

81. *Gesture and Speech*, 107; *Le geste et la parole*, 1:153.

Figure 6. No Smoking sign

by language. Gelb gave such forms the rather ungainly name *semasiography*, from Greek terms meaning "the inscription of significance," and the label stuck. Semasiography does not represent speech but communicates meanings via visual representations without designating an unambiguous vocal or linguistic correlate. Its diagrams point not to words, but to the world. In part, it taps into the more general pool of shared gestures and acts recognizable by humans in general. But drawing, as Leroi-Gourhan remarks, has a multidimensional freedom, while writing is more or less linear, subjugating the image to the rule of phonetic sequence. The viewing eye is free to rove over an image as it wills, but the reading eye must track a text largely in serial order, following the "ant paths" of the written text, in Jesper Svenbro's beautiful metaphor.[82] Images may have structure, but they do not have strict syntax. Though drawing is figurative but not linguistic, it is clearly the primal source from which writing practices emerge.

Consider, for example, the "Not allowed" sign—a red circle with a diagonal slash superimposed on an image of the banned activity in question.[83] Its use is widely understood by the eye, hugely divergent to the ear. Not only could this sign be translated as variably as "*Interdit de fumer*," "*Ikke røyke*," or "*Μη καπνίζετε*"; it could also be stated in one language as variably as "No smoking," "Don't smoke," "Smoking is not permitted," and so on. Semasiographic signs convey meaning without providing instructions for decoding or pronouncing the underlying language. Like visual art and images more generally, with which they share a deep tie, such signs do not specify syntactic or phonetic content. Other modes

82. Jesper Svenbro, *Myrstigar: Figurer för skrift och läsning i antikens Grekland* (Stockholm: Bonnier, 1999).
83. Powell, *Writing*, 19–20.

Figure 7. Eye, can, knot, sea, ewe. Rebus for "I cannot see you."

of writing enable tighter verbal specification—alphabetic writing allowing us to dictate what words we mean letter by letter, for instance—but semasiography is not a precision instrument for encoding speech. A semasiographic text lends itself to paraphrase in many languages. There is no way to discern which renditions are superior or more faithful. Even though it lacks a feature that we alphabet users might think essential for writing—exact replication of discourse—we should not think of semasiography as outmoded. Semasiographic conventions are used mundanely in road signage and do-it-yourself instructions for assembling furniture and electronics, and sublimely in mathematical and musical notation. Nor should we view semasiography as deficient in deep meanings. Images, like music, remain some of the most moving things we know, even if words fail us to say why. One thinks of Felix Mendelssohn's answer to the question of why he wrote songs without words. "What I have to say," he supposedly said, "is too precise for words."

The key breakthrough occurred around 3400 BCE with the rise of logographic encoding, or word writing. Goody and Watt put the innovation well: "The notion of representing a sound by a graphic symbol is itself so stupefying a leap of the imagination that what is remarkable is not so much that it happened relatively late in human history, but rather that it ever happened at all."[84] The key device seems to have been the *rebus*, a picture sign that evokes a sound which in turn evokes a word. The rebus uses images to call up names which are exact or near homophones of other words. Like all historic modes of writing, the rebus is still in use; it is found in children's picture puzzles and, if we follow Freud, in our dreams as well. (Freud, an amateur Egyptologist, liked to think of

84. Jack Goody and Ian Watt, "The Consequences of Literacy," *Comparative Studies in Society and History* 5, no. 3 (April 1963): 304–45, at 315.

dreams as hieroglyphs—i.e., texts written in nonalphabetic scripts—and himself as their Champollion, the great decipherer of ancient Egyptian.) The rebus may seem a roundabout way of representing speech—a picture suggests a thing whose name, when pronounced, sounds like another word probably completely unrelated to the thing—but all writing systems involve complex contrivances to some degree. Uniting diverse sorts of data streams (image, concept, word, sound) is fundamental to the work that writing does.

It is an alphabetic prejudice to think that alphabets are the only writing systems that instruct the reader in how the underlying speech sounds. Before the alphabet, Sumerian cuneiform, Chinese and Egyptian logograms, and proto-alphabetic syllabaries (such as Aramaic and Hebrew) all suggested the sounds of speech. Sound encoding has been a feature of writing since the discovery of what Gelb called "the phonetic principle" in the fourth millennium BCE in the Fertile Crescent, even if the rules for sounding out were obscure and not always reliable.[85] (Whether writing has a single origin is debated, but diverse writing practices have independently found ways to indicate sound, and the case of Mayan glyphs would seem to argue for polygenesis.) Both Chinese and Egyptian hieroglyphs are phoneticized logographic systems. (Both languages have been subject to fantasy by European thinkers—Chinese as a purely ideational language and Egyptian as sensuous and allegorical.)[86] The great majority of Chinese characters are compounds of radicals that indicate meaning and sound. Since each word in a logographic script has a unique sign, learning to read and write it takes a great investment of time and effort. To read a modern Chinese newspaper, one must know about three thousand characters. (Chinese is the only major ancient script to have survived to this day. Sumerian cuneiform—the first of all logographic systems, and one that lasted for millennia—has gone extinct, as have Egyptian hieroglyphs and Mayan glyphs.) Figuring out that Egyptian hieroglyphs were full of phonetic indications—in contrast to the old romance of a purely visual language—was the key step for Champollion's decoding of the Rosetta Stone in the 1820s.

Historically, priests, scribes, scholars, and bureaucrats have had little

85. Gelb, *A Study of Writing*, 67 ff.
86. Derrida, *Of Grammatology*, 76–81.

incentive to make writing technology more accessible. Barriers to entry, as Innis would remind us, aid monopoly control, and the history of writing is not only a succession of scripts but a struggle between groups for control over the means of communication. Indeed, many prealphabetic scripts are full of maddeningly labyrinthine rules that seem almost intentionally designed to be obscure and difficult. (The brave might work through Gelb's discussion of six different types of logosyllabic writing.)[87] The sociological norm for ancient scripts was what some scholars call "oligoliteracy"—literacy of the few—a sharp contrast with the modern norm that every citizen must read, write, and reckon.[88] In medieval and Renaissance Europe many elite women were literate in the vernacular, but only a minute few knew the language of learning: Latin was an overwhelmingly male province.[89] Even with the printing press first appearing in the mid-fifteenth century, it was not until the late eighteenth century that mass literacy was achieved in North America (among white men and women) and in northern Europe. Invention is not the same as impact.

Though they stand at the beginning of the inscription of language, logographic practices are by no means dead. We still use logograms such as $, £, €, ©, Σ, √, ∞, †, ♥, 1, 2, 3, 4, 5, and so on. The letters of the alphabet can be used as logograms for some purposes as well. Logograms may have an implied sound, but phonetic rendering is often open-ended. Though speakers of mutually unintelligible languages (or "dialects") in China won't necessarily understand each other's speech, they can almost always read the same Chinese characters. (This fact gives rise to the false idea that Chinese characters are purely ideational and without phonetic instructions.) We can read *Rx* aloud as "prescription" or "are ex" and it won't matter. The meaning of *I ♥ NY* is clear whether one says "I love New York" or "I heart New York." The series of signs *2 × 2 = 4* will be understood by almost any eye on earth, but the corresponding vocal sounds will vary enormously: "Two times two is four" or "*Zwei mal zwei gleich vier*" or "*Dos por dos son cuatro*." Written visual signs do not always have an unequivocal acoustic counterpart. If I write the sign *1*, a majority of

87. See, e.g., chart in Gelb, *A Study of Writing*, 100–101.

88. Goody and Watt, "The Consequences of Literacy," 313.

89. Walter J. Ong, "Latin Language Study as a Renaissance Puberty Rite," *Studies in Philology* 56, no. 2 (1959): 103–24.

earthlings will know what it means but not agree on how it should be read aloud; different speakers may say "one," "*eins*," "*satu*," or "*yksi*." But additional signs can clarify pronunciation: *1st* means first, *1º* means *primero* (Spanish), and *1er* means *premier* (French). The meaning remains clear to the eye, but the additional sign hints the sound to the voice and ear. (The additional sign complementing a logogram is often called a "determinative." Freud found determinatives in our dreams. Equivalent functions are routine in Chinese and Egyptian.) This ability to imply the sounds of language distinguishes logography from semasiography. All scripts give indications as to both meaning and sound; there is no such thing as a script that is nothing but sounds or nothing but meanings.[90]

Mixing signs that represent concepts with signs that represent sounds is not foreign to English. The cross, a well-known logogram in English, can be spun in many different phonetic and semantic directions: *†s* means cross and *†d* means dead; *Xmas* means Christmas and *xing* means crossing. "Twenty" was the name of a British spy ring because that number in Roman numerals is *XX* ("double-cross"). Such ingenuity is found in writing both ancient and modern, and it gives us an idea of how, for instance, Chinese writing works. Medieval heraldry compressed names into designs on shields. Voltaire once responded to a dinner invitation with the message "Ga." That is, "*Gé grand A petit*" (big *G*, little *A*), or "*J'ai grand appétit*" (I am very hungry). Today one must read logographically to make sense of phenomena as diverse as vanity license plates and hip hop names and titles. Telephone texting also reactivates ancient logographic strategies: *l8r* in English means "later"; *7ac* in French means "*c'est assez*" (that's enough), *oqp* means "*occupé[e]*" (busy), and *je x* means "*je crois*" ("I believe"—"*croix*," cross, is a homophone with "crois"); in Spanish *s3* yields "*es*" (S) plus "*tres*" (three), or "*estrés*" (stress). To make sense of a text message, you have to know which letters and numbers should be read as logograms and as phonetic markers. The sign *7ac* is not read as "set-ack"; rather, the *a* and *c* are treated as logograms with a distinct name and sound. The *l* and *r* in *l8r* work alphabetically as phonemic elements, while the *8* is pronounced as a free-standing logogram.[91] De-

90. Florian Coulmas, *Writing Systems: An Introduction to their Linguistic Analysis* (Cambridge: Cambridge University Press, 2003), 18.

91. David Crystal, *Txting: The Gr8 Db8* (New York: Oxford University Press, 2009).

ciphering text messages can be quite a jumble for the noninitiate who is not privy to the code—very much the status quo in the history of writing. Reading has long seemed oracular to onlookers, and in ancient Greece it was conceived of as interpreting omens and dreams.[92] *Rune* means both writing and mystery. In reading, we still search for signs.

By any standard the Greek phonetic alphabet was a huge transformation, but it is difficult to get an adequate fix on its historic significance, since there is so much accompanying ideological freight. Too often, claims about writing's history are mixed up with claims about cultural superiority. For Powell, the writing of vowels does nothing less than demarcate the historic divide between East and West, a view enthusiastically escalated by Kittler.[93] Havelock clearly sees Greek writing, and therefore Greek culture, as superior to Hebrew, a valuation Derrida contests.[94] The Greek alphabet was not a clean break with the past. The invention of what Havelock calls "a short atomic table learnable in childhood" did have all kinds of consequences, but it is easy to miss its continuities with earlier graphic systems for representing speech.[95] For Gelb, the "greatness of the Greek innovation lies . . . not in the invention of a new method of indicating vowels but in a methodical application of a device which the early Semites used only in an irregular and sporadic fashion."[96] Several Hebrew letters still do double duty as vowel and consonant: the so-called *matres lectionis* (mothers of reading), *alef*, *he*, *vav*, and *yod*. The Greeks were systematic developers of practices long implicit in previous forms of writing.

The innovations of the alphabet were accessibility and efficiency. Obviously the Greek alphabet was not the first writing method to record the sounds of speech in a decodable form; it was, rather, the first to rep-

92. Jesper Svenbro, "Stilles Lesen und die Internalisierung der Stimme im alten Griechenland," trans. Peter Geble, in *Zwischen Rauschen und Offenbarung: Zur Kultur- und Mediengeschichte der Stimme*, ed. Friedrich A. Kittler, Thomas Macho, and Sigrid Weigel (Berlin: Akademie, 2001), 55–71.

93. Barry B. Powell, *Writing and the Origins of Greek Literature* (Cambridge: Cambridge University Press, 2002), 120; Friedrich Kittler, *Musik und Mathematik* 1.1 (Munich: Fink, 2006), 101–21, passim.

94. For a devastating critique of Havelock's ethnocentrism, see Assmann, *Das kulturelle Gedächtnis*, 259–64.

95. Havelock, *The Muse Learns to Write*, 9.

96. Gelb, *A Study of Writing*, 182.

resent speech by nothing but signs for the phonemes of the voice—and thus in a form relatively accessible to all. Only a competent speaker of Egyptian or Hebrew could read those scripts aloud: the visual marks yielded sounds only if you could divine what the underlying words were. With the Greek (vowel) alphabet, a reader could figure out sounds without knowing the language; its superiority lies in the transcription of the sounds of *foreign* languages. The ambition of the Greek alphabet, never perfectly realized, was to provide unambiguous codes of sound to the eyes—that is, to create a one-to-one correspondence of grapheme and phoneme. Despite what some of its devotees, such as Havelock, seem to claim, the Greek alphabet was no tape recorder capturing vocal sounds in all their particularity.[97] It didn't represent prosody, pitch, pacing, volume, or the infinite variety of tone color. It represented phonetics graphically, in a brilliant, innovative, and enduring way, but it did not create an exact medium for sound production. There are nearly infinite shadings of how to pronounce any given vowel, but the alphabet crunches them all into one sign. No writing system is ever purely phonetic—and we should be grateful for the alphabet's astonishing gift of data reduction. This abstraction is not a loss of, say, the fullness of the voice; it is a service. Backgrounding the voice is writing's achievement. In the great pun of postwar French thought, "*la lettre*" (the letter) reveals "*l'être*" (being).

The history of scripts resembles more a punctuated equilibrium—sudden lurches of innovation followed by long plateaus of use—than an ever-progressive spiral. The principles that govern alphabetic writing today are essentially the same as those laid down by the invention of the "vowel-alphabet" (as German scholars call it) somewhere in Greece about 800 BCE. Some alphabetically written languages, such as English, are rather far removed from systematic vocal representation, and might even seem retrograde by the standards of "progress." *Ghotiugh* can famously be pronounced as "fish," taking the *gh* as in rou*gh*, *o* as in w*o*men, *ti* as in na*ti*on, and *ugh* as in bo*ugh*.[98] English arguably even has some features of syllabic writing systems such as Arabic or Hebrew (in which vowels are implied) or Japanese hiragana (which indicate sounds through fixed syllables pairing one consonant and one vowel). The pho-

97. Havelock, *The Muse Learns to Write*, 59–61.
98. Gelb, *A Study of Writing*, 225.

netically identical "sh" sound in "suspi*ci*on," "*sh*ut," "*su*re," "sta*ti*on," "crusta*ce*an," and "sess*i*on," for instance, can only be recognized in context; the morphologically identical *-ed* makes three different sounds in *started*, *tacked*, and *tagged*. This is no atomic table in which each free-standing letter possesses a unique sound, but a much more volatile and interactive chemistry!

The written form of a language can contain intelligence that its spoken version does not. This is true of both English and Chinese, though much more intensely so in the latter.[99] Many Mandarin words were phonetically more differentiated in ancient times but have since merged in pronunciation, leaving the language with many monosyllabic homophones that stand for distinct written characters. This leads to a situation in which a single story of ninety-two characters about a poet who eats lions can make perfect sense to the eye but, when read aloud, consists of nothing but variations on the single syllable *shih*.[100] Here the written form can take authority over the spoken. The visual or mental "reading" of Chinese ideograms disambiguates homophones more quickly than does hearing them spoken, and though Chinese speakers usually rely on syntactic context to specify the implied character, they will sometimes draw the character in the air or on paper in line with Chinese's important manual-graphic dimension.

In English, the priority of the written form is weaker but still evident. English's erratic spelling, though often a target for reformers, holds steady because it is a treasure trove of the language's history and, even more, an indicator of the identity of words. In English, word differentiation depends on the graphic sign: such terms as *but* and *butt*, *threw* and *through*, and *sight*, *site*, and *cite* are phonetically identical. Context normally distinguishes them, but recourse to the written form, either as seen or spelled, decisively clarifies which word is meant. The written form—here is the point Derrida would underscore—is the decisive way to tell *but* and *butt* apart. (The very ideas of an isolated word and of spelling are derivative of writing practices.) Writing defines the word as much as

99. Powell, *Writing*, 48.

100. Deborah Fallows, *Dreaming in Chinese: Mandarin Lessons in Life, Love, and Language* (New York: Walker, 2010), 39–43.

speech. Without writing, speech would have remained as uncharted as the deep and open sea.

Listening with the Eyes

It is curious that visual recordings came very much earlier in the history of human cultural technics, and auditory recordings very late. Drawings date to the Upper Paleolithic; sound recording to the late 1870s. Why were images so easy to capture and sounds so hard? This question takes us back to the earlier discussion of materiality: many optical objects stay put in space, but acoustic objects never do. Sound appears and disappears; its being is in time. No purely sonic entity ever endures. In the millennia of prehistory, spoken words lived on after their utterance only in the evanescent media of sound, memory, and collective linguistic competence (Saussure's "*langue*"). Echoes were often thought of as supernatural or haunted. But writing discovered how to trap the "winged words" of speech. It domesticated the flowing sounds of speech to a degree. At least in its phoneticized forms, writing was a kind of phonograph long before Edison, sound transcribed onto space. (Linguists even use the term "phonographic" for writing that provides precise recipes for vocalizing sounds.) The eye learned to process language, to act in time. This "verbivocovisual" (James Joyce) achievement represents the great sensory-cognitive synthesis of human history.

The marvel of writing, in other words, is its union, through a variety of methods, of two very different sensory registers—the predominantly spatial order of vision and the predominantly temporal order of hearing. Visual perception tends to be all at once (synchronic) and auditory perception tends to be one thing after another (diachronic). The eyes are particularly apt at seeing resemblances, while the ears hear things whose sources we have had to learn to identify by experience. When we hear a sound, we instinctively turn to see its source. But when we see an object, we don't instinctively ask what it sounds like. Sounds often provide cues about where to look, but sights rarely tell us where to listen. Sound effects in radio and cinema depend upon the fact that decontextualized sounds, no matter how familiar they may be in everyday life, are often not recognized without an accompanying visual (or other orienting)

stimulus. Shaken aluminum foil can pass as thunder, wooden blocks on a table can pass as horse hooves, and in the movie *Titanic* frozen celery stalks provided the sound of Rose's hair freezing. The two most dominant human sense organs, then, perceive the world in strikingly different ways. The eyes are high-bandwidth devices that take in whole fields at once but are indiscriminate in small intervals of time (a fact that makes cinema possible). The ears, in contrast, are lower-bandwidth organs that are far more temporally acute than the eyes but less able to identify *Gestalten*. They are more apt for the acoustic submarine world of time and passing events; our ears ally us with cetaceans. And ears are also the primordial sense for convention-based meanings—that is to say, for language, the chief of all systems of meaning based on convention rather than nature. Seeing, in other words, rests largely on an "iconic" relation to the world, to use the term of Charles Sanders Peirce. Hearing, in contrast, is basically "symbolic" in that it grasps the world through learned habit or convention.[101]

Writing did the incredible feat of marrying the two sensory modes of seeing and hearing. It got space to masquerade as time and the flat surface to hold marks that stood for sounds. Writing united visual, auditory, and linguistic processing. "Writing includes both the holistic characteristics of visual perception, and at the same time, without contradiction, the sequential character of auditory perception. It is at once atemporal and temporal, iconic and symbolic. In short, the potential for writing is at the nexus linking the visual and the auditory channels of perception."[102] Writing teaches the eye to behave like an ear, as McLuhan liked to say. In reading, the eye moves serially from one sign to another, not looking holistically at the overall visual pattern but rather "listening" for the sounds or words indicated by the conventionalized shapes. To read, the eye must become a serial processor and follow the discipline of the line. Writing gives auditory objects (words, speech) a visual habitation, and temporal events a spatial home. Somehow writing was able to transpose speech's auditory semiotic structure to a visual plane. Writing media are

101. This paragraph is based on a brilliant essay by my teacher, John S. Robertson, "The Possibility and Actuality of Writing," *The First Writing: Script Invention as History and Process*, ed. Stephen D. Houston (Cambridge: Cambridge University Press, 2004), 16–38.
102. Robertson, "The Possibility and Actuality of Writing," 19.

voice resonators; in both Europe and China, turtle shells and metal bells have served as both as inscription surfaces and sound amplifiers. In Svenbro's pun, writing provides speech a "*réson d'être*."[103] In this sense, writing combines at once art and music, sight and sound.[104]

Writing converts time and sound into space and vision; reading vocally, as most people seem to have done in history, converts space and vision into time and sound. Writing is a technical means of using the eyes and hands to speak and hear across distances, of processing complex and massive arrays of data, of transforming space into time and time into space, and of giving us access to a realm beyond time's irreversible flow. It stands at the switch point of time and space, vision and hearing, face and hand, fixity and fluidity. In this it is the most fundamental medium of communication. Media are apparatuses that translate meaning across space and time, through visual, auditory, verbal, and manual registers, and writing was the first great medium to do so. All media of recording, transmission, and processing since follow in its wake. Quevedo, the great Spanish poet, wrote that in reading, "escucho con mis ojos a los muertos" (I listen with my eyes to the dead).[105] Eyes that listen to the dead, intermingled senses that stretch across distances: Quevedo defines the heart of media theory.

The centrality of writing to any possible media history lies, I claim in apparent contradiction to what I have just argued, in its power of nonlinearity. McLuhan, like many others, thought writing essentially linear. The arrangement of signs into rows that must be grasped ordinally is a key differentiation of writing from drawing, of text from image. But linearity, as we have seen, is only one side of reading and writing, and emphasizing it misses what is most important about writing as a medium: the temporal reversibility that spatialization makes possible. (In digital video production, nonlinear editing means the ability to alter any point in the image stream—in contrast to old-fashioned film editing, which required scrolling between frames and did not allow editing within the

103. Jesper Svenbro, *Phrasikleia: Anthropologie de la lecture en Grèce ancienne* (Paris: la Découverte, 1988), 183.

104. Sybille Krämer, "Zur Sichtbarkeit der Schrift oder: Die Visualisierung des Unsichtbaren in der operativen Schrift. Zehn Thesen," *Die Sichtbarkeit der Schrift*, ed. S. Strätling and G. Witte (Munich: Fink, 2005), 75–83, at 76.

105. Thanks to Juan Ramón Muñoz-Torres.

frame. Something similar was enabled by the more or less random-access structure of the codex, in which any page is as handy as any other.)

Even in everyday reading, there is no such thing as a purely linear text—the footnote and the marginal comment both invite the eye to jump off the line. In most writing systems the spatial order of graphic signs does roughly correspond to the temporal order of spoken signs, but not always. We read *$100* as "one hundred dollars," such that oral speech reverses the order of the written signs, putting the denominator after the numerator. In arithmetic we work from right to left, in contrast to the left-to-right reading norm, a sign of the differentiation of letters and numbers.[106] In digital (base two) notation, reading a number such as 01000000 (64) slows down the eye and makes us realize we are reading from right to left. The diverse routing of the eye can likewise be noted in Hebrew, which reads words right to left and numbers left to right. Even at the most minimal syntactic level, texts are not purely linear, and for larger units of text, anyone who reads knows how choppily we enter and exit the world of any book.

The tendency in orality and literacy studies to lament the linear rigidity of the written word is thus one-sided. Take, almost at random, some lines from Havelock: "Once inscribed, the words in a document become fixed, and the order they appear in is fixed. All the spontaneity, mobility, improvisation, the quick responsiveness of spoken speech vanishes."[107] At first reading this seems like common sense, but on deeper reflection it is clear that he gets it exactly backward. Oral speech is linear too. In writing or reading you can move backwards, delete, skim, and reread. The codex format enables nonlinear jumping across a text more easily than in a scroll, but even in a scroll you are not in thrall to the written order. (It is curious that Facebook "pages" and computer documents have resurrected the scroll format.) To be fair, Havelock readily acknowledges the great advantages of textual fixity; and live interaction can allow for quick correction of misunderstanding. But the world of writing affords a nonlinear editing that is the envy of anyone who's ever said something aloud that they desperately wish they could retract—as the words hang in the air seemingly forever, burning their imprint on the memories of offended

106. McLuhan, *Gutenberg Galaxy*, 181.
107. Havelock, *The Muse Learns to Write*, 70.

others. In orality, the first draft is usually the final draft, but writing is both permanence and change. There is no backspace key in face-to-face talk; this is one reason that some people prefer online to co-present interaction. None of us can turn back the clock on speech, no matter how hard we try. (Recording devices have made this wish even more fervent for politicians who get caught in gaffes or damnable admissions.) But writing, by spatializing data, makes it possible to play with time. We can read backward or forward. We can jump from page 1 to page 271 in a codex or, with a little more trouble, from one spot of a scroll to another. Writing was the first technique of altering the time domain. Instead of linear narrative writing as the norm, we might take operative writing as the paradigm case, a kind of writing whose aim is not just to save words but to manipulate data about the world.

The Interconvertibility of Space and Time

A brilliant synthetic article by Hartmut Winkler, building on the work of Innis, Bernhard Vief, Krämer, and Kittler, makes just this point by rethinking the relationship between recording and transmission.[108] With Innis we typically think of transmission as the overcoming of space and recording as the overcoming of time. A telegram cuts across geography; an engraving cuts across history. One transcends distances of space and the other distances of time. (In distant light from the stars, space and time become one; cosmic distances are measured in light-*years*.) Writing has been at the center of both kinds of transcendence historically. But these relations turn out to be reversible. To transmit costs time; to record costs space. On earth we don't notice the minute empirical lags in simultaneity during a long-distance phone call, for instance; but at astronomical distances, the cost of transmission, limited by the speed of light, is obvious, as Einstein saw and perhaps some dolphins have discovered. George Gamow, the comic cosmologist, estimated that God lives 9.5 light years from earth. In 1904 at the beginning of the Russian-Japanese war, Russian Orthodox churches started praying for the destruction of Japan; nineteen

108. Hartmut Winkler, "The Geometry of Time," homepages.uni-paderborn.de/winkler/.

years later, in 1923, the Kanto earthquake struck. The delay, Gamow reckoned, owed to the time spent in sending and receiving.[109]

Winkler synthesizes this in a diagram highly suggestive for media from tombs to computers:[110]

	OVERCOMES	CONSUMES
Transmission	Space	Time
Storage	Time	Space

How transmission costs time is clear from Gamow's wisecracking calculation. How recording costs space is not as immediately clear. Winkler builds on Vief's use of the fable of the hare and the hedgehog. The two animals challenge each other to a race, and each one runs in its furrow; but the hare, clearly the faster animal, always loses. As the hare runs, he always finds the hedgehog already at the other end; after zooming back and forth and finding the hedgehog always waiting at the finish line, the hare dies of exhaustion. The hare has not been very attentive, at least not to gender differences, as the hedgehog has stationed his wife at one end of the furrow and himself at the other. The hare principle stands for the temporal cost of transmission: no matter how fast, any transit across space costs time, however slight. The hedgehog principle, in contrast, is simultaneity or predistribution of identicals, the mode typical of publishing and broadcasting. If multiple copies are already spread out in many places, then there is apparent simultaneity. The hedgehog appears to be in two places at once, at no cost of time. (How the hedgehog has found the time to communicate with his wife and when the positioning has taken place are not accounted for.) For Winkler, Mr. and Mrs. Hedgehog represent a principle found in writing: the ability to jump between spatially distributed points outside of time without any temporal expense, because at least two copies have already been distributed.

Within a codex, as opposed to a scroll, one can likewise access any page as quickly as any other. Time is a river, as the songs all say, but

109. Singh, *Big Bang*, 334.

110. The computer, of course, is central to Winkler's interests. Everything a computer does is reducible to processes of writing, reading, transmitting, recording, and processing. See Winkler, "Processing," homepages.uni-paderborn.de/winkler/.

recording media chop and freeze temporal events and inscribe them onto spatial coordinates. A text stands for the flow of words, and a score for the flow of music, hung up and dried on the page. A text can suspend linear logic, allowing the multidimensional eyeing that Leroi-Gourhan thinks defines the perception of images. Random access instead of serial processing can prevail. As Winkler argues: "Technical transformation—technically converting time into space—is the only basis on which reversibility can be achieved at all." On the recording surface the segments can be rearranged, thus breaking the linear flow of time. The film can be played slow, sped up, played backwards, or edited for comic results, just as a phonograph record or tape recording can be played fast, slow, or backward. Recording spatializes data onto durable materials, and playback is a kind of liquefaction or reanimation of the frozen signs into time. Here time starts to become expensive again: one second of playback costs twenty-four frames of film or fifteen-sixteenths of an inch of a microcassette tape.

In writing, musical notation, or computer memory, data are put into a virtual space a bit like the entanglement between an Atlantic ship and the Greenwich meridian. The calculation of longitude involved distant simultaneity: comparing the times of sunrise at the ship and at Greenwich. If you knew your own latitude and the time of sunrise, you could calculate the difference between your ship's time and the chronometer's, which was set to Greenwich time. The earth spins twenty-four hours per day, more or less; the time gap was also a measure of distance, and thus of longitude. It is as if the chronometer sent a message from Greenwich to the ship without physically having to send a signal across the sea: it said exactly how long it took the earth to spin between Greenwich and the ship. It was possible for it to be in two places at once without any of the effort or lost time that attends any transmission. We might call this "space axis manipulation."[111] In enabling distant communication between two points without any need to send a message, it was the hedgehog prin-

111. I owe this term to Paul Frosh. Eratosthenes's impressively accurate ancient estimate of the earth's circumference used a similar logic: he knew the angle of the sun at Syene (Aswan) and Alexandria at the same time, as well as the distance between the two. Being in two places at once in imagination, he could extrapolate the earth's girth.

ciple at work. (It is also the promise of "cloud computing" to have your documents already on hand.)

Recorded materials enable what Kittler famously calls "time axis manipulation," arguably the central concept in his work. As Krämer, who makes this argument, puts it, "The most basic experience of human existence—and this is relevant because the human is, after all, a physical being—is the irreversibility of the flow of time. Technology provides a means of channeling this irreversibility. In media technology, time itself becomes one of several variables that can be manipulated."[112] Spatialized time allows us to spin optical, acoustic, and linguistic signs recording serial events, and even to send them in a crabwalk against its original time. New recording media prolong the afterlife of the dead by apparently giving new homes for their faces, voices, and movements. And the oldest media of memory seem to have been designed to remember the dead.[113] Recording defies the inevitable fate that time for each of us will run out.

A good example can be seen in Edison's phonograph, a prototypical analog recording medium that was immediately hailed for holding the voices of the dead. His initial aim for the device was to improve telegraph transmission. Copying of any kind corrupts, and the electrical telegraph required amplification or copying to relay messages over long distances. The phonograph would instead bypass the human or mechanical intermediary and enable undistorted sending at a distance by catching the original dictation in a stable form. The phonograph, in other words, recast the problem of transmission as a problem of recording. The desire to transcend distance inspired a device for preserving time. To send a message (transmission) it must be preserved from death or corruption in transit (recording). To transmit, one must record the data in some form; to record, one must alienate the original by writing onto some surface, such as the grooves of a wax cylinder. Edison's inadvertent discovery—that sending and saving are twin faces of the same circuit—foreshadows

112. Sybille Krämer, "The Cultural Techniques of Time Axis Manipulation: On Friedrich Kittler's Conception of Media," trans. Geoffrey Winthrop-Young, *Theory, Culture, and Society* 23 (2006): 93–109, 96, trans. slightly modified.
113. Assmann, *Das kulturelle Gedächtnis*, 60–63.

the time-space continuum of twentieth-century physics. Ironically enough, just as physics was discovering irreversibility, media engineered reversibility. Thermodynamics was contemporaneous with the great analog media of time axis manipulation, the phonograph and the film.

Winkler shows the symbolic to be the realm of spatial inscription and of temporal experiment and play.[114] In a rehearsal a play or speech can be interrupted and cut into at will; in practice the difficult passage in the piano piece can be repeated as often as necessary. The symbolic decouples events from real time and substitutes slack time—in text messages or any other recording medium. The costs of messing with the time axis are minimized by playful time-outs. Play and practice are age-old forms of reversibility. For Krämer and Winkler, play fends off death. Events may happen once; but they may, if recorded, be played over and over. Recording is a resurrection machine. "Media, precisely because they are designed for time-reversal and experimental action, are obsessed at the level of content with death, dying, and the threat of death, from ancient tragedy through crime novels to first-person shooter games . . . ."[115] We've already seen the mortuary metaphorics of writing and clocks, and the same holds abundantly for photography.[116] The grave and the symbol go together. *Sēma, sēma*: the sign is a tomb. But it is also a dance around the tomb. Media manipulate time, but as ships make the sea navigable, they also reveal its alienness.

This is really big news: we have hit the cultural-historical jackpot that humans have been hunting for since behavioral modernity: How to suspend the one-way flow of time and its inevitable crash, like the running hare, toward death. The answer is the symbolic realm, with its devices of temporal storage and alteration. Media, in one of Kittler's well-known dicta, are the world of the symbolic, which is the world of machines. These machines have tremendous leverage on the human estate: they can achieve great damage or healing all at once. The latest version of this ambition is quantum computing, which extends the parallel processing first launched by writing. The premise of quantum computing is that pro-

114. Hartmut Winkler, *Diskursökonomie* (Frankfurt: Suhrkamp, 2004), 215–30.

115. Hartmut Winkler, personal communication, 21 April 2011, my trans.

116. The classic treatment is Roland Barthes, *Camera Lucida*, trans. Richard Howard (New York: Hill and Wang, 1981), 31. Barthes links ancient Greek theater with the cult of the dead, the masks being the deceased who return.

cessing can be achieved in a parallel world that costs no time, allowing computations prohibitive in our current regime to be done in apparently no time. Most of our cybersecurity practices depend on the cost of serial processing, using encryption techniques that are essentially insoluble in real time given current computer power. If quantum computing were implemented, all bets would be off about passwords, since a quantum computer could jump sidewise out of time and perform what are currently impossibly laborious calculations (such as factoring the product of enormous prime numbers).[117] The guarantee of confidentiality in computation is the same as the mark of intimacy in interpersonal relations: finitude, that is, the scarcity of time.

Despite the symbolic reversibility provided by media, everyone still dies. The body will die for sure (the life of documents is more open-ended). *Volat irreparabile tempus*, as the sundial says. The old marine metaphor is irresistible to David Eagleman: "We are stuck in time like fish in water."[118] Unheard melodies may be sweeter, but that is because they are free from the round of birth and death. Music is the most temporal of all arts. A phonograph record, tape, or compact disc does not really hold sound: sound exists only as pressure in time and space. Acoustic storage media hold recipes that, with the right equipment, can produce more or less the same sounds over and over, but they don't hold sounds the way a cave wall or canvas can hold an image. Everything that happens in time has to be started over and over in real time. The sound does not last, the word flies away, the vibration dissipates. The vinyl record can endure, but the music it plays on a stereo does not. It needs to be retransmitted into the air every time. The sound or movement is only ever in the now, and is always a unique event, giving any temporal event an element of performance. If sound, as noted, didn't decay instantly, the world would fill up with brown noise. The symbolic realm can only dam the thermodynamic drag of time for so long. Temporal beings have to disappear to be at all.[119]

In the end, space and time are not symmetrical, at least not for us.

117. Gleick, *The Information*, 370–71.

118. Bilger, "The Possibilian," 65.

119. Friedrich Kittler, "Blitz und Serie, Ereignis und Donner" (1993). To see the master at work: vimeo.com/21605213. English: "Thunder and Series—Event and Thunder," trans. Geoffrey Winthrop-Young, *Theory, Culture and Society* 23 (2006): 63–74.

(Media are always species-specific). Humans could store pictures early in their technical history because many objects (not clouds) in the field of vision are relatively stable and because surfaces can stay put as a medium of incision. Vision catches stable objects and the hand can render them durably. You cannot, however, make a sketch of a noise or take a snapshot of a sound, at least not until the nineteenth century. It took a lot of accumulated ingenuity to build devices that could write linear processes of sound and motion onto scrolls of paper, smoked glass, film, or wax. Time can be defied, but never conquered. Spatial inscription can fade or be erased as paper acidifies, film degrades, or stone erodes, but at least it can preserve its content in instantly readable form. Despite the interconvertibility of storage and transmission, time and space, and the time-confounding powers of recording, nothing in the end can stop the universe from degrading, and it degrades in a linear path towards chaos rather than order. Time is likely the effect of cosmic entropy, the tendency of everything to run down steadily in one direction. Atonement is reversibility: the power to unbind the past and to bind the future, the power of forgiveness and promise.[120]

Unlike dolphins, humans have durable media, material moldables into which we can imprint our schemes. Among the greatest of all human technical achievements is the ability to record the data of happenings in spatial form and then spin them back later into real time. We have so many options, from old stone to new (silicon). But we cannot, in the end, capture time's events and weather. There is no material that catches and molds real time. At best we can make skins and suits for time to wear. We lack any medium of four-dimensional plasticity. We have to convert time into space to manage it. Space is the only way we humans have ever been able to fix something. We can only "write" or record events on some lasting spatial substrate that can play them back with some kind of fidelity. The best we can do is substitute space for time, and firm for fluid matter.

As dolphins lack enduring spatial media of inscription, so we lack media of temporal inscription. We may yet develop highly effective three-dimensional printers, but will never print in four dimensions. Time marks the limits of all our material shapings. Our cetacean siblings mirror our lacks. As they are to matter, we are to time: profoundly limited

120. Arendt, *The Human Condition*, 236–47.

in manipulation. We are material beings, but we have not yet found any material that can fully stop time in its disappearance. The text may hold time, but our bodies, our deepest media, are fated to vanish. Nor should we want to be able to store and mold time. Pain, like time, is overwhelmingly present in the now, but fades—blessedly—into nothingness. What if pain did not vanish and we could capture it for eternal playback? Four-dimensional storage would be a diabolical and infernal piece of *Dasein*! Irreversibility is both wonderful and hideous.[121]

All materiality, in any case, will be wrecked in time; we have the assurance that everything we know will one day vanish. In five billion years, when the sun turns inexorably into a red giant, the earth will be completely incinerated. The oceans will turn to steam; our archives, whatever their form, will burn up; all the accumulated history in whatever DNA remains replicating on earth will be melted; all of our carefully tended graves will be aerosolized. This assumes that humans as a species, against all odds, will make it that far. Humanlike creatures have existed only for millions of years; only for several myriads of years have we had language, only for five millennia have we been able to memorialize our words in the nonhuman form of writing, and only for a century and half or so have we known to capture temporal process for playback. The result is a zombie universe of the library (or library of the universe) that still both freaks us out and calls forth our devotion and care. In *Moby-Dick* Ishmael uses a coffin as a life buoy to survive the sinking of his ship. "Beauty, like order, occurs in many places in this world, but only as a local and temporary fight against the Niagara of increasing entropy."[122] Writing is a boat in which we launch ourselves over the falls, hoping it will protect us while we drop.

121. See my spoof, "The Anatomy of a Circumcerebral Quantum-Entangling Experience Engine," *Das Medium meiner Träume. Hartmut Winkler zum 60. Geburtstag*, ed. Ralf Adelmann and Ulrike Bergermann (Berlin: Verbrecher Verlag, 2013), 31–42.

122. Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (Boston: Houghton Mifflin, 1950, 1954), 134.

Chapter 7

God and Google

> "Les banques de données . . . sont la 'nature' pour l'homme postmoderne."
> (Data banks . . . are "nature" for postmodern man.)—Jean-François Lyotard

The Web of Knowledge

The Internet is a vast inscription medium. It is hard to understand what this thing is, this labyrinth, library, world-brain, engine of commerce, coupler of people, purveyor of porn, system of surveillance. The Internet is an ocean, a graveyard, a market, a brothel, a zoo, a waste dump, and an archive. The Renaissance had a couple of centuries to develop the idea that the world was a book, but this new thing has arrived on the scene much more quickly. It has become the data lifeblood for the planet, the medium that engulfs all others. Whatever else it is, the Internet is a documenting machine; it both serves and mirrors a mood of storagemania. The Buddha would be alarmed by our attachments to teeming bits. The Internet's staggering data piles burn commensurate amounts of carbon and put human memory to shame in a way that no library, no matter how vast, ever could. What will remain of all this work and business? What shall we do with the vertiginously expanding record? What does it mean to live in an apparently untappably rich informational habitat?

That inscription systems have large existential consequences is a key argument of this book. History—variously organized documents of past time—is an apparently unique anthropological condition. Other animals

carry their species history in their genes and have individual and even collective memories. We carry our deep history in DNA as well, but we also carry it in external storage media. Our nature interacts with our history. Externalization means both power and fragility—the leverage we have seen with ships, fire and agriculture, sky media, and writing. The human investment in external storage media creates problems such as information overload and artificial intelligence. The bank of knowledge in a literate society always exceeds what any individual can know. The classical name for this condition is *library*; the more recent name is *Internet*. In antiquity already, several cultures possessed collections of writings that far exceeded what a single mind could know. The rabbis thought—with complete justification—that the five books of the Torah exceeded what could be mastered in a lifetime's study, and no tradition ever thought more creatively about the theology of the text. The Torah was "the one object which could be apprehended by man in its absolute state in a world where all other things were relative."[1] The rabbis understood it to be not just a book, but part of the constitution of the universe, and a holder of the secrets of Creation.[2] The greeting for Rosh Hashanah today is still "May you be inscribed" (into the book of life), the sense being not that the world holds the book, but that the book holds the world. Accounting and inscription logics are deeply built into Orthodox Jewish practice.[3] In a similar spirit but different tradition, Du You, a scholar in the Tang Dynasty, said: "Whenever one consults the books of the ancients, it is because one wishes to reveal new meanings and form institutions in accordance with present circumstances. Their way is inexhaustible."[4]

The printing press refueled the complaint that there was too much to know.[5] To paraphrase Leroi-Gourhan, knowledge belongs to the face, but books belong to the hand, and they can accumulate without regard

1. Gershom Scholem, *Kabbalah* (New York: Quadrangle, 1974), 168.
2. Susan A. Handelman, *The Slayers of Moses: The Emergence of Rabbinic Interpretation in Modern Literary Theory* (Albany: State University of New York Press, 1982), 37 ff.
3. Sharrona Pearl, "Exceptions to the Rule: Chabad-Lubavitch and the Digital Sphere," *Journal of Media and Religion* 13 (2014): 123–37.
4. Quoted in Michael Cook, *A Brief History of the Human Race* (New York: Norton, 2003), 196–97.
5. Ann M. Blair, *Too Much to Know: Managing Scholarly Information Before the Modern Age* (New Haven: Yale University Press, 2010).

to how much a single person can read. Only in an oral culture is the total stock of knowledge in alignment with what a mortal knower can retain, thanks to the "structural amnesia" that maintains a more or less constant level in the reservoir of collective knowledge.[6] An equilibrium between mind and matter does not hold in literate cultures, which have difficulties with order and disposal, although fire and the madness of kings can purge whole forests of text. Modern libraries, as a rule, are committed to open-ended storage and agnostic surprise about tomorrow's treasure. One extreme of the save-everything policy is the *genizah* in the Jewish tradition, a crypt for superannuated texts too holy to be destroyed. The problem is that unusable texts still hold God's name and must not be harmed, so they remain stashed on life support in these storehouses (which have proven to be of enormous archaeological and philological value). What about digital versions? According to a 1999 rabbinical ruling, the command to save all text containing the divine name does not apply to the pixels of computer screens, since they are not "anything more than a sequence of ones and zeroes."[7]

The vertigo of an infinite text has perhaps changed little, but for sheer quantities, the digital era jacks up the information overload sweepstakes astronomically. More digital data is generated every year than all the writing done in history. John Milton, it is said, read all the books available in his time, but no one could come even close today, and Milton hardly did even then. And even if Milton read everything, how much did he keep in his mind? *Paradise Lost* is an amazing feat of memory, among other things, but even that epic is but a flashlight into years of reading, most of which must have vanished in the haze. Avid readers know how strange and virginal texts can appear on rereading, as if they had grown into new creatures or had disappeared into some black hole.[8] Books you have read share a deep ontological similarity with books you haven't: both can be profoundly fuzzy. At times books you haven't read shine more brightly than those you have, and often reading part of a book will shape your

6. Jack Goody and Ian Watt, "The Consequences of Literacy," *Comparative Studies in Society and History* 5:3 (April 1963): 304–345, at 309.

7. "Rabbi OKs Deleting 'God' on Computers," *Los Angeles Times* 2 January. 1999, http://articles.latimes.com/1999/jan/02/local/me-59668.

8. Patrick Süskind, "Amnesia in Litteris: The Books I Have Read (I Think)," *Harper's* (March 1987), 71–73.

mind more decisively than reading all of it; there is no inherent epistemic superiority to having read a book to not having read it. (Scholars are experts at talking about books they haven't read.)[9] But machine-searchable databases tilt the imbalance between human and nonhuman filtering. What is one supposed to do with our ever more massive databases? How should we treat the guardian ghosts that shape and becloud our memories? How much is lost to the "dark web," or to the vast seas of hidden, inaccessible, or untagged realities? What is knowledge and where is it located? Is its home in human brains, libraries, our species, or some hybrid network of humans and nonhumans?

The Google search engine is a convenient target to see how the arts of memory are altered by digital infrastructures. Just as writing manages the inhospitable materials of language and voice, so Google deals with the intractable problem of memory's order. In addition to the seacraft, pyrotechnics, chronometrics, and graphic techniques covered so far, this chapter takes up mnemotechnics, the question of how to tag and give order to a mass of materials. The art of searching, like that of fire, consists largely in elimination. Knowledge is not the gathering but the throwing away of information. Learning involves discarding as much as gaining—students must abandon fear, habit, and attitude. But we make books to manage the discarding: every library has a paralibrary of reference materials, notes, and catalogs. Metamedia are media themselves. Even reference works—whose point is to guide people to information—take up space and need to be managed.[10] Google's genius to figure out that library is its own index. It is the latest map of the library, a craft that makes an inhospitable element navigable.

Every civilization has been in the business of recording, transmitting, and processing data. Databases, broadly defined, are collective storage media and may include many forms of preservation such as cemeteries, genealogies, temples, cairns, chanceries, and libraries. But the asymptotically nil cost of digital storage, the miniaturization and personalization of digital devices, the expansion of bandwidth and a network infrastructure,

9. See Pierre Bayard, *Comment parler des livres qu'on n'a pas lus* (Paris: Minuit, 2007); a book I haven't yet read.
10. Blair, *Too Much to Know*, ch. 3, passim.

and a strong resurrectionist will have created historically unprecedented conditions for archives.[11] Long vanished books, newspapers, film clips, videos, magazines, songs, and photos are reappearing in mushrooming digital compilations. The same is true of people, who keep popping up on social media as if back from the dead. The parallel universe of the Internet is, to speak with Bruno Latour, a parliament of nonhuman things. Materials tagged are like the sundial's gnonom: things endowed with knowledge. The key fact about the digital library of the web is not just greater accessibility to users, but greater interconnection among texts (there is, of course, a politics to the forms of interconnection).[12] There are networks of things as well as of people. Google search is the symbol and symptom of the universe-database's growing self-knowledge. If our being is moored by signifiers, and changes in their infrastructure alter the course of our history, the Internet is surely of great interest.

The Universe as a Library

In asking questions about this abundance, our intimacy with gnomic things, and the metaorganic network that has tumbled into being, this chapter follows Jorge Luis Borges, the man who conceived of the universe as a library, and who understood better than anyone the fragility of memory, the strange ontology of the book, and the theology of monstrous catalogs. Seeing Borges as the patron saint of Google or even of the Internet is certainly nothing new; Google's own rhetoric and self-presentation, as we will see, eagerly cultivate such a lineage. In August 2011, for instance, Google honored Borges with a "doodle" celebrating his 112th birthday, in which he is shown facing a stylized Library of Babel. But Borges's relevance is much deeper than as the dreamer of a total library; he was the student of the tie between mortality and memory, the way in which books can be as deeply alive as any metabolizing carbon-

11. Lisa Gitelman, "Welcome to the Bubble Chamber: Online in the Humanities Today," *Media History and the Archive*, ed. Craig Robertson (New York: Routledge, 2011), 30–39.
12. See Ted Striphas, "The Abuses of Literacy: Amazon Kindle and the Right to Read," *Communication and Critical/Cultural Studies* 7:3 (2010): 297–317.

based creature, and an apparently random page can be the script of God. He pondered the demiurgic tremors that books exercise on each other, and the odd metaphysical loomings by which encyclopedias and other projects of totality are made of nothing but networks. He knew from the rabbis and from Josiah Royce, who anticipated Google in 1899: "The Universe, as Subject-Object, contains a complete and perfect image, or view of itself. . . . Whatever is, is a part of a self-imaged system."[13]

Kittler, a great lover of Borges's work, once announced the central doctrine of "information-theoretic materialism": "*Nur was schaltbar ist, ist überhaupt*."[14] Only that which can be switched (gridded) exists at all. It is a nice statement of media as ontological operators, as the arts and crafts that process the world and enable things to be at all. Though Kittler called it materialist, the idea actually has a clearer idealist lineage. Idealism is not only a philosophy that wants to explain the world, as Emerson said, by principles besides carpentry and chemistry, but one that reduces the universe to its index. Being can be replaced by operations, the world by ideas, the Internet by its tags. For George Berkeley, the great Irish idealist whose name adorns the California city, existence meant perception. His slogan is not far from Kittler's: *Esse est percipi*, to be is to be perceived. Some read Berkeley as saying the universe is so perfused with mind that matter is not real, but he is better read as performing a great pragmatist reduction: The world and all its furniture is—practically speaking—only so much stuff in the minds of perceivers. As William James noted, "Berkeley doesn't deny matter, then; he simply tells us what it consists of. It is a true name for just so much in the way of sensations."[15] Idealism is the implicit philosophy of tagging. We don't need to worry about *esse*; we can substitute the more manageable *percipi*. The library is the catalog. The Internet is the search engine. The event is the record. The universe is perception. In this string of sentences, we can see the ambition of media studies at its most grandiose: to be a successor discipline to metaphysics, as the field which accounts for the constitution of all that is.

13. Josiah Royce, *The World and the Individual*, 2 vols. (New York: Macmillan, 1899), 1:553.
14. Friedrich Kittler, "Real Time Analysis. Time Axis Manipulation," *Draculas Vermächtnis: Technische Schriften* (Leipzig: Reclam, 1993), 182–207, at 182.
15. William James, *Pragmatism* (1907; New York: Meridian, 1970), 68.

Whether *Esse est percipi* holds for stones, frogs, and trees, and for "things" in all their variety, it clearly does in some ways for books, the chief of all human artifacts of mind, whose nature, we will see, says much about the Internet. It is no accident that idealist thinkers Berkeley, Schopenhauer, Royce, and Borges were all bibliophiles. The being of books is in some way ideal. To exist as more than a paper-pulpy object, the book must be read or remembered. But the book is more than its readings. The absence of readers does not mean an absence of intelligence. I once found in the University of Iowa library a book last borrowed, according to the checkout stamps, in 1938 that was so alive and smart, so full of things I absolutely had to know, and which spoke to me with the freshness of the morning and no must or smell of the crypt about it. Where had it been all those years? What had kept it alive? Its author, Karl Jaspers, was long dead, and so his brain was not the keeper of its flame. Authors in any case would be poor keepers of their books, not only because they are often not the best readers of their work, but because they forget what they have written as quickly as readers forget what they have read. (Forgetting may enable multiple books in the way it enables multiple births: a better memory of the process might discourage repetition.) The reader activates the book as the ship activates the sea.

Since our time is limited, each book is a blessing and a burden. Schopenhauer remarked that buying books would be better if you could also buy the time to read them. Books are different from natural objects in that they can overwhelm us in a way that nature's abundance rarely does. There has always been too much to know; the universe is thoroughly baffling. When we walk into a bookstore, it is easy to feel oppressed by the amount of knowledge on tap. Why don't we have the same feeling in a forest, at the beach, in a big city, or simply in breathing? There is more going in our body every second than we will ever understand, and yet we rarely feel bothered by our inability to know it all. Books, however, are designed to make demands on our attention and time: they hail us in ways that nature rarely does. A thing is what Heidegger calls *zunichtsgedrängt*, relaxed and bothered about nothing. A plant or stone is as self-sufficient as the Aristotelian god or Heidegger's slacker things, but books are needy. They cry out for readers as devils hunger for souls. They want to possess us. "A book is a thing among things," said Borges; "a vol-

ume lost among the volumes that populate the indifferent universe, until it meets its reader, the person destined for its symbols."[16]

Most meaning-imbued intelligent things exist without living curators. (If existence is perception, every time someone dozes off, some part of the universe vanishes—and another part of it springs into being.) What would happen if some plague killed all humans but left all material objects untouched? Would collections in museums and libraries, piles of documents in offices and customs houses, have any meaning? (Books and computers, like corn and poodles, need human care to thrive; they are the ultimate domesticates.) Would there be any intelligence without living beings to read all the externalized memory storage? This is an important question if we want to hold, as I do, to the principle that intelligence is objective or public, not subjective or private. I believe that all the texts left by such a plague would continue to mean, just as Egyptian hieroglyphs continued to mean during the centuries when no one knew how to read them. The language was dormant but still really there in some way that is difficult to specify ontologically. It did not exist in a brain between the last writer of hieroglyphs and Champollion—at least in no human ones—but it continued to exist as an orphaned text packed with intelligence.

The scenario that wipes out readers is not only a thought experiment: it *is* our situation. We live in datascapes and cultural storehouses that exceed not only any possibility of mastery, but even the slightest acquaintance of any living creature. Knowledge is held in trust by the entire species, if not beyond. In storage media, mind outgrows brain. Most of the contents of the universe, whether natural or artificial, have no cognitive guardian, and lie untouched by any mortal intelligence. In Berkeley's idealism, such contents risked disappearing into nothingness, so he saved them by God's omniscient perception. (We'll return to omniscience.) Because God perceived everything, no sinkholes of neglect would gobble up reality.

A book is like the sea: perfectly happy to exist without meddling, but fully inaccessible without some technical labor. But a book's being is harder to specify. Beings less intelligent than humans can make use of the

16. Jorge Luis Borges, "Prologue to the Collection," *Selected Non-Fictions*, ed. Eliot Weinberger (New York: Penguin, 1999), 513–34.

sea, but only humans or beings more intelligent than humans make use of books as repositories of meaning. Fire and silverfish make other uses of books: materialism is the philosophy of animal intelligence on down; idealism is that of human intelligence on up. What is a book? How could one possibly answer such a question? (It is the same question as "What is a mind?") A book is a body, an animal, a ghost, a person, a work of art, a piece of music, something to eat, a revelation fallen from the heaven or a treasure dug up from the earth, a doorstop, a line on a resumé, a companion, a bestseller, a way to show off, a gift, a guide for living, a piece of kindling, a reason to avoid other people, a royalty check, a pirated object, a hand tool, a corpus, a writ of divorcement, a piece of evidence, something to carry all semester long in a backpack and then sell, a foreign country—something sealed, censored, cursed, translated, unread, or not yet written. John Milton—echoing, as he often did, the opinion of the rabbis—thought that books were lively creatures, susceptible of springing up in sudden progeny, like dragon's teeth, and that killing a good book was in some ways worse than killing a person, because the person is God's image, but a good book is reason itself, killing "the Image of God as it were in the eye."[17] Heinrich Heine noted that when books are burned, people are next in line.[18] Books have intimate ties to living intelligences. As a living being, a book has both a *bios* and a collective dimension; books are preeminent political animals.

Defining a book is as difficult as defining language, and Google revives a way to think about both: they are networks. Google is the latest step in the methods of classifying and valuing that deny any transcendental truth or central authority for determining it. Like academic peer review, which measures the quality of research by the community of expertise, Google sorts through meaning purely immanently by means of linkages. (One suspects that the turn to a philosophy of immanence owes something to the media a priori of Google.) In this it is also like the linguistic theories of Ferdinand de Saussure, who saw language as a network of interconnected terms. His late-life lectures, compiled famously as *Cours de linguistique générale* (1916), radicalized the point of any dictionary: If you look up a word, you find another word, and that word will send you

17. John Milton, *Areopagitica* (1644), 6:5.
18. "Dort, wo man Bücher verbrennt, da verbrennt man am Ende auch Menschen."

to another, and so on. His point was not exactly that made by some of his readers later, that meaning is infinitely deferred, but rather that each word's meaning lies in the unique pattern of its network, its entanglements, and kinship with other terms.

Libraries, too, were always networks, even before systematic methods of cataloging developed. No book can exist without other books; they exist in delicate systems of interlinks like aspen groves. In scholarly books the web of citations to other writings is mostly explicit, but all books exist in a dense tangle of explicit or implicit hyperlinks (what literary scholars call intertextuality). A wind and weather of influences blow through books; Harold Bloom has devoted his life to studying them. Some books are so central to a language that they provide much of the DNA for what follows; in English, the King James Bible and Shakespeare enjoy a genetic founder effect, as the Luther Bible and Goethe do in German. Almost everything written in English or German since makes outlinks to those homepages.

Search On

I've already started to use the language of Google, which explicitly models itself on a library. Google is a remarkable company, full of energy, hubris, imagination, whimsy, and ruthlessness. And money. It leads the way in comedic capitalism along with other cutesy, jokey businesses such as Spanx and Zappos. It has been the subject of several solid studies, both scholarly and journalistic.[19] Google is a particularly appealing target for scholarly analysis because it is so close to the scholar's basic modus operandi of searching. It represents many enterprises devoted to patrolling and tracking the moorings of our being. But my focus here is not the

19. John Battelle, *The Search* (New York: Penguin, 2005); Ken Auletta, *Googled: The End of the World as We Know It* (New York: Penguin, 2009, 2010); Jeff Jarvis, *What Would Google Do?* (New York: Collins, 2009); Siva Vaidhyanathan, *The Googlization of Everything (and Why We Should Worry)* (Berkeley: University of California Press, 2011); Ken Hillis, Michael Petit, and Kylie Jarrett, *Google and the Culture of Search* (New York: Routledge, 2012); Nicholas Carr, *The Shallows* (New York: Norton, 2010); and Steven Levy, *In the Plex* (New York: Simon and Schuster, 2011).

company or its everramifying projects and purchases, which move too fast for a book dedicated to long time like this one. It's not even clear whether Google will exist in a couple of decades, though it also may rule the world by then. Rather, my interest lies in what it does best: "search," as it has come to be called (I would prefer the gerund *searching* to the naked verb, but the battle appears to be lost). Whatever Google's ultimate fate, its search method has provided a stunning answer to the enduring problem of how to find your way around the library or universe. Some version of its solution will undoubtedly persist as long as the Internet does. Google gives us a way to understand the long history of navigational aids for records and memory. Data is its business, and its logistical genius authorizes, in part, my argument that digital media revive the oldest problems of civilization, especially that of how to manage basic infrastructural elements. Google is the leading logistical gateway to the online universe, and thus a chokepoint worth attention, though there are many other potential corporations and targets worthy of analysis.

Google is arguably the emblematic media corporation of our age. It makes clear a point with which this book began: media have shifted from mass media to cultural techniques not only in theory, but in fact. Fifty years ago, the flagship media companies in industrialized countries were in the business of producing a scheduled delivery of drama and news packaged in genres with mass appeal. Companies such as CBS, NBC, the BBC, and NHK programmed the nation's cultural fare and also shaped the objects and timing of people's leisure. Google, in contrast, does not produce programs as such but provides organizational services such as search, mail, maps, document storage, calendars, translation, and reference, along with a whole host of curious side projects, and it does so around the clock and on a personalized basis. In its reflected light, it is easy to understand media as data processors that connect subjects and objects across time and space rather than as nationally focused culture industries. The only thing that hasn't changed is the basic economic arrangement in which advertisers pay for audiences' attention. Google's revenues were $57 billion in 2013, up from $44 billion in 2012. Never were Innis's worries about monopoly more relevant.

Google presents itself as a search service, but its real business is data mining. As of 2010, it burnt through about twenty petabytes of data per

day. A petabyte is a million gigabytes; everything ever written in all languages in the history of the world is estimated to weigh in at about fifty petabytes. Google has logged every single search, and the subsequent "clickstreams" of its users, through cyberspace and will continue to do so as long as it exists. This log presents very valuable data, full of secret knowledge about business, politics, crime, and passion. Much that has been plotted, wondered, desired, hoped, or shopped for in the past decade is housed on Google's servers and also churned back into Google's model of the web. (With a typically unerring sense for inspired names, Google calls its large file system "Colossus," echoing the World War II computer that the British used to help decrypt German radio transmissions.) We all leave digital trails every time we go online, and collectively these ant paths provide illuminating material to those who know how to access and analyze them. Here, in data, is a new version (as we will see) of the book of life. Those who build the databases have the power, and vice versa.

Previous library classification schemes such as the Dewey Decimal System or the Library of Congress system were based on title, author, and subject; but Google figured out how to do subject searches of unprecedentedly fine resolution. Google was to be a smart library—not only a repository of books, but an intelligence fingering its way through documents and coming to know itself, something like Hegel's absolute *Geist* coming to self-consciousness in algorithms. The original paper in which Sergey Brin and Larry Page, the company's co-founders, presented Google—published online as "The Anatomy of a Large-Scale Hypertextual Web Search Engine" (1998)—introduces the basic logic of Google's online searching. As PhD students in computer science at Stanford University, they saw their search engine as free of the "mixed motives" that colored other search engines whose business model depended on advertising. They even cited the venerable muckraking classic about the ill effects of concentration of media ownership, Ben Bagdikian's *Media Monopoly*—a book that in retrospect seems to have served them more as a how-to guide than as a warning. Their aim was the facilitation of academic research, and the web was a gigantic library without a card catalog, "a vast collection of completely uncontrolled heterogeneous documents." Indeed, unlike every other large-scale collection of

documents in history, the web was born without a central card catalog or retrieval system.[20] Google aimed to fill the gap.

Setting aside the complex engineering, the principles of Google's search method are easy to grasp. Google reads the web as the map of itself. The mathematics of expander graphs applied to the web sees it as something like rainfall on a landscape: the aim is not to know every square inch of soil but to figure out topography from the water flows. More simply, the content of documents can be inferred from their location in networks. Computer scientist Jon M. Kleinberg, in an article inspirational for Google, made this point clearly: "The network structure of a hyperlinked environment can be a rich source of information about the content of the environment." Many websites do not identify themselves with obvious search terms: www.harvard.edu does not necessarily use the term "higher education" a lot, nor should we expect to find the term "automobile manufacturers" on the Toyota or Honda homepages. Some links, Kleinberg noted, were simply navigational ("click here to return to the home page") but other links were implicit votes of relevance. Links are not created equal, but can be sorted and weighed.[21]

PageRank, Google's original search algorithm, built on Kleinberg by defining relevance relationally and systemically, not by the manifest content of the webpage. (PageRank is named after Larry Page, not after the webpages it ranks.) Brin and Page decided to read the web as the embedded intelligence of millions of users, "an intricate form of populist hypermedia," as Kleinberg put it. PageRank is parasitic on the knowledge built into the web. Every link between websites is a kind of vote about worth or "authority" (Kleinberg). Google reads the infrastructure of the web as the interpreter of its content. The metadata used for indexing are not contained in a document but are inferred, kind of like Saussure's network of language. Google's crawlers are interested in key words on websites, but are even more interested in network strength and density, reading for inlinks and outlinks. (PageRank rarely points to broken links.)

20. Thomas Haigh, "The Web's Missing Links: Search Engines and Portals," *The Internet and American Business*, ed. William Aspray and Paul E. Ceruzzi (Cambridge, MA: MIT Press, 2008), 159–200.

21. Jon M. Kleinberg, "Authoritative Sources in a Hyperlinked Environment" (1997), www.cs.cornell.edu/home/kleinber/auth.pdf, accessed 23 April 2013.

Google reverse-engineers the web and extracts its intelligence. Blessed are they who know how to read infrastructure. Like Turing's machine and DNA, Google makes no material separation between metamessage and message—which are made of the same exact stuff. Turing's infinitely spooling paper strip contains both data and commands. In the DNA code structural and control genes mingle side by side—that is, epigenetic control of the code is managed by the code itself. In Google the material of search is the web itself. The recursive collapse of the "meta" into the thing itself is a distinctive feature of media in the age of Turing.[22]

The reading logic of PageRank, which mimics the academic prestige system, is another way in which Google ties to campus culture. "Publish or perish" is the famous rule for university professors, but the calculus is actually more subtle. Professors love to read; and even more, they love to write. Even more than writing, they love to publish. But even more than publishing, they love to be read. Better than being read is being cited. Even better than being cited, however, is being cited by someone important. And how do you know who is important? By citations, of course: an important scholar gets cited a lot. Scholars who are cited by other scholars a lot confer greater authority when they cite another scholar: they channel the power of their inlinks.

The network of scholarly co-citations was already a kind of World Wide Web and an implicit hierarchy of values, as has been recognized by pioneers in information science such as Paul Otlet and Eugene Garfield. Just as scholars want to be cited by Scholar Big, so web page designers want their page to be linked to by a page with lots of inlinks. What academic journals call "impact factor" is analogous to what is sometimes called Google juice: the strength of a site or document's position in the web as defined by incoming web links. PageRank follows a bibliometric logic pioneered in the analysis of academic citation patterns now run by Web of Science.[23] A citation is structurally identical to a hyperlink. Page once dreamt of downloading the entire Internet as nothing but its links, and saw the best search engine as "a reference librarian with complete mastery of the entire corpus of human knowledge."[24]

22. Friedrich Kittler, *Gramophon Film Typewriter* (Berlin: Brinkmann und Bose, 1986), 357.
23. See Hillis et al., *Google*, chapter 4.
24. Auletta, *Googled*, 35; Battelle, *The Search*, 252.

This dream is fulfilled, more or less, in the constantly updated map of the Internet that Google's web crawlers assemble. Its spiders maintain a constantly updated map of the web cosmos. (This is where the "Matrix" or the "simulacrum" of Baudrillard exists.) I am tagged, therefore I am. For many, Google *is* the Internet. When Google decided for a while to cooperate with the Chinese state and alter searches on www.google.cn, so as not to show sensitive results, it operated ontologically. "An unindexed Internet site is in the same limbo as a misshelved library book."[25] Google's agreement with the Chinese state, since scotched after a very rocky relationship, effectively consigned a piece of the web to limbo; for its Chinese users, Google not only hid information but altered what is. A tweak in its algorithm can move a website from the first page of search results to the outer darkness of the fourth or fifth page. Like Lenin, the general secretary of the Bolshevik Party, Google's control of documents suggests an enormous ethical and political dilemma.[26] The phrase favored by Spanish monarchs and German media theorists is tailor-made for Google: "*Quod non est in actis, non est in mundo*." It is a cousin to Berkeley's "*Esse est percipi*," Derrida's "*Il n'y a pas de hors-texte*," and Kittler's "*Nur was schaltbar ist, ist überhaupt*." Google is the text that contains the universe, the latest branch off the Torah family tree.

Google is a medium, and media have ontological effects. The saying that what is not in the files is not is in the world can be read in several ways. Assuming that the world is fuller than the files, the saying asserts the administrative priority of records. Legally, if it's not in writing, it doesn't exist. But you can also read the Latin *quod* more aggressively as *because*, thus denying reality to anything undocumented. Brin, in defending the Google Books project, argued that it saves books from oblivion: "Even if our cultural heritage stays intact in the world's foremost libraries, it is effectively lost if no one can access it easily."[27] He sounds like Berkeley discussing an unperceived part of the universe. What does it mean to lose a cultural heritage? Does Google have knowledge? Do I have knowledge of the books I have read but forgotten, or of the megabytes of per-

25. James Gleick, *The Information* (New York: Pantheon, 2011), 410.

26. James Grimmelmann, "The Google Dilemma" (2009), works.bepress.com/james_grimmelmann/19/, accessed 23 April 2013.

27. Sergey Brin, "A Library to Last Forever," *New York Times*, 8 October 2009, sec. A31.

ceptual data my senses discard by the second? Do I add to knowledge when I state something in this book that is already known by millions? I might add to the knowledge of my particular readers, but do I add to aggregate knowledge? Is knowledge found in the world's libraries and artifacts, in the networked embodied minds of knowers, or only in an individual's brain? Isn't most knowledge, in fact, close to what Google makes: an artifact of organization and networking? If education among individuals matters, then repetition must not be in vain. There must be some species value for the increase of knowledge held in common among diverse people.

A 2005 parody by *The Onion* took the ontological indiscernibility between file and fact to its logical extreme. The satirical newspaper reported a project called Google Purge, which aimed to burn all the books it couldn't scan. John Battelle, a friendly commentator on Google, opines fictionally: "You'll never have to worry that your search has missed some obscure book, because that book will no longer exist. And the same goes for movies, art, and music." The burning of books is just phase one in *The Onion*'s spoof: eventually all that Google can't index will be destroyed. Hard drives, thoughts, and feelings will be purged and those who refuse a Googlebot-administered DNA scan will have their brains liquefied.[28] As often happens, parody uncovers the key point: the ontological power of the tag to create and destroy.

One implication of Google's network understanding of the web was friendliness to imprecise search terms. In their founding paper, Brin and Page "vehemently" opposed the idea that search queries should be exact and lengthy. They favored demotic entreaties, open access to the inarticulate. Google search faces polysemy, the many senses that cohabit single terms, and offers a pragmatic answer. Should the search query "Washington" deliver pages about the state (WA), the city (DC), the president (George), or the actor (Denzel)? (The semantics of proper names drives both philosophers and search engines crazy.)[29] The algorithm is designed

28. "Google Announces Plan to Destroy All Information It Can't Index," *The Onion* 31 August 2005, www.theonion.com/articles/google-announces-plan-to-destroy-all-information-i,1783/ accessed 3 Aug 2012.
29. Levy, *In the Plex*, 46–52, passim.

to hedge bets by including the range of branching meanings. A chief discovery of Google is semantic, that names are not rigid designators. Google treats its search algorithm not like a logical positivist, searching for the purity of a rigorous definition that would eliminate the semantic penumbra, but like a happy-go-lucky pragmatist willing to crawl the snail trails of associations wherever they lead. Google's logic of valuation is rather like Saussure's banking vision of linguistic meaning: the meaning of a word is another word. Just as the dictionary consists of a web of hyperlinks to words without ever grabbing hold of so-called reality, so no transcendental gold standard backs the floating currency of the web. A page is valued by how other actors in the system value it, and their power to value it is determined by the value that others place in them. Precision of meaning or point-by-point coverage is not Google's aim, though it increasingly wants to predict your searches; it acknowledges the fuzziness built into the nature of things.

Another implication is Google's complete indifference to the underlying organization of the web. This is not to say that Google as a company does not have strong policy preferences about the Internet's design and evolution; it sees the Internet as an open field to be surveyed rather than as either a social hive or a walled garden (the rival visions of Facebook and Apple).[30] Underlying architectural order is indifferent to Google search. Google organizes the web by tagging, not by tidying. In the Dewey Decimal System, a call number tells you not only what a book is about, but where to find it. Dewey, writing in the 1870s, not only changed how books were labeled, but changed the design of libraries down to the shelving of books. He proposed a taxonomy and hierarchy of the print kingdom to clean up the sprawling mess of nineteenth-century libraries. He had to rely on human indexers to decide what a book was about and where it belonged.

Google, in contrast, doesn't care where the documents are and trades physical order for ease of retrieval. It can look inside books and read their networks. It operates like what Andy Clark calls embodied mind: not by making a clean representation of the web, but by knowing how to

30. Fred Vogelstein, "Great Wall of Facebook: The Social Network's Plan to Dominate the Internet—and Keep Google Out," *Wired* 17 (22 June 2009).

play with it. Architecture was once the foundation of the art of memory, based upon placing concepts into places (topoi) that could be traversed in memory (presumably difficult for dolphins).[31] Shuffling through bits takes less labor than ordering shelves of books, at least once the digital infrascruture is in place. (Even Windows file management systems have recently shifted from folders to key word searches: you don't have to know where a document is, only how to find it.)

The idea that the Internet is free of the grunt work of shelving is particularly clear in the rhetoric of the *cloud* as a universal space of digital storage. The cloud metaphor has been a smashing success for the information technology business, and fluffy, benign cumulus clouds are now the standard iconography of online storage. Google insiders Eric Schmidt and Jonathan Rosenberg report: "It's called 'cloud computing' because the old programs to draw network schematics surrounded the icons for servers with a circle. A cluster of servers in a network program had several overlapping circles, which resembled a cloud."[32] Though correct about the metaphor's origins, they are quite disingenuous about its effectiveness and ubiquity, and have to know what a public-relations coup cloudy rhetoric is. The cloud evokes ancient ideas of a heavenly record containing everything ever said and done, a record both worldly and infallible. If ever there were a target for old-fashioned Marxist demystification, this would be it.[33] Anyone who talks casually of "the cloud" should see the excellent film *Take Shelter* (2011), which is guaranteed to make you think twice about cloud menace. We may yet have to revive terms such as *cloudburst* and *cloud attack*, the latter referring to poison gas. And fantasies of what Mark Hansen calls "atmospheric media" presuppose an electrical grid.[34] Information is not smokeless. Google's servers burn up millions of dollars of electricity every month and produce an enormous amount of heat that requires cooling. "The transfer of infor-

31. See of course Frances A. Yates, *The Art of Memory* (1966; London: Pimlico, 1994).

32. Eric Schmidt and Jonathan Rosenberg, *How Google Works* (New York: Grand Central, 2014), 11.

33. See Vincent Mosco, *To the Cloud: Big Data in a Turbulent World* (Boulder, CO: Paradigm, 2014).

34. Mark B. N. Hansen, "Foucault and Media: A Missed Encounter?" *South Atlantic Quarterly* 111 (2012): 497–528, at 497.

mation cannot take place without a certain expenditure of energy," said Norbert Wiener.[35] Computation is never thermodynamically free; any act of intellectual organization runs uphill against the tendency of everything to degrade. The need for cooling has always set limits on computer design, specifically on how densely components can be packed.[36] The noosphere requires an infrastructure. Perhaps the angelic record is unconstrained by heat, but Google, despite its pretensions, is very much an earth medium rather than a sky or sea medium, either of which it would obviously prefer to be. There is plenty of dirt on data. Much computation depends on coal and coltan, and data centers alone are estimated to use from 1 to 3 percent of electrical output. Data processing is dependent on the furnace arts. Vulcan, not Apollo, is the lord of cyberspace.[37]

Google as Religious Medium

Sergey Brin famously suggested that "the perfect search engine would be the mind of God." This half boast, half ambition puts Google into a long line of hieratic readers of the sky, and has a nice a touch of Kabbalah as well.[38] It shows Google's membership in a distinguished family of religious media. Google's project is to build a temple to meet the sky, anchor remembrance, and serve as a canon of all knowledge.[39] Its aim is nothing less than a metamedium that would be the guide for the perplexed of cyberspace. Google inherits the narrative of the priestly class that discerns the universe, renders order out of chaos, answers our entreaties, and invites us to take part in mantic acts of divination. From the unaccountably vast array of possibles Google provides the answer you

35. Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (Boston: Houghton Mifflin, 1950, 1954), 39.

36. Charles H. Bennett, "Notes on the History of Reversible Computation," *IBM Journal of Research and Development* 44 (2000): 270–77, at 272.

37. James Glanz, "Power, Pollution, and the Internet," *New York Times*, 22 September 2012; Jean-Francois Blanchette, "Computing as if Infrastructure Mattered," UCLA, 27 September 2012.

38. In modern Hebrew, a receipt is called a "kabbalah," which nicely connects the divine and bookkeeping.

39. Jan Assmann, *Das kulturelle Gedächtnis* (Munich: Beck, 2007), 177 ff.

seek, rather like fortunetelling and haruspicy or the priests who stood in the *templum* watching the sky for augurs and omens. Google is a clergy defined by its control over the means of inscription and retrieval—as clergies and priesthoods always have been. Google also picks up on the long romance that mathematicians have had with infinite and ultimate things. "The respective interpretation of the symbols 0 and 1 in the system of logic are *Nothing* and *Universe*," wrote George Boole.[40] This was a variant of Leibniz's view of digital notation as shuttling between creation and the abyss—indeed, in the space where Google likes to shuttle.

Obviously, media are central to whatever we take religion to be. Some strains in Protestant and New Age thought may value immediacy as the only authentic religious mode, but neglect the infrastructures that make it possible. Religious practices in all their varieties have some kind of sacred media at their core; immediacy is usually the achievement of some hidden cultural technique.[41] The Abrahamic book religions are selectively friendly toward devices of divinity, but they also harbor touchy iconoclastic strains ready to attack what are taken as false (objectifying) media.[42] The fight here is about the right media, not about whether media are part of the equation or not. "Religious media" is not an oxymoron; indeed, they may ultimately be the only kind of media there are. Scrolls and Bibles, holidays and calendars, clocks and bells, astrolabes and sundials, sacraments and rites, prayer wheels and divining rods, towers and temples, ram's horns and organs, stained glass and incense, choirs and diaries, relics and places of pilgrimage, robes and veils are among the media that make religious practice and experience possible. Media can focus and collect spiritual energies, foster communities or zones of likemindedness, store and transmit culture, and unfold the data of the divine. Invoking an old theological term for the sacraments, we may call media *media salutis*, media of salvation.[43]

40. Gleick, *The Information*, 164.

41. Birgit Meyer, "Mediation and Immediacy: Sensational Forms, Semiotic Ideologies, and the Question of the Medium," *Social Anthropology* 19 (2011): 23–39.

42. See *Deus in Machina*, ed. Jeremy Stolow (New York: Fordham University Press, 2012), Régis Debray, *Dieu, un itinéraire* (Paris: Odile Jacob, 2001), and Peter Sloterdijk, *Gottes Eifer: Vom Kampf der Drei Monotheismen* (Frankfurt: Verlag der Weltreligionen, 2007).

43. I owe this point to Prof. Heinrich Assel of the University of Greifswald.

Google all but begs for a theological analysis. The history of conceptions of omniscience is also a history of database media in all their forms, an implicit catalog of different recording formats. God and Google are both passive miners of data; not a sparrow falls nor a click occurs without their notice. The notion that Google is somehow godlike is already well developed, and Google avidly cultivates this mystique. A Google search of "God and Google" yielded 1,110,000,000 hits as of April 2013, including bits of loser-generated content about the church and ten commandments of Google, and several purported sightings of God captured by Google's roving Street View cameras. There are also distressed pleas from traditional churches that God should not be treated like a big search engine.[44] One church advertised its Sunday sermon: "Google does not have all the answers." One of the many business books admiring the company is called *What Would Google Do*. Canadian philosopher of technology Darin Barney made a similar play in a book called *One Nation under Google*. Everyone gets whose name Google is replacing. The baldest recent play is the cover design of the 2014 bestseller *How Google Works*, which provides a close-up of a Google search page, the book's title sitting in the search box. Above that hovers the Google logo, truncated at the second *O* such that a quick glance at the cover—ubiquitous in bookstore displays as this book goes to press—makes it look like "God."

Google's claims to know all and not be evil, rather like a priest set apart to heavenly things, helps explain its widespread credibility.[45] Its corporate mission—"to organize the world's information and make it universally accessible and useful"—presents the company as giving away information when its business is actually the taking in of information. The service it provides—apparently for free—is the public face of its data mining. Google defines its searches according to something like the Prime Directive of *Star Trek*: no interference. From the beginning Brin and Page noted the danger of biased search protocols and the temptation to slant results in the direction of paying advertisers (Google re-

44. Tracy Carbaugh, "God & Google: Do You Ever Treat God Like a Search Engine?," *Christianity Today* (September 2003), www.christianitytoday.com/iyf/hottopics/faithvalues/14.14.html, accessed 23 April 2013.

45. Hillis, Petit, and Jarrett, *Google and the Culture of Search*.

mains explicit in acknowledging sponsored pages). "There are even numerous companies which specialize in manipulating search engines for profit," wrote Brin and Page in 1998 with becoming innocence. (Search engine optimization is as old as search engines, like Lenin using the secretary position to rule the Bolveshik party.) Google's algorithm, billed as a purely artificial intelligence in contrast to Yahoo's partly curated (human-filtered) searches, was supposed to be neutral and universal in its indifference.

Google presents one face to the public—with its whimsically changing logos ("doodles"), April Fool's Day send-ups, baby-talk-like name. and infant-nursery colors—and another to its advertisers. What Google reads from search requests and web crawlers is secret and proprietary, the latest round of oligoliteracy or, rather, oligonumeracy.[46] My former student, Evelyn Bottando, begins her doctoral dissertation on Google Books by recounting her visit to the company's headquarters in Cambridge, Massachusetts. The first thing she had to do was sign a nondisclosure agreement.[47] Not all of the world's information, evidently, was accessible. Google's constantly tweaked PageRank algorithm (four hundred changes in 2010 alone) is as secret as the recipe for Coca-Cola. In their founding statement, Brin and Page said that previous search engine technology had been a "black art." Little has changed.

Google itself is nervous in the light it shines on everyone else. Since 2007, Google's special camera-mounted cars have taken 360-degree photos of streets, shops, and buildings in several countries for the Street View application on Google Maps. Street View has aroused complaints about invasion of privacy, since it has immortalized men urinating in public and provided glimpses through people's windows, and in early 2013 Google paid a seven million dollar fine (relative chump change). Street View typically blurs faces, license plates, and other sensitive items, defending its practice as one-size-fits-all objectivity. Curiously, the pictures Street View provides of the Googleplex, its corporate headquarters or "campus" in Mountain View, California, are taken from odd angles:

46. Thanks for Geoff Winthrop-Young for this suggestion.

47. Evelyn Bottando, *Hedging the Commons: Google Books, Libraries, and Open Access to Knowledge* (PhD dissertation, University of Iowa, 2012).

as of August 2012, one could see the volleyball court and one building.[48] Evidently the all-seeing eye of Google does not look in the mirror very often. (The one time I visited the Googleplex, without an invitation and in the company of a friend, we were quickly invited to leave by a polite security guard. On the way out I admired the power cords, dangling from the carports, that employees may use to charge their electric vehicles for free.) Power draws the center of the map blank. Because of its claim to "consecration," as Hillis et al. call it, Google's slips are all the more glaring. It is characteristic of sacred things to be easily desecrated; profane things are more robust, more accustomed to dirt. Small blemishes stand out on a beauty; small vices stink worse on a would-be saint.

The stunning aesthetic of the Google search page is rife with religious suggestiveness. Compared to the clutter of, say, MySpace, Google's spaciousness screams class and elegance. (Visual crowding in design signals trashiness.) Google's color scheme—which seems to show up on all the books about Google as well—suggests Play-Doh basics; its "pristine sea of white" suggests purity and perhaps the pearly gates or the cloud in the sky.[49] A white background also suggests a new document in which to type: this is not the black background with green letters in DOS days of yore. (White is the color of the Apple logo and many of its products.) White also suggests greater expenditure of energy: it costs more energy to color pixels than to turn them off. Google offers the visitor a threshold space, and loves to host a short visit, but it will stalk you on all the rest of your paths. Like Jesus, Google says: "I am the door."[50]

The home page's two options for scouting the web—"Google search" and "I'm feeling lucky"—are an essential touch. "I'm feeling lucky" is a subjective mode of address. This is not Google addressing its user with "You're feeling lucky"; this is me, the first person, entering the web, and also the cry of the gambler, muttering incantations over something he can't control. The Google search page is the portal of desire, the throne to which people bring their petitions. (Its servers house the Archive of Wants.) "I'm feeling lucky" also invokes religious practices of casting

48. I owe this example to Siva Vaidhyanathan.
49. Haigh, "The Web's Missing Links."
50. John 10:19.

lots.[51] The frequent effectiveness of the "I'm feeling lucky" button gives Google a reason to brag. (Of late it usually takes you to a Wikipedia page, but earlier its results could be more surprising.)

Even though Google makes no money on the 1 percent or so of searches that are done on the "lucky" button (which delivers only a single result, and thus none of the advertising peripherals), the company's leaders have been remarkably firm in keeping it in the face of criticism from the guardians of the bottom line. They know what they are doing. The lucky button amply repays the lost income by maintaining the oracular aura and geeky charm. Its loss would be incalculable. At the Google search page, you stand on the threshold and knock. Two alternatives await you side by side: the ancient one of divination and the modern one of Google. The cultural resonance of the company comes in pairing its computerized claim to trawl the totality with *I Ching*-like mystery. Ancient, modern; God, Google—the continuities are clear. Its search page is perhaps most religious in the simple structure of the search or quest. What do people seek? A signal amid the static. True love. A fugitive from justice. A lost key ring. Google can help find some of these things.

Google gives hints of ever greater demiurgic visions. Adam and Eve had "knowledge" once they ate the forbidden fruit, and they "knew" one another to have children (one reading of the Apple logo.) Could Google do that? Apparently yes, according to an ad Google ran during the 2010 Super Bowl. Called "Parisian Love" and viewed nearly seven million times on Google-owned YouTube as of April 2013, it is a little narrative jewel telling the story of a romance in twelve Google searches, with a soundtrack as clever as the images. The first search query, entered into Google's white home page, is "study abroad paris," and is archetypally loaded: American boy goes to the city of romance. The second query is for "cafes near the Loo . . . Louve," which Google corrects to "Louvre," gently mocking our subject's lack of French. (Google knows better.) The third is "translate tu es très mignon" (You are very cute), which, presumably, someone had told him, and which is what we are supposed to think about Google. Then "impress a french girl," "chocolate shops paris," "what are truffles," and "who is truffaut." (The serendipity of search en-

51. On ancient randomization devices, see Hugh W. Nibley, "The Arrow, the Hunter, and the State," *Western Political Quarterly* 2, no. 3 (September 1949): 329–44.

gines!) The American in Paris is getting culture and falling in love. Then "long distance relationship advice": we hear a phone ringing, answered by an expectant female voice with a Gallic "Allo!" Time has telescoped between the searches, and the rhythm of the ad accelerates. Then "working in paris," "AA120" (a possible product placement) with jet and airport sounds, and "churches in paris." These searches allow Google to show off its diverse services: translation, flight updates, maps. As a church is selected on the map and celebratory bells ring in the background, a final query is entered. "How" is typed in, briefly (at forty-four seconds) revealing "How to get pregnant" as the jokey option among the several autofill items, and is then completed as "How to assemble a crib." In a final narrative twist, we bolt in a time lapse from the marriage to the birth. (Google delivers expedited results.) As the final screen reads "Search on," we hear a baby coo.

There are many things we could note about this ad. One is the odd context of the Super Bowl. Google ran the ad online for three months before the Super Bowl as part of its stable of edifying videos, many of them backed with pulsing but polite octave-heavy piano music, called "Google search stories." (This roster of edification about divinely facilitated couplings could make a nice study.) The Super Bowl was a surprising choice, since Google's claim to advertising excellence had always been presented as an alternative to throwing money away on diffusely targeted ads: Google as a smart bomb, not a weapon of mass destruction. Evidently now it was time for corporate potlatch, the prestige that came from being part of the world's biggest advertising fiesta. More subtle was the implicit message of the ad: Google guides your life. It connects people—from the awkward beginnings of groping for a common language through media, such as telephone and airplane, to the sacral media of bells and church, and then to the homey assembling of a crib. Google is a spinner of fate and matchmaker. Using its time-tested creative strategy of riding already existing cultural materials (boy-meets-girl, Paris as romance, Louvre, chocolate, French cinema), the key message was: Google makes babies. Its knowledge was presented as not only intellectual, but carnal.

"Parisian love" presents searching as eros, the desire to connect in the most fundamental way possible. (It also indirectly acknowledges what statistically is one of the web's main affordances: erotic content and sexual coupling.) Here a classic boy-dream company presents itself not only as

the spinner of fate and source of all intelligence, but as reaching into the mystery of making a new life. Google wants to show its command over conception in both senses, and stakes its bid for the most long-lasting kind of preservation. Plato, founding the traditional fantasy of male-only, purely intellectual creation apart from the mediation of women, treated *theōria* as *eros*. But little suggests that nature needs to know or is particularly concerned with epistemological truth. The animals give no reasons for the torrid lives they feel, however much our *theōria* and *technē* prey off their evolutionary achievements. In some vague way, Google confesses its envy of what Goethe called the eternal feminine. (Technology is womb envy.) Masculine theoretical knowledge is not enough to satisfy Google's ambitions.[52] The datascape wants to reach into the bioscape, the world of recording media into the cycle of life itself.[53]

The Book of Life

Google revives the ancient dream and nightmare of a "book of life" in which every human deed is recorded for the Day of Judgment and thus stands in a long line of sacral and bureaucratic bookkeeping.[54] Writing classically combines mortuary and memorial functions, and so many traditions see the realm of the dead as maintained textually. Ancient Babylon had books of fate, and Egypt had decrees signed by the god Thoth. The Greek fates were always either knitting or writing in the primal unity of text and textile. In the Jewish tradition, in contrast, there was no book of fate free of human agency, which in turn contrasts with astrological fate books of surrounding cultures. Jesus warned that you will give an account of every *ῥῆμα ἀργόν* (*rhema argon*) or idle word at the day of judgment, thus suggesting some kind of registry (Matthew 12:37), and the early Christians took from the Romans the idea of a list or registry of citizens. The second-century theologian Tertullian, for instance, spoke

52. See Page Dubois, "Phallocentrism and its Subversion," *Arethusa* 18 (1985): 91–103, on masculine fantasies of autarkeia.

53. This ambition is clear in 23andMe, a company co-founded by Anne Wojcicki (who married Sergey Brin in 2007) and whose aim is not just to report on ancestry, but to compile a gigantic genetic and health database.

54. See Gleick, *The Information*, 395–96; Hillis et al., *Google*, chapter 5.

of being taken up into the "census of Christ." The Qur'an, in turn, says that Allah "has the keys to the unseen: no one knows them but Him. He knows all that is in the land and sea. No leaf falls without His knowledge, nor is there a single grain in the darkness of the earth, or anything, green or withered, that is not written in a clear Record" (6:59); this verse traditionally adorned astrolabes, logistical devices of heavenly orientation. In all three religions of the book, metaphors involving textual practices—editing, documenting, registering—are constituent parts of the imagination. They form, says the leading scholar of this metaphor, "an imagistic expression for the all-encompassing knowledge of God."[55] Later, but in the same tradition, the Renaissance discovered the book of the world. René Descartes, for instance, decided to set aside the scholastic teachings of his youth in favor of "*le grand livre du monde*."[56]

A nice comparative study could be made of the history of terrestrial and celestial databases for housing the living and the dead, but for present purposes, a quick scan of nineteenth-century ideas will suffice. We start with Charles Babbage, one in a long line of computer theorists with strong theological interests, alongside Pascal, Leibniz, Boole, and Wiener. Babbage gave the greatest statement of the dream of an infinite database in the *Ninth Bridgewater Treatise* (1838), his freelance addition to a series of lectures endowed by the Earl of Bridgewater to defend natural theology. Babbage's argument was that natural religion is not subject to the fallible transmission of testimony, but is ever fresh in the barely perceptible hum of nature. In a chapter wonderfully titled "On the Permanent Impression of our Words and Actions on the Globe We Inhabit," he argued for total cosmic storage. This chapter, now widely known in media theory, deserves quoting again:

> What a strange chaos is this wide atmosphere we breathe! Every atom, impressed with good and ill, retains at once the motions which philosophers and sages have imparted to it, mixed and combined in ten thousand ways with all that is worthless and base. The air itself is one vast library, on whose pages are

55. Leo Koep, *Das himmlische Buch in Antike und Christentum: Eine religionsgeschichtliche Untersuchung zur altchristlichen Bildersprache* (Bonn: Peter Hanstein, 1952), 127, passim.
56. Ernst Robert Curtius, *Europäische Literatur und lateinisches Mittelalter* (Bern: Francke, 1948), 321–27, at 324.

> for ever written all that man has ever said or woman whispered. There, in their mutable but unerring characters, mixed with the earliest, as well as with the latest sighs of mortality, stand for ever recorded, vows unredeemed, promises unfulfilled, perpetuating in the united movements of each particle, the testimony of man's changeful will.

The infinite subtlety of infinitesimals, taken from Babbage's colleague Laplace, provides the mathematical heart of the vision. "The pulsations of the air, once set in motion by the human voice, cease not to exist with the sounds to which they gave rise . . . The motions they have impressed on the particles of one portion of our atmosphere, are communicated to constantly increasing numbers, but the total quantity of motion measured in the same direction receives no addition." The right kind of infinite intelligence could hear it all.[57]

In claiming that "the air we breathe is the never-failing historian of the sentiments we have uttered," Babbage saw the universe as an infinite library, a complete cosmic memory. The air was not the only repository: "Every shower that falls, every change of temperature that occurs, and every wind that blows, leaves on the vegetable world the traces of its passage; slight, indeed, and imperceptible, perhaps, to us, but not the less permanently recorded in the depths of those woody fabrics."[58] Here was a solution to the problem of data gathering about weather and climate, an issue Babbage worried about (indeed, the whole post-Laplacean lineage is centrally concerned with chaotic atmospheric systems), and dendrochronology is now an important technique in reconstructing climate. Babbage's rhapsody suggests that the world was ready for photography and similar means of autographic tracing of nature that were introduced in the nineteenth century. His vision of a complete inscription, says Kittler, is "a founding charter of all analog media."[59]

Contemporary observers of photography used Babbage-like language. In 1840, Edgar Allan Poe proclaimed that a daguerreotype was

57. *The Ninth Bridgewater Treatise: A Fragment*, second edition. *The Works of Charles Babbage*, ed. Martin Campbell-Kelly, vol. 9 (London: William Pickering, 1989), 35–39, at 36.

58. Babbage, "Note M: On the Age of Strata, as Inferred from the Rings of Trees Embedded in Them," *Ninth Bridgewater Treatise*, 110–14.

59. Friedrich A. Kittler, *Aufschreibesysteme, 1800/1900*, 3rd ed. (Munich: Fink, 1995), 291. His *Gramophone, Film, Typewriter* recounts several stories of voices remaining audible after death.

"infinitely" more perfect than a painting could ever be. "If we examine a work of ordinary art, by means of a powerful microscope, all traces of resemblance to nature will disappear—but the closest scrutiny of a photogenic drawing discloses only a more absolute truth, a more perfect identity of aspect with the thing represented."[60] Poe's belief that photography's fidelity held across all possible levels of magnification, inspired by his own reading of Laplace (and probably of Babbage), was echoed by Oliver Wendell Holmes Sr. in 1859: "One may creep over the surface of a picture with his microscope and find every leaf perfect, or read the letters of distant signs . . . . Theoretically, a perfect photograph is absolutely inexhaustible. In a picture you can find nothing which the artist has not seen before you; but in a perfect photograph there will be as many beauties lurking, unobserved, as there are flowers that blush unseen in forests and meadows."[61] Such fantasies miss the lower limits of depiction—at some point, detail will give way to graininess—but they are metaphysical fantasies about analog media, not descriptions of how early photographs worked. Holmes authorizes the idea found in the film *Blade Runner* (1983, dir. Ridley Scott) that you can spelunk forensically inside the microscopic labyrinths of the "absolutely inexhaustible" photograph.

Thomas Hill, a mathematician and the president of Harvard, responded to Babbage. Hill also thought the day might come when "our own ears may be quickened to hear our own [previously uttered] words yet ringing in the air." But he had a more traditional repository for the total record: the sky. "Thus considered, how strange a record does the star-gemmed vesture of the night present! There, in the seemingly fixed order of those blazing sapphires, is a living dance, in whose mazy track is written the record of all the motions that ever men or nature made. Had we the skill to read it, we should there find written every deed of kindness, every deed of guilt, together with the fall of the landslide, the play of the fountain, the sporting of the lamb, and the waving of the grass."[62] His moral punch line: The universe always witnesses your deeds. (Babbage

60. Edgar Allan Poe, "The Daguerreotype" (1840), *Classic Essays on Photography*, ed. Alan Trachtenberg (Stony Creek, CT: Leete's Island Books, 1980), 38.

61. Oliver Wendell Holmes Sr., "The Stereoscope and the Stereograph" (1859), *Classic Essays in Photography*, 73, 77–78.

62. Thomas Hill, *Geometry and Faith: A Fragmentary Supplement to the Ninth Bridgewater Treatise*, revised and enlarged edition (New York: Putnam's, 1874), 46, 50.

likewise thought that the airy library had a moral effect: the sufferings of slaves could not be hid forever.) Whatever you say or do will remain perceptible to intelligent beings endowed with finer sensory powers. (He sounds like my undergraduate students cautioning each other about which pictures not to put on Facebook.) Hill even explains the physics of the Last Judgment: Instead of the heavens predicting everything that will befall humans, as the ancients thought, they are a record of everything that has already happened: the stars hold the past, not the future. Hill was a student of Harvard mathematician Benjamin Peirce, and so the resemblance of his views with those of Benjamin's son Charles Sanders is not accidental.

The most famous nineteenth-century figure of scientific omniscience was Maxwell's demon. James Clerk Maxwell, the great Scottish physicist, imagined in 1869 an intelligence positioned at the partition of two chambers that were filled with gas molecules in motion. By dint of instantaneous tagging of all molecules and savvy opening and closing of the gate between the chambers to allow the faster ones into one and the slower ones into the other, his demon could make entropy run backwards. One chamber would get hot, and the other would cool down—in other words, become more ordered.[63] Nothing less was at stake than turning back the irreversible degradation of the cosmos. The intelligence that watched the molecules had an immediate, we might say angelic, cost-free epistemic relation to the molecules. Maxwell's demon became famous as a way to escape the "heat death" that haunted the late nineteenth century. (Norbert Wiener stated the well-known Achilles heel of this thought experiment: "In nineteenth century physics, it seemed to cost nothing to get information.")[64]

Maxwell's colleagues, physicists Balfour Stewart and Peter Guthrie Tait, redeemed the constant loss of energy as the price of cosmic memory in their key book *The Unseen Universe* (1875). They started with the seeming wastefulness of the universe, so much energy that does nothing but dissipate, and turned it into an engine of cosmic memory. Unlike Google's public rhetoric, they recognized that databases cost energy: "All

63. A nice recent account of the demon is Gleick, *The Information*, chapter 9.
64. *The Human Use of Human Beings: Cybernetics and Society*, 2nd ed. (Boston: Houghton Mifflin, 1954), 29.

memory consists in an investiture of present resources in order to keep a hold upon the past. We have seen that this medium—this ether—has the power of transmitting motion from one part of the universe to another. A picture of the sun may be said to be travelling through space with an inconceivable velocity, and, in fact, continual photographs of all occurrences are thus produced and retained. A large portion of the energy of the universe may thus be said to be invested in such pictures."[65] Stewart and Tait found a way to make entropy a preservative rather than destructive force in this great solar photo album. They answered the deepest worries of Victorian elites—the absence of God and the collapse of cosmic meaning—with the medium of all media, the ether, which, much more than the telegraph, was the Victorian Internet. (Ether is of course the element that corresponds to this chapter.)

The Victorian photographer William Jerome Harrison also read light as a recording medium: "Every action which has ever occurred on this sun-lit earth of ours—or indeed, for that matter, anywhere within the illuminated universe—is recorded by the action of light." Harrison makes explicit what Babbage and Stewart and Tait only assumed: To read inscriptions in light, one would have to exceed its speed. If we could do so, Harrison reasons, we could travel into space and catch the records made by the waves. As we caught up with these hurtling photo-documents, we would see events unfurled before us in reverse order, our own youth, the lives of our parents and ancestors. "History would unfold itself to us. We should only have to continue the journey long enough to see Waterloo and Trafalgar fought out before our eyes; we should learn the truth as to the vaunted beauty of the Queen of Scots; and the exact landing place of Julius Caesar on the shores of Britain would no longer be a mystery."[66] Harrison invokes several staples of time travel, from gazing at beauties to resolving historical mysteries, all within the frame of British nationalism, and anticipates the dream of outer space as a broadcast archive, a theme in such films as *2001: A Space Odyssey* and *Contact*. Harrison grasps the interconvertibility of transmission and recording: the transmissions of

65. Balfour Stewart and Peter Guthrie Tait, *The Unseen Universe, or Physical Speculations on a Future State*, 3rd edition (London: Macmillan, 1875), 155–56. Thanks to Chad Vollrath.
66. W. Jerome Harrison, "Light as a Recording Agent of the Past," *The Photographic News: A Weekly Record of the Progress of Photography* 30, no. 1427 (8 January 1886): 23.

light across the cosmos constitute a mobile archive. When the universe is a library, recording (saving time) and transmission (bridging space) are one.

Even in biology, protoplasm was a form of universal memory storage, as Robert Brain shows.[67] William James and Sigmund Freud, the two greatest psychologists around 1900, thought that nervous tissue was the bank of all experience. "Down among his nerve-cells and fibres the molecules are counting [experience], registering and storing it up," wrote James in the *Principles of Psychology* (1890). "Nothing we ever do is, in strict scientific literalness, ever wiped out." In a Laplacean spirit, James thought the neurological present contained both past and future: "Each present brain-state is a record in which the eye of Omniscience might read all the foregone history of its owner."[68] Freud, in turn, saw the brain as a chaotic filing system in which everything was recorded, though it might not be easily found—rather like the Internet before search engines or, to use his metaphor, a writing pad on which everything written piles up in some indecipherable hieroglyph.[69] For Freud, the problem was not recording but retrieval; trauma was the reappearance of a lost file at an inopportune moment. Unlike Babbage, Hill, Stewart and Tait, or Harrison, all of whom found nothing unbearable in a perfect record, Freud and James knew of the misery caused when the deleted data refused to go away.

Festivals of Tagging

The dream of a record in which the eye of omniscience could read every subsequent state has collapsed, even though Google profits from the continued cultural relevance of these fantasies, including the suggestion

67. Robert Michael Brain, "Protoplasmania: The Vibratory Organism and 'Man's Glassy Essence' in the Later 19th Century," *Zeichen der Kraft: Wissenstransformationen 1800–1900*, ed. Thomas Brandstetter and Christof Windgätter (Berlin: Kadmos, 2008), 199–227.

68. William James, *The Principles of Psychology*, 2 vols. (New York: Dover, 1950/1890), 1:127, 234.

69. Sigmund Freud, *Traumdeutung*, I, 20, approvingly quoted the French psychologist Delboeuf's claim "que toute impression même la plus insignifiante, laisse une trace inaltérable, indéfiniment susceptible de reparaître au jour."

that information can be given away for free. Rather than a perfect representation of the world searchable at all levels, Google has made its peace with fuzziness and imprecision. It has a post-quantum notion of surveillance, and has fully taken on board the results of the probabilistic revolution. Recognizing that vast patches of reality might be composed, in Borges's apparent oxymoron, of "*rasgos singularmente vagos*" or singularly vague features, Google maps the web pragmatically, not in every speck. The Victorians thought their mathematics and media could reveal the world as an ordered totality down to every detail, but Google makes no such claims. Google doesn't index every data point, Babbage-style. That would take up too much bandwidth. But its claims to infinity remain, starting with the one implicit in its name. As Brin and Page stated in 1998: "We chose our system name, Google, because it is a common spelling of googol, or 10^{100}, and fits well with our goal of building very large-scale search engines."

Google belongs to an era of sublimely large sizes. Big data once only belonged to God. YHWH in Jeremiah (31:37) says: If heaven above can be measured, then I will turn away from Israel—implying that celestial measurement and abandonment of the chosen people are equally impossible. "Thou shalt not number the tribe of Levi" (Numbers 1:49). King David's plan for a census was frowned on both by his advisors and by the Lord, all of whom knew that any such count was a prelude to taxation and conscription. Wiener once imagined a star catalog being executed to a godlike degree of resolution: "If a human *Durchmusterung* of the stars—as we call these catalogs—stops short for stars less intense than a certain magnitude, there is nothing too repugnant to us in the idea of a divine *Durchmusterung* going much further."[70] But there are new possibilities of exactitude in science. It is now estimated that there are 7×10^{22} visible stars.[71] All kinds of multitudes can be counted. As in chapter 3, the US government estimates that 1,282,600,000 pounds of salad or cooking oil were consumed in the United States in December 2007, and marine biologists put 2.9×10^{29} microbial cells in the subseafloor sediment. Even

70. Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine*, 2nd ed. (Cambridge: MIT Press, 1961), 31.

71. Andrew Craig, "Astronomers Count the Stars" (2003), news.bbc.co.uk/2/hi/science/nature/3085885.html.

the complete contents of the universe can be measured at about 10^{80} protons—an alarmingly banal notation for all that is.

For unimaginably large sizes, we have to turn to culture, not nature. Borges's "library of Babel," consisting of all possible books composed of all possible variations of twenty-three letters (presumably dropping *k*, *w*, and *x* from the alphabet, in the Spanish custom), would hold $10^{1,834,097}$ books, as William Goldbloom Bloch calculates in his very interesting book. If we figure variations in arrangement on shelves, the number of combinations becomes even more dizzying.[72] This number dwarfs 10^{80} to a boggling degree. The term *astronomical* is not large enough to describe how many times the Library of Babel would hold the Library of Congress, the world's biggest library of around thirty-five million books and a standard unit in discussions of big data. Each proton in our universe would have to hold not only one Library of Congress but $10^{1,834,010}/3.5$ of them to match the Library of Babel. This bit of absurdist algebra shows that the really big numbers are found in the realm of mind, not matter. The question is whether such gigantic numbers are really as precise as they seem. As Bloch shows, they may be countable, but they are unimaginable. The only grasp we could have of them would be unaccountably vague. Vagueness, it may be, is a good thing.

Borges has a brief, ingeniously whimsical text that offers a new proof of the existence of God, which I paraphrase. Borges closes his eyes and imagines a flock of birds; is its number definite or indefinite? If God exists, he knows how many birds Borges saw. No other being could possibly access such a private phantasm. If God does not exist, then no one could possibly determine how many birds were in the vision. That means the number of birds that Borges saw was fewer than, say, ten, or more than one, but also none of the whole numbers from two to nine. But a whole number between one and ten that is not two, three, four, five, six, seven, eight, or nine is not conceivable; therefore, God exists.[73] Borges's lightning leaves out some intervening steps and is ultimately no more persuasive than other proofs that move from necessity in concepts to ne-

72. *The Unimaginable Mathematics of Borges' Library of Babel* (New York: Oxford University Press, 2008).

73. Borges, "Argumentum ornithologicum," in *El hacedor* (Buenos Aires: Emecé, 1960), 17.

cessity in being. What is interesting for us is the point at which a definite rather than indefinite aggregate carries deep metaphysical consquences.

There is an old joke about a Texas rancher and a city slicker sitting in an airplane. The city slicker looks out the window and sees a herd of cattle. "Lot of animals down there," he says. "Yes—in fact, there are exactly 434 cattle in that herd," replies the rancher. "How do you know?" "Easy," says the Texan; "I just count up their legs and divide by four." Aside from the Texas braggadocio, the humor lies in the impossibility of a superabundantly precise summing of a multitude so indefinite. Georg Cantor, the mathematician who discovered that infinity came in different sizes, said he chose the term *aleph* as the general name for infinity partly because *aleph* in Arabic means a herd of cattle (*Rinderherde*); but he probably also dimly knew that a history of this letter would be a history of the universe.[74]

Thanks to Google, what once was the figure for the uncountable, a herd, can now be inventoried. The study mentioned in the last section of chapter 4, that discovered "magnetic cows," was carried out using satellite images taken from Google Earth. The scientists recognized the biases of the pictures—most were taken in the daytime when the sun was high, in calm weather conditions, and, in the Northern Hemisphere, during the summer—but they were still able to gather a huge data set of 8,510 milk and beef cattle in 308 locations, randomly selected from all six continents. Gathering such data otherwise would have required a crippling amount of resources—the research team's replication of the results in photographic field observations of roe deer involved 1,080 animals in 152 locations, itself a gigantic logistical undertaking. But the observations were readily available as a by-product of Google's maps. Something unnoticed by farmers, herdsmen, and hunters for thousands of years was shown through data mining of satellite pictures.[75]

But tagging is one of the most characteristic acts of communication today. *Tagging* suggests the tracking of bird and animal populations, as well as the adorning of public buildings with graffiti.[76] Naturalists like

74. See Borges, "El Aleph."

75. Sabine Begall et al., "Magnetic Alignment in Grazing and Resting Cattle and Deer," *Publications of the National Academy of Science* 115, no. 36 (9 September 2008): 13451–55.

76. Every discipline ever exercised upon humans was first tried on animals—and books.

Audubon banded birds in the early nineteenth century, but bird banding and fish tagging were not systematic scientific practices until the turn of the twentieth century, especially in North America and Scandinavia. Harpoon marks were used to track whales as early as the 1910s, and "identity discs" were shot into whales starting in the 1920s.[77] By the 1980s, thanks to miniaturization of technology and prolongation of battery life, it became possible to tag a great variety of marine animals—tuna, hammerhead sharks, elephant seals, and whales of many kinds.[78] Animal tagging clearly blazed a trail for other kinds of aggregates such as inventories, consumer preferences, marathon runners, and people in Facebook photos. An animal population, kind of like a radio audience, posed a complicated statistical problem of estimation, and the statistical methods for both arose in the 1940s.[79]

Google's map would eventually coincide with the universe. Borges gave us the story, inspired perhaps by Lewis Carroll, of a map that would coincide point by point with its territory—only to show us how deliciously absurd such a map would be. In some collections the estimate is probably more accurate than a full inventory. How many islands are there in Indonesia? How many lakes in Minnesota? How many grains of sand on the seashore? How many clouds in the sky? How many water droplets in a cloud? How many grains of wheat make a heap? How many prokaryotes on earth? How big are global wolf, whale, or tuna populations? These questions stall on basic definitional problems, the infrastructural fuzziness that Bowker and Star analyze in *Sorting Things Out*.[80] What is counted and how it is counted is one of the most basic and delicate of all operations. How far into land or sea does the seashore go? How big is a lake? Should we count artificial lakes, or count bodies of water that are connected underground? How long is the coast of England? The answer to this last question famously depends on the length of the measuring

77. Burnett, *Sounding*, 154.

78. For an overview of tagging devices for sea animals, see Whitlow W. L. Au and Mardi C. Hastings, *Principles of Marine Bioacoustics* (New York: Springer, 2008), chapter 13.

79. The key figure in radio was Paul F. Lazarsfeld. For animal populations, see D. B. DeLury, "On the Estimation of Biological Populations," *Biometrics* 3, no. 4 (1947): 145–67. The breakthrough work was in genetics in the 1920s.

80. Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and its Consequences* (Cambridge, MA: MIT Press, 1999).

stick: the shorter the stick, the more it can account for small squiggles of shape, and thus longer the measured length. The great discovery is that a constant "fractional dimensionality" holds across measuring sticks of all length.[81] Trying to count or measure vast quantities casts light on the features of the media we use. There is simply no answer to the question of how long the coastline of England is. The quest for exactitude in science reveals the specificities of our instruments, which in turn reveal that generalities are vague, as are specifics.

A Universe Full of Etceteras

In its public face, Google is retro, reactivating nineteenth-century ideas about an infinite census of things; but in its engineering guts, it is happy to work with shortfalls from absolute knowledge. Good enough is good enough for Google. Anything will show up sooner or later in search results if people think it worthy of tagging. Google need not be anxious about what it hasn't yet tagged. (The equivalent is my lazy attitude about scholarly journals. If something really important is published, I trust my web of contacts to notify me. I don't need to be constantly scanning.) The universe is finite enough to be patterned. Borges's Library of Babel shows that a total library would be suffocating. Every sentence I utter surely has a completely different meaning in some language found somewhere in the Library. But the sure knowledge that life is almost infinitely too short to even begin to find it means that my sentences mean something, that they are a choice that matters. In a universe of limited life spans, choice is real and contributes to the cosmos's fate in some way. It is a mistake to read Borges's Library of Babel as dystopian or gloomy: it is a deadpan charter of rejoicing. It is so easy to say something new in a small universe like ours, with options so restricted. Thermodynamics shows that there are infinitely more ways to be messy than to be ordered, so order stands out. The gaps in the library show us that the universe is itself incomplete, and blessed with blurs of etcetera. We can be like the lovers in Catullus's poem, lavishly tossing away data like kisses. Catullus pleads with Lesbia

81. Benoit Mandelbrot, "How Long is the Coast of Britain: Statistical Self-Similarity and Fractional Dimension," *Science* 156 (1967): 636–38, building on Lewis Fry Richardson.

to give him a thousand kisses, then a hundred, then a second thousand, then a second hundred, and finally so many so that neither they nor anyone else could ever know how many kisses they have shared. A universe of gaps is a universe in which we have something to do.[82]

For Victorian physics, the only limit to accessing the universal record in the air, the plants, or the sunrays was bandwidth. With enough computing power, Babbage et al. thought, the universe would be traceable in every bit. That is not how things look after statistical mechanics, transfinite numbers, quantum mechanics, and fractal geometry, with their lessons of the inherent chanciness of events, the uncountability of some infinities, the costliness of information, and the dependence of measures upon metrics. Happenings are themselves indefinite. A more perfect machinery of documenting the motion of every molecule might only show (or produce) swerves at the heart of things. As one Vienna Circle philosopher said with too much zeal: "The doctrine of the exact location of physical events in space and time is metaphysical, and therefore meaningless."[83] Things often get fuzzier the better they are documented. Said Peter Strawson: "The idea of an 'exhaustive description' is quite meaningless in general."[84] Google is an adaptation to a lo-fi universe, one that requires the term *etcetera* in its inventory.[85]

Consider the obsessive attention received by the deaths of martyrs and leaders: Socrates, Jesus, Lincoln, Kennedy. Take, for instance, this seemingly simple question: At what time was Jesus crucified? One of the most remembered events in history has a number of complexities. John's Gospel says Jesus was crucified after the sixth hour—that is, in the afternoon—while Mark's says it occurred at the third hour. If Mark is right, then we have to assume that Pontius Pilate was out of bed and at work well before nine in the morning, which might be early for a Roman official. Both schedules assume the Jewish reckoning in which the

82. Thus Borges thought to refute Nietzsche's eternal return, which he seems to have understood as a wash-cycle loop of bad infinity: "La doctrina de los ciclos," in *Obras completas 1: 1923–1949* (Buenos Aires: Emecé, 1996), 385–92.

83. Hans Hahn, "The Crisis of Intuition" (1933), in his *Empiricism, Logic, and Mathematics: Philosophical Papers*, ed. Brian McGuinness (Dordrecht: Reidel, 1980), 76.

84. P. F. Strawson, *Individuals*, quoted in Ian Hacking, *Representing and Intervening: Introductory Topics in the Philosophy of Science* (Cambridge: Cambridge University Press, 1983), 94.

85. Wendell Johnson, *People in Quandaries* (New York: Harper and Bros., 1946), 212–213.

hours are counted from sunrise; that is, from around 6 a.m. But if Mark was using the Roman reckoning, then he and John agree. Or perhaps John was doing a bit of theological harmonizing by making the crucifixion happen at the same time of day as the ritual slaughter of the Passover lambs?[86] Each interpretive frame yields another reading of the evidence. There are all kinds of subtle disagreements between the canonical Gospels on this and much else, and we often cannot discern what is a literary flourish, a theological comment, or a historical guess. Whatever way our reading leans has to rest upon assumptions that are largely untestable, let alone upon the larger assumption of historicity in the New Testament sources. Here, as elsewhere, there is no fact that is not saturated with theory.

The assassination of Abraham Lincoln, like that a century later of John F. Kennedy, has sustained microscopic inquiry. When did the Lincolns arrive at the theater? Around 8:30 p.m., during the first act of the play *Our American Cousin*. When was Lincoln shot? Despite varying testimony, it seems to have been around 10:30 p.m. How far did John Wilkes Booth jump from the presidential theater box to the stage? Witnesses put the distance between nine and fifteen feet. But Ford's Theater was gutted in 1866, so the answer remained unclear until its original architectural plans were found, providing the precise detail of ten feet, six inches. (History is distinguished from fiction by its greater number of corroborating sources.) Did Booth break his leg in the jump? The only contemporary witness is Booth's backdated diary, a source that has been shown to be unreliable on a number of counts. Eyewitnesses saw him "rush" or "run" across the stage. What did Booth shout? The witnesses largely agree it was "Sic semper tyrannis," though other options include "The South shall be free," "Revenge for the South," "The South is avenged," "I have done it," and "Freedom." For his part, in a diary entry written sometime between the Lincoln assassination and his own death in a shootout twelve days later, Booth claimed only to have said, "Sic Semper." [87]

Another mystery is what Edwin Stanton, Lincoln's secretary of war,

86. Example taken from D. Moody Smith, *John among the Gospels*, 2nd edition (Columbia: University of South Carolina Press, 2001), 204–205, n15. Thanks to Doron Mendels for this source.
87. All information taken from Timothy S. Good, *We Saw Lincoln Shot: One Hundred Eyewitness Accounts* (Jackson: University Press of Mississippi, 1995).

uttered while standing at the bedside upon Lincoln's last breath. "Now he belongs to the ages" was long the undisputed benediction. Recently "Now he belongs to the angels" has been advanced instead. The dispute involves two readings of Lincoln: as a Christian romantic (angels) or as an modern Stoic (ages). In a thoughtful essay, Adam Gopnik shows that the "ages" quote, which was taken as historical fact for a century, was not recorded until twenty-five years after the assassination, in a 1890 biography of Lincoln written by two of his secretaries. The "angels" interpolation is more recent, motivated by an interest in reading Lincoln as a Christian figure, but there are at least somewhat plausible historical reasons for it. In the end, we don't know what Stanton said, or even if Stanton knew what he said. If a tape recorder had been in the crowded, chaotic room—a room filled with a changing cast of grieving people—it might not have resolved anything. The same is true for a recording of what Booth shouted in the theater. As Gopnik concludes, "The past is so often unknowable not because it is befogged now, but because it was befogged then, too, back when it was the present."[88] We might add the meteorological wisdom, "Forget about forecasting; even nowcasting is near impossible."[89]

Contra Babbage, if we could recall the air from that night and listen to it, it might be full of clouds and what sound engineers call "lossiness." Perhaps the past cannot be tapped in its full immediacy because the present is not fully immediate. There are vast patches of unobserved reality silently lurking in every moment—at higher and lower levels of magnification, for different organs of sense, for minds quicker or slower than ours. Even for the most acute observer, descriptions might be incomplete, not only because of limited tools but because reality is lacking. Just as we often do not know what we mean when we speak, so the universe might not always be so sure of itself. The cosmos is structurally incomplete, as gap-ridden as its files. Such wonderful conditions these are! The universe generously accommodates our every new act, word, or thought. There is still plenty to do. It is open for new events; it is a container with a gracious void. A growing universe is a (retroactively) incomplete one. The universe would shatter into nothing if a complete

88. Adam Gopnik, "Angels and Ages," *New Yorker*, 28 May 2007.
89. Rivka Galchen, *Atmospheric Disturbances* (New York: Picador, 2008), 90.

description were ever possible, because then it would have frozen. Its incompleteness means that it is game for novelty, for ongoing creation.

Even absolute knowledge might be vague. Could God make use of efficiencies? There was a major debate in medieval Christian and Muslim theology about whether God thought in generals or particulars.[90] Did God tag every rain drop and grain of sand in the capacious catalog of his concern, or did he perceive the cosmos according to general principles? (The former view might seem more religiously comforting in its suggestion of a divine presence responsive to the prayers and engaged in the lives of individuals.) Google's operation suggests the second view. Post-quantum omniscience would use heuristic shortcuts, such as expander graphs. It would watch the weather by seeing where the rain collects, not by making a *Durchmusterung* of every raindrop. Maybe God is not in the details. Perhaps divine knowledge is not infinitely focused, but richly general. Perhaps patchy reality means patchy omniscience. Which is greater: the exhaustive tagging of all, or the creative coping with cloudy patterns? Perhaps divine intellect is vague. This is why the definiteness of the number of an imagined flock of birds implicates the existence of God. Knowing all would be a fractal ladder. For Saint Augustine the contents of the *liber vitae* were easy to write because it was actually the *liber praedestinationis*: with everything set from the beginning, there was no real challenge in tracking. Real empiricism (like gambling) turns on not knowing the future, which enables prediction and the capacity to be surprised. (Theological finitism and radical empiricism share an elective affinity.) What if divine knowledge were general and pragmatic, and worked by abductions and the probabilistic gropings of love? How many days out would the divine weather forecast extend? Why would God clutter his mind with extraneous details when intelligence moves faster by feeling and intelligent leaps? The possessor of the deepest catalog of all might only need a really good and fast index.

In discussion following one of Friedrich Kittler's last lectures, Peter Bexte brought up a passage by Leibniz in which he stands on the seashore, listening to the roar of the sea, and reflects that noise exists for mortals but not for God, since God's ears would be able to sort through the con-

90. Jorge Luis Borges, "La busca de Averroes," in *El Aleph* (Madrid: Alianza Editorial, 2007), 104–17, at 104.

fused waves and turn them into the medley of periodic sounds that they are. Kittler was delighted by Bexte's comment, quipping that God is the great Fourier analyst, but he hesitated on the question of whether noise exists for God. Kittler was long fascinated by the discovery that absolutely any sound, even superlatively noisy ones such as the rumble of thunder or waves of the sea, can be modeled by the right superpositioning of sine waves.[91] The question of whether God hears noise is a deep one, and Kittler was right to hesitate. For my part, I would vote yes, that he can hear noise, if only because compassion would dictate an encompassing empathy with the experience of his children. But perhaps there is also intractable noise in the universe.

A world in which omniscience has cloudy patches would be one in which not everything is spelled out in advance, noise is audible, and our choices have real consequences—a pluralistic universe in which there is such a thing as irreparable loss. That is the universe I think we live in, one full of risk and danger. Single choices can have eternal consequences. Angels can fall to everlasting doom. A single act can wreck a life of goodness. Our cosmos has the possibility of irreversible wreckage but also of radical novelty, of an innovation so complete that the past is completely transformed or even forgotten. Erasure is both damage and salvation, an operation that runs against entropy. Deletion is the most thermodynamically rare and stunning of all actions.[92] Everything we humans do leaves a trace—on this the crime shows agree with Babbage rather than Darwin (as we will see in the next section). At some level of magnification, in some medium, clues and traces are left for the investigator. Hackers can find the ghosts of your deleted files somewhere in your computer's innards. The genuine feat would be to alter history so that no trace was left anywhere. Atonement makes the past reversible, and erases the indelible ink. Such power, like Stalin's pencil, would have to be under the control of an omnibenevolent being, since it otherwise would be so ripe for cosmic abuse. (How a morally perfect being with all power could remain so without the constant education and humiliation of error is itself a great

91. Friedrich Kittler, *Und der Sinus wird weiterschwingen: Über Musik und Mathematik* (Cologne: Kunsthochschule für Medien Köln, 2012), 46–50.

92. Gleick, *The Information*, 362, 371, passim. "Snapchat" offers the service of sending messages and pictures that self-destruct after ten seconds: there is a market for deletion.

mystery.) The true sign of a divinely powerful mind would be not to track every molecule, but to wipe the record clean in those few crucial points where it needed cleaning most—the most expensive computation in the universe. Deletion enables our greatest griefs and greatest joys. There is also, then, an ethical argument for why omniscience would need to contain blank spots. That God can forgive and forget, that the occasions of our worst moral disasters could become blank or overwritten spots in his memory—on this hangs our hope!

The Biased Record

Most of the world is not on the web, and most of the web is not open to search. There are the dark and deep webs; the proprietary, classified, and firewalled sites; the treasures in password-protected sites such as Facebook or iTunes; the dead links, link rot, and all the rest. The web, like the world, is full of black holes. Not only does the Internet have vast deserts of unsearchableness, but it is obviously biased toward some kinds of accumulations over others. Google tweaks its algorithms in certain directions—for example, away from porn. It stabilizes and pacifies the web.[93] It opens new searches, but much of the universe lies beyond its ken. Huge steppes of reality remain immune to indexing. Most of them are in the past and many more are in the future, and possibility so outspins any documentation. No one has figured out how to make digital records last for thousands of years.[94] (My dissertation is lost on the floppy discs I used in 1986 but lives on faithfully on paper in a few libraries; even in the past three decades paper has proved to be a more robust storage medium than its competitors.) The web is a prototypical example of what Innis would call a space-biased medium. And the web doesn't know what it doesn't know. Such vast self-oblivious holes are also found in libraries or archives, of course, as their defenders sometimes forget, though they are holes with different shapes. We have traces of only the smallest pro-

93. Vaidhyanathan, *Googlization*, 14. The man at Google responsible for developing the anti-porn algorithm was nicely named Cutts.

94. See my "Proliferation and Obsolescence of the Historical Record in the Digital Era," in *Cultures of Obsolescence: History, Materiality, and the Digital Age*, eds. Bärbel Tischleder and Sarah Wasserman (Palgrave Macmillan, forthcoming).

portion of what took place in any form. The universe is an active recycler, but each storage medium wrests its bits from chance in its own way.

For Innis, every record and medium meant bias. History was a problem of communication over time and space, and every medium selectively transmits, records, and makes the past accessible to discovery. Each medium of history—documents, ruins, household artifacts, bones, DNA, or whatever else has survived the journey from past to present—had inherent slants. There could be good bias and bad bias, but never no bias. Historians who study long temporal spans, Innis noted, usually stress religion and neglect bureaucracy because the documents that endure are typically designed by time-conserving agents, like sages and priests, rather than by space-controlling agents like lawyers and merchants. Interpreting the past means not only reading the content of the historical record but studying the swerve of the record itself. "Bias" implies not only potential threats to objectivity: Innis had in mind the textile metaphor of a slant cut: as historians necessarily read along the diagonal, bias is not a deficit but more evidence. Different media of inscription carry different cargo. You'll never find the daily weather on stone tablets. Writing records not what "really happened," but what was susceptible to being written down. (Only communication can communicate, in Niklas Luhmann's oracular expression.) Each medium filters the manifold of events, and every record is also an implicit record of what it is not.

Loss and damage, then, are as important as storage. The fantasy of a historical record in which microbes would always have existed posits an ideal knower that even theology, as I will argue, cannot support. Babbage was only one side of the debate in nineteenth-century Britain. In his epoch-making *Principles of Geology* (1830–33), Charles Lyell wrote of "ruins," a trope beloved of the romantics and borrowed from the baroque. He saw earth as a text. The geologist had the task of "deciphering monuments" and reading the "ancient memorials of nature . . . written in a living language."[95] Though geological memorials were written in a living language, the record was fallible, partial, and fragmentary. Lyell thought that by studying the processes that had shaped the earth

95. Charles Lyell, *Principles of Geology*, vol 1. (1830; Chicago: University of Chicago Press, 1991), 73, 75.

recently, such as erosion or sedimentation, one could also view the same processes that had both written and obliterated so much of the text of its past. Confidence in the sameness of geological process across historical time—as opposed to a history of cataclysms, creationist or otherwise—was central to Lyell's famous "uniformitarianism," a term coined by William Whewell, one of the English language's great coiners. Geological conceptions of a textual earth were a critical twist on the ancient metaphor of the world as a book, since it was a text inscribed neither by human nor by God. Nature's collected works could be read only by decipherment.

Lyell's follower, Charles Darwin, advanced the textual metaphor for earth history in chapter 10 of *The Origin of Species* (1859), "On the Imperfection of the Geological Record," a treasure trove of reflections on the methodological problem of how to draw inferences from an incomplete record of deep time, a problem with central relevance to media theory. Darwin read not only the distorted pieces of the geological record, but the distortions and trauma themselves. Facing scant evidence of transitional links between species, Darwin appealed to the nature of the recording medium. Noting what would later be called a sampling problem, he argued that it was the geological record that was fragmentary, not the real but inaccessible history of life itself. In geological history, there are "blank periods of enormous length." If we had a full archive of life's history, we would find the intermediate links, which are unattested in the fossil record not because they did not occur, but because the record was mutilated and abbreviated. The record of life's history is subject to all the obliterating processes of earth history, from erosion to volcanism. Like a good media scholar, Darwin read texts by reference to the processes that formed them. To uphold his uniformitarian assumptions in the face of a catastrophic record, Darwin argued gaps in the transmission of the past, not gaps in the past per se. Looking for evidence of links between species in the geological record would in Darwin's view be like trying to find the ancient Olympics on a video compilation of the greatest moments in sports history: the history of the medium rules it out. This positing of a full past beyond the broken record is a constitutive act of scientific idealism. It is a variant on the microbe effect that rewrites the past as if what we have recently discovered has always existed.

Darwin's peroration in chapter 10 is a *locus classicus* of nineteenth-century textualism:

> For my part, following out Lyell's metaphor, I look at the geological record as a history of the world imperfectly kept, and written in a changing dialect; of this history we possess the last volume alone, relating only to two or three countries. Of this volume, only here and there a short chapter has been preserved; and of each page, only here and there a few lines. Each word of the slowly-changing language, more or less different in the successive chapters, may represent the forms of life, which are entombed in our consecutive formations, and which falsely appear to have been abruptly introduced. On this view, the difficulties above discussed are greatly diminished, or even disappear.[96]

In the earth's library the books have been pillaged, scattered, censored, and burned. (The earth's library looks rather like Freud's or Lacan's unconscious.) Darwin's theory of evolution is clearly kin to the other historicist sciences that emerged in the nineteenth century, from archaeology and astronomy to philology and psychoanalysis, all of which read weak signals sent across great distance and interference. For Darwin and Lyell, the earth was a profoundly fallible recording medium that inscribed hieroglyphs at best and blank stretches of oblivion at worst.

In their conviction that history can be memorialized only in fragments, Lyell and Darwin pick up one strand in a conversation about the nature of media inscription. They find a certain melancholy lesson in the spectacle of life's wreckage (natural selection is itself one such spectacle). Darwin was a good Victorian in his sense of the sublime edification possible from the contemplation of nature: "A man should examine for himself the great piles of superimposed strata, and watch the rivulets bringing down mud, and the waves wearing away the sea-cliffs, in order to comprehend something about the duration of past time, the monuments of which we see all around us."[97] Darwin took a humble joy in seeing the

96. Charles Darwin, *The Origin of Species* (1859; Hazleton, PA: Electronic Classics Series, 2001–13), 278.

97. This passage, reminiscent of the "Spring" chapter in *Walden* (1854), invites the question of whether Darwin could have read Thoreau; we know Thoreau read Darwin.

lapses of time, rather like Emerson, who invited his readers to "respect the *Naturlangsamkeit* which hardens the ruby in a million years, and works in duration in which Alps and Andes come and go like rainbows."[98] But Darwin believed that the recording media could eventually somehow be disentangled from the real history. He thought that behind the shards there had to be the real past. In this way he sustained the dream of a total record—as something that only exists in absentia—that Google sponsors in reverse.

A latter-day Darwinian, Richard Dawkins, makes a very similar argument about the geological record: If every creature in an individual human's direct maternal line were buried on the same spot for a billion years, with every fossil pancaked into a single centimeter, the pile would have to be about six hundred miles (one thousand kilometers) thick—much thicker than the earth's crust. If the Grand Canyon could be filled with fossils, he adds, it could only hold about the remains of about one in six hundred creatures that have ever existed.[99] A source with a very different sensibility makes a similar point. The last verse of the Gospel of John ends on a plaintive note: "But there are also many other things that Jesus did; if every one of them were written down, I suppose that even the world itself could not contain the books that would be written" (21:25, NRSV). This verse is a neglected source for the idea of an infinite library and one of Borges's literary ancestors, with its world overflowing with uncontainable books and its sense of the infinitesimal narrative plentitude of any act. But its point, of course, is to show how absurd such an overstocked library of Jesus stories would be, and thereby to claim authority for the Gospel of John's particular take against competitors. To add to the slight vertigo, chapter 21 is widely regarded as an addendum by a later hand that wants, perhaps guiltily, to preemptively halt the piling on of new texts such as itself. You don't always need Derrida for deconstruction; some texts come that way ready-made.

For the evangelist and the evolutionist alike, what remains is a tiny fraction of the unimaginable excess of what actually occurred. Neither Dawkins or John 21 seems very sad about the loss (in contrast to Dar-

98. "Friendship," *Selected Writings of Emerson*, ed. Donald McQuade (New York: Modern Library, 1981), 211.

99. *Unweaving the Rainbow* (New York: Mariner Books, 1998), 13–14.

win's melancholy reflections on the fossil record). The geological record and the Gospel are both radically incomplete and highly privileged. It is, evidently, an honor to live on as fossil or scripture. The universe merrily wipes the slate clean of everything that has ever existed in it. [100] Both the Gospel of John and Dawkins treat a total record as a monstrous absurdity, and celebrate a limited record. This unlikely pair has found one thing, at least, to agree on: archival depletion is a handsome condition.

Ontology is Bent

Google came of age when the cosmos was being charted in a new way. In common images the Internet looks like the Big Bang, a nebula, or a brain. Recent cosmology, like Google, is a totality project, and both show that the royal road to knowledge of the universe is reading its structure as a recording and transmitting medium. To know the universe is also to know our time and place in it.

The cosmos is subject to *Seinsgeschichte* as much as anything else, and the sky requires shiplike media in order to be accessible. The telescope placed earth in a system unimaginably vaster than the reigning geocentric vision. The closed universe gave way to seemingly endless space, frightening Pascal, among others. As Lyell put it, "The senses had for ages declared the earth to be at rest, until the astronomer taught that it was carried through space with inconceivable rapidity. In like manner was the surface of this planet regarded as having remained unaltered since its creation, until the geologist proved that it had been the theatre of reiterated change, and was still the subject of slow but never ending fluctuations."[101]

Perhaps it was William Herschel, discoverer of the planet Uranus, organist and court astronomer to King George III, who first discovered the interchangeability of space and time in astronomical observation. As he noted around two hundred years ago, "A telescope with the power of

100. Compare Steve Jobs's 2005 commencement address at Stanford: "Death is very likely the single best invention of Life. It is Life's change agent. It clears out the old to make way for the new."
101. Lyell, *Principles of Geology*, 73.

penetrating into space has also, as it may be called, a power of penetrating into time past." He boasted, with eminent justification, that "I have looked further into space than ever human being did before me. . . . I have observed stars of which the light, it can be proved, must take two million years to reach the earth."[102] Two million years was and still is a long time, but the most recent observations suggest that the universe is around 13.81 billion years old, more than three kalpas. The Hubble Ultra Deep Field survey has caught images of seven galaxies that took shape more than 13 billion years ago, one of them sending "light fossils" from as long ago as 350 million years after the Big Bang, around the time that light came into being.

What does this convergence of seeing old and seeing far mean? That distance in space is distance in time was central to the work of the man for which this telescope is named, Edwin Hubble. Hubble's Law, formulated in the 1920s, states that the farther away a celestial body is, the faster it is moving and the older it is. The farther we see into space, the earlier we look into time. The light we see from distant galaxies is old to us, but young in its date of transmission. A supernova witnessed recently may have occurred billions of years ago. It is tempting to think that if we could see far enough we could look back to the beginning of everything, but light came on the scene hundreds of millions of years after the beginning, and the observable universe is limited by the cosmological horizon, the point at which we can no longer retrieve information. Astronomy is not, as Auguste Comte thought because only observation and no experimental manipulation was possible, the purest science next to mathematics; it is, like geology, a historical science. The universe is its own fossil record. An enormous universe has taught us that all transmissions come out of the past. Telescopes are machines of time travel as of space travel; we could call them paleoscopes.

Both geology and astronomy face the problem of belated reception, of interpreting messages that come posthumously. The content of both sciences is inseparable from signal and channel properties. "We cannot magnify the object without magnifying the medium," said Herschel in

102. Richard Panek, *Seeing and Believing: How the Telescope Opened Our Eyes and Minds to the Heavens* (New York: Penguin, 1998), 119.

1800.[103] One could not better state the point where media theory and the philosophy of science converge: the indiscernibility of medium and object. The very fact that we possess evidence of distant bodies at all is the problem to be solved. What events have shaped and distorted optical, radio, and other signals as traveling for billions of years? It takes a lot of interplanetary funksmanship to get them right. Disturbances in transmission are key data for the history of the universe. The older the light, the longer its journey. Since the universe is expanding, light that travels the farthest risks the most extreme disturbance. The universe continues to hurl itself apart at appalling speeds, such that the sources of old light have moved even farther away during the time their light has been traveling toward us. According to the Doppler effect, waves from receding objects stretch, and waves from approaching objects shrink. Light from distant cosmic sources shifts into longer, red and infrared, wavelengths because the distance between those sources and us is expanding, since every part of the universe is still rocked by the explosion of the Big Bang. The red shift is a measure of the velocity of such sources and thus, indirectly, of their age, like growth rings in a tree. The earlier a light has shone in the history of the universe, the faster it will be receding, since the greatest speeds of expansion were presumably found earliest. The oldest light, in fact, is no longer even visible as light, since it has red-shifted into the cosmic microwave background, itself a treasure of cosmic history.

Infrastructural warps can be embraced as epistemic sources. As in Google, ontology and epistemology meld. When red shifts were discovered in astronomical imaging in the later nineteenth century, some were tempted to reject them as disturbances, but soon they were embraced as vital sources of evidence. The perturbation of the channel was not the ruin of the message, but a message in its own right. (The same is true more recently with gravitational lensing.) The shape of the cosmos lets us understand how it works. Knowledge is necessarily historical, even in sciences where history might seem irrelevant. The universe is a distorted text that comes from afar: a classic hermeneutical situation. In contrast to Lyell and Darwin's assumptions, recent astronomy prevents us from

103. William Herschel, "On the Power of Penetrating into Space by Telescopes," *Collected Scientific Papers* (1800; London: Royal Society, 1912), 2:31–52, at 49.

assuming uniformity in processes; and it is even possible that some of the basic constants of nature have changed over time. Messages from the edge of the cosmos suggest that the past could have played by different rules than in the present (e.g., it could have had a different gravitational constant).[104] The present signal we can only interpret as what comes to us after having traveled for billions of years across a universe whose shape and laws may well have since changed, however subtly. Long journeys, as we saw with the ship, always put being into play.

That the medium is the message in astronomy is clear in the genesis of Einstein's special theory of relativity, as fascinatingly recounted by Peter Galison. The theory of relativity has specific technical and historical conditions: a "media a priori," as Kittler would put it. The standard account of Einstein's discovery of special relativity in 1905—one he himself actively propagated—paints him as a lonely, bored genius working in a patent office in Bern, Switzerland, dreaming away of space and time, his talent being wasted, like Kafka's, in the service of middle-European bureaucracy. As it happens, Einstein was not a solitary brain dreaming great thoughts, but an expert situated at the heart of modern timekeeping and telecommunications media, working in the great homeland of clocks, Switzerland, with the specific assignment of reviewing patent applications having to do with the nexus of the clock and the telegraph. Though trained as a physicist, he achieved a high degree of competence as an engineer by studying signal amplifiers and switching relays that linked clocks into national and international grids—devices that, once transfigured to a higher level of abstraction, provided the imaginative context for relativity. The question of "distant simultaneity"—for example, of how two remote clocks can be synchronized, given the lag time of any signal between the two—was not only the founding question of Einstein's theory, but the question that kept him busy on a daily basis, as proposals crossed his desk for electrical methods of coordinated timekeeping. The patent office was no backwater; it was, as Galison says, "a grandstand seat for the great parade of modern technologies." The examples animating relativity theory—elevators, train schedules, flashlights, synchronized watches, space travel—are not simply good things to think with, but things that point to the theory's historical conditions of possibility. Ein-

104. See John D. Barrow, *The Constants of Nature* (New York: Pantheon, 2002), ch. 12.

stein was a modern man living in a plastic world of space and time. One can hardly imagine relativity theory (or its mathematical ancilla, non-Euclidean geometry) before the nineteenth century and its new distortions of speed, time discipline, and consciousness.[105]

Einstein's great discovery was, as he put it in a 1905 note to a friend, that "there is an inseparable relation between time and signal velocity."[106] This impossibly brilliant insight spans from the engineering experience of telegraphic signals—the very matrix of modern technical media—to the heights and depths of modern cosmology, a field whose evidentiary basis depends radically on the minutiae of media practices. Einstein faced the problem that the universe can communicate with itself only at finite speeds. Information can move no faster than the speed of light. For deep space, this is not very fast. To the question of whether standard time is possible on a cosmic scale, he concluded that there could be no universal clock, no absolute "now" valid for all points. Einstein understood light not simply as a signal carrier, but as the basis of the universe's structure—as not just message but being. Time can move no faster than its communication; the nature of the cosmos governs the kinds of messages it can carry. For Newton, gravitation operated instantaneously, irrespective of distance. For Einstein, gravitation is not an action at distance, but a warping of the time-space field; information from a massive object's movement can travel no faster than the speed of light, which explains his later resistance to the "*spukhafte Fernwirkungen*" (spooky actions at a distance) of entanglement.

Relativity, in other words, is a theory of communication—more specifically, a theory of the universe's difficulty of communicating with itself. There is no cosmic telegraph to synchronize clocks at distant points. Einstein's universe, curiously enough, looks more like the old order of clock time before railroad time, where every town had its own local time (noon set by the point of the shortest shadow, when it points due north), than like the Newtonian regime of Greenwich Mean Time, where the whole planet is centrally coordinated in a single grid. (Einstein's theory was a pacifist's revenge against the standard time pushed by the German

105. Peter Galison, "Einstein's Clocks: The Place of Time," *Critical Inquiry* 26 (Winter 2000), 355–89, quotes from 387, 389.
106. Quoted in Galison, "Einstein's Clocks," 375.

military that he hated.) There is no single "now" that pervades the universe. Every now has a radius of dissipation, a broadcast "footprint" like a satellite. "Now" only stretches as far as our signals carry: a finding that perhaps the dolphins and humpbacks got to first. We have seen how the clock bears traces of its origin in the Northern Hemisphere, but Einstein also showed how the clock owes to the finitude of earth, with its claim of an encompassable now. Signal propagation and time, ontology and the speed of transmission, are inseparable: media theory has hardly begun to understand what this means. Here we see something like Dewey's constant point that means and ends always come together.

In Einstein's universe, no place in the universe is truly simultaneous with any other; even on earth, as we have seen, there is no true simultaneity. Presence is an effect of clumsy sense organs too slow to detect the slippage, and of an elegant brain that knits jumbled inputs into a single story. We live slightly in the past perceptually; our senses synchronize diverse signals traveling along distinct neural architectures into a coherent picture, and that takes time, often up to one hundred microseconds.[107] The tidy physics on the earth's surface might convince us that past, present, and future are three symmetrical entities like length, breadth, and depth. Seen in the larger scheme, however, perhaps only the past exists. Entropy devours the present instantly. Just as any light we see from Alpha Centauri is 4.3 years old, any communication we receive from another person comes out of the past, undergoing even in face-to-face talk an infinitesimal delay between departure and arrival. In the infinitely small interval between your utterance and my hearing, the universe could end. That such catastrophes are rare does not mean they are impossible. Strictly speaking, no act of communication is ever received in the same space or time as its origin. Most tragedy and comedy occurs in the space between sending and receiving. Romeo and Juliet died because of the delays of the medieval post. (A decent cell phone plan would have saved them.) Distances and delays are not obstacles to communication; they are its sum and substance.

Consider Olbers's paradox once more. The darkness of the night sky is evidence that the universe is not in touch with itself. Why isn't the night

107. David M. Eagleman, "Brain Time," *What's Next? Dispatches on the Future of Science*, ed. Max Brockman (New York: Vintage Books, 2009), 155–69, at 159, 163, passim.

sky thick with light at every point? Because the light hasn't reached us yet. Darkness is evidence of the slowness of cosmic self-consistency or cosmic youth. The immediate picture of the night sky is also a signal of cosmic history. Some remote part of the universe we are beholding could have "already" ceased to exist two billion years "ago" (whatever "already" and "ago" mean in this context) and we would not find out for eons longer than two billion years (because in the "meanwhile," that part of the universe continued to recede). The universe is too big, and is expanding too fast, for all the distant light to have reached us. The gap is not just a delay in knowing: time, the universe's key dimension, is tied to signal velocity, and ontology is bound by the finitude of communication.

Is our partiality as observers bad news? I don't think so. As David Deutsch suggests, astrophysics needs a theory of people, an account of those who are knowing the stars.[108] The universe looks just as it would look to beings that could have evolved with the ability to look at it. The fact that I even exist to see the sky coincides in some way with the history of the universe. Position in time and space and insight are inseparable. The "anthropic principle" suggests that only a certain kind of universe could support us as knowers, and could do so only at a certain point in its history. (Deutsch has troubles with this principle, but that's another matter.) The universe would have to be old and cool enough to have produced the complex chemicals that are necessary to sustain intelligent life as we know it. The possibility of our knowing the universe requires the kind of universe in which we could exist. By the time the universe is old enough to support organic life forms with the right chemistry for brains that are able, in some measure, to understand it, it will necessarily be cold, empty, dark, and old enough to have produced the chemicals that compose our bodies and light enough to reach our eyes. (Though perhaps intelligent life can take forms besides the organic.) "What we can expect to observe must be restricted by the condition necessary for our presence as observers." [109] This is also a first principle of media theory. Whatever else, the anthropic principle points to the convergence of existential situation and epistemological capacity. Historians of the universe are necessarily part of that history. Only at a certain point in the history

108. *The Beginning of Infinity* (New York: Viking, 2011), 70.
109. Barrow, *Constants of Nature*, 160–76; quotation from Brandon Carter on 162.

of the universe can we be its spectators or historians; subject and object are made of the same stuff. Our receptivity to transmissions from deep space and deep time owes to our position in space and time. Medium and message are inseparable. As Emerson might have said:

> My experience is democracy
> Of everything that is. *Tat tvam asi*.

Media Theology (The Sixfold)

The recent interest in nonhuman entities has typically stopped short of inquiring into the ultimate nonhuman otherness—except in the case of Latour, who fully gets the relevance of theology. The problem of the organization of intelligence is raised most acutely in the problem of the omniscience of God. Theology, in Gilles Deleuze's witty blasphemy, is the science of nonexisting entities.[110] Theology would then have to be the most encompassing science possible, because things that don't exist so vastly outnumber those that do. The mind boggles at the catalog of everything that doesn't (yet) exist as our heresiarchs, fantasists, and fearmongers populate the universe. In fact, some things that don't exist shape our worlds radically: zero, decimal points, the twenty-four-hour day, tomorrow, "not," and similar paterial media. Existence, *pace* Anselm, is not a prerequisite for significance. Linguistic shifters like *now*, articles like *the*, conjunctives like *if*, prepositions like *of*, and the whole class of signs that grab onto language rather than onto the world have plenty of consequence, though their materiality is a puzzle.[111] Euclid's *Elements* begins with this definition: "A point is that which has no part." The same mixed status is true for most mathematical concepts. Prime numbers, for instance, despite their apparent footing in nothing but mind, behave with an unpredictable obstreperousness that resembles more ordinary empirical entities. That the ideal world is subject to discovery drives both mathematics and metaphysics. Both can be empirical sciences—the view of philosophers such as Peirce, Whitehead, and Hartshorne. Indeed, the

110. Gilles Deleuze, *The Logic of Sense* (1969; New York: Columbia University Press, 1990), 281.
111. These signs are sometimes called, in a term of squid-like ugliness, "syncategorematic."

ability to work with nonexistent things is a decent description of intelligence. Theology, the study of things that are not, encompasses vastness.

In truth, Deleuze's definition is less risqué than well-informed about the history of Christian theology. In Genesis, Borges observed, God had a name, Elohim, a plural form implying preeminence. Throughout the Hebrew Bible, God is a strong personality—jealous, angry, sorry, compassionate, almost all too human, "indisputably Someone, a corporal Someone whom the centuries will magnify and blur." By the first centuries of the Christian era, God became, as Borges wonderfully puts it, "a respectful chaos of unimaginable superlatives" via words starting with "omni." But any description is also a limitation, and some theologians found only the via negativa adequate; that is, any attribute we ascribe to God must be negated. Scotus Erigena defined God as the *nihilum* (nothing).[112] Saint Anselm's ontological proof defined God as "that than which nothing greater can be conceived," and thus implicitly tied nothingness to God's identity. If God is the greatest thing we can think of, then surely he must exist, because existence is surely prerequisite to greatness; thus thinking delivered being in one of the all-time greatest acts of metaphysical obstetrics. Modern thinkers such as Kant were much less happy with the delivery, though of course Descartes pulled being out of thinking in a different way. Borges sums it up: "To be something is inexorably not to be all the other things; the confused intuition of this truth has induced mankind to imagine that being nothing is more than being something and is, in some way, to be everything."[113]

Borges regards the preference of negation over being as misguided, and I agree (although a world without negation would not be a world). All things that exist are particular, including deity. From this finitist view follows a theology not of nonexisting entities but of superhuman ones, a theology absolutely central to the question concerning technology. Theology is not necessarily any more about God than psychology is about the soul. As a set of human-made discourses about ultimates, theology is also an archive of imagination about the conditions and media of knowledge; an inadvertent encyclopedia of media history; an assembly of metaphors

112. See the hilarious essay by P. L. Heath, "Nothing," in *Encyclopedia of Philosophy* (New York: Macmillan, 1967), 5:524–25. Thanks to Pete Simonson.
113. Jorge Luis Borges, "From Someone to Nobody," *Selected Non-Fictions*, 341–43.

about databases, might, and glory. Prophets speak the truth of God after the manner of human speech, and priests, scribes and theologians figure out what the prophets mean; but by that point it is a question of translating one human language into another, not of communicating an unadulterated holy substance. God is a skittish being, easily frightened away by ink. His presence would be so overpowering that real theology would become not the science of nonexisting entities but a nonexisting science.[114] The revelation of God in fullness would come as embodied presence. Theology is perforce a fallen discipline: like every other discipline, an open confession of exile from God's presence, but even more openly, a discipline subject to all the imagination-stimulating powers of the distance technology of writing. Paul of Tarsus thought it legitimate to speak in a human manner about divine things (Romans 6:19). Theology is insulated from the prophets, an insulation that provides it safety as free inquiry, and danger as a rival source of truth. A believer may consider the craziest conceptions without fear, since the living God blasts through the intellectual pantheon birthed by the philosophers and theologians. As all iconoclasts have always known, the monotheist is structurally in the same position as the infidel, since such a person is a radical skeptic in all cases but one. The devout person seems to believe nothing that everyone else preaches.

If zoology is the open book of media theory, inasmuch as it is a constant study of the varieties of embodiment and the diversities of endowments, then theology might be as well. The whales and dolphins discussed in chapter 2 were sooner objects of thought than empirical creatures, what-ifs in an alien habitat, whose purpose was to illuminate the human estate. We can make the same inquiry about beings whose habitat is the cloud in a similarly subjunctive mode. What could God's relationship to body, environment, and *technē* possibly be? Could God have a *bios* and a habitat?[115] If God is alive, would he not only have *zōē* but also *bios*, and an order of existence more like a living organism than like a sign, number,

114. "La parole théologienne se nourrit du silence où, enfin, elle parle correctement." Jean-Luc Marion, *Dieu sans l'être* (1982; Paris: Quadrige, 2013), 9.

115. Steven L. Peck, "Crawling out of the Primordial Soup: A Step toward the Emergence of an LDS Theology Compatible with Organic Evolution," *Dialogue: A Journal of Mormon Thought* 43, no. 1 (spring 2010): 1–36; and Gershom Scholem, *On the Mystical Shape of the Godhead: Basic Concepts in the Kabbalah*, trans. Joachim Neugroschel (1962; New York: Schocken, 1991).

or zero?[116] What would a biology of immortal life forms be? What kind of ecosystems and habitats would sustain bodies enjoying a deathless life?

These brain-busting speculations—a biology without death?—are perhaps more difficult than the question concerning divine technology. Why would the divine habitat not have a technical dimension? For traditional Christian theology, nature is God's handiwork, thus blurring the contrast of *technē* and *physis*.[117] Creation in such a view is a divine artwork. The idea that God uses media should not be repugnant: "In God every end is converted into a new means," said Emerson.[118] Theotechnics would be the craft not of making gods, but of divine work with matter. We see a curious symmetry among deities and cetaceans from the human point of view. As we look to cetaceans, we see a split of technique from technology, of art from matter, since they live in an element that allows little to no creative commerce with inorganic matter. They can only leave a stamp on their own bodies and minds, not on a world. As we look to God, in contrast, art and nature are ontologically indiscernible. For God, the ablative being, everything would be a technical medium. According to the traditional theology of God as creator of everything, including matter, all that exists is material for or the product of theotechnical creation. For cetaceans there would be no art that does not lie in their nature; for God there would be no nature that does not lie in his art.[119] Humans, in contrast, stand between the made and the natural. Craft and being are irrevocably mixed up for us, but we also cannot help but see their separation when the ship crashes, or when one of us dies.

This book began by saying that media theory should be a version of philosophical anthropology, and here we see theology and zoology as the sciences neighboring anthropology in the broadest sense.[120] Together they are the sciences of diversely living beings. Media theory should start

116. Living beings have genders. Throughout I use the traditional *he* for God, respecting Mosaic prohibitions; but see John A. Widtsoe, *A Rational Theology* (Salt Lake City, 1915), chapter 12, for a more inclusive view of divine gender.

117. See Hans Blumenberg, *Geistesgeschichte der Technik* (Frankfurt: Suhrkamp, 2009).

118. *Nature*, *Selected Writings of Emerson*, 23.

119. I personally subscribe to the principle of equiprimordial matter and deity and to a distinction in the created status of God's children and his works, but that is for another day.

120. See Joel Robbins, "Anthropology and Theology: An Awkward Relationship?" *Anthropological Quarterly* 79, no. 2 (2006): 285–94.

with the kingdom of living beings but not end there, as there are other kingdoms, notably of things and nothings—but theology, anthropology, and zoology, worked into the sixfold of gods, mortals, animals, sky, earth, and sea, delimit media theory's domain nicely.

The Sages' Release

The sense that documentation is an unseemly preoccupation with the temporal is found among several ancient sages. Among the world's most influential moral teachers, some refused to write their doctrines. This is not, of course, the case with all. To Moses is attributed the authorship of the whole Pentateuch, a feat whose miraculousness is only burnished by the account of his death in its last chapter (and a feat explained in creative diversity by the rabbis). Other books of scripture have clear authors. But we have no record that Confucius, Socrates, or Jesus, three of the most influential moral teachers in history, wrote anything for posterity. (One could expand this analysis to the Buddha as well.)

There are, of course, importance differences among those teachers: two died for their doctrines, one (Confucius) did not; one (Jesus) was a religious savior, two were not; two started doctrines that later became state ideologies, one (Socrates) did not. But all three share the peculiarity that they left no evidence of their own doctrine written in their own words. Each had an odd, and oddly powerful, way of communicating with subsequent generations. In each case their teaching was recorded, codified, glamorized, or distorted—nobody knows exactly which—by their disciples. Socrates we know chiefly as the hero of Plato's dialogues, though Aristophanes also gives us a comically wacky Socrates, holding forth about the clouds in "thinkeries" that look a bit like psychoanalytic clinics, and Xenophon offers a more genteel Socrates who looks rather like a pop Benjamin Franklin, a hearty dinner guest ready to dispense pithy wisdom.[121] Jesus's words are recorded canonically in the four Gospels of Matthew, Mark, Luke, and John, though apocryphal gospels and other traces of his sayings (*logia*) also survive inside and outside the canon of Christian scripture. In his lifetime Confucius, according

121. Aristophanes' term *phrontistērion* lives on in modern Greek, where it means "cram school."

to legend, had various numbers of disciples (seventy-two, three thousand, etc.), and what we possess of his teaching, *The Analects*, is a posthumous redaction of controversial fidelity. The fate and diffusion of all three teachings owe much to institutional politics, such as the nearly thousand-year-long survival of Plato's Academy, the adoption of Christianity as the official religion by the emperor Constantine, and the formation of the state cult of Confucius, first in the Han Dynasty, and with further development in the Tang.

That doctrines can be codified posthumously and depend on the accidents of documentary history is well known. What is more unusual is the attitude apparently possessed in common by the historical Socrates, Jesus, and Confucius: the refusal to commit their doctrines to writing. There is no doubt that they were all literate. Socrates certainly was on intimate terms with writing and written works, as Plato's *Phaedrus* makes clear. As a rabbi, Jesus was versed in the Hebrew scriptures, which he read aloud in the synagogue (Luke 4:16ff), and John 8:8 (a text itself that many biblical scholars regard as a later addition of dubious authenticity) depicts him scribbling on the ground. Confucius spent much of his life's work as an editor of the Chinese Five Classics. "I transmit, I do not create," he said (*Analects* 7:1). Even if "Spring and Autumn" was "authored" by him, it is presented not as a statement of original doctrine but as a historical redaction whose arrangement presents the doctrine indirectly. Even though he was an editor, "Confucius says" not "Confucius writes" is the phrase by which he has always been remembered. He, Socrates, and Jesus were all fundamentally oral teachers whose immortality rests, paradoxically, on the medium of writing.

Their collective failure to write, then, was not a question of capacity, but of will. Perhaps they all recognized the hubris or futility of trying to fix the transient or the eternal, to commit the living spirit of thought to ink and paper. Perhaps they rejected the absolute power over life and death possessed by the written decrees of kings and emperors. Perhaps they were too humbled by the pre-existent texts to add to them—the text of "the laws" for Socrates, the law and the prophets for Jesus, the ancient writings for Confucius. None of these figures had any notion of "authorship" as it emerged in the modern European culture of individual expression and copyright. Indeed, each of their doctrines rejects the very

idea that an individual can be a source of truth: for Socrates, truth comes from contemplation of the place beyond the heavens as the soul learns to unforget its divine history; for Jesus, truth comes from the Father; for Confucius, it comes from the ancients. Whatever their reasons, Socrates, Jesus, and Confucius did not write—and via a sort of textual ventriloquism orchestrated by their disciples, they became the moral guides for much of the human family. It must be one of the greatest ironies of history that the medium of writing has delivered us the teachings of people who abandoned their own words to the air or to the memory of their disciples. Their sayings, delivered orally in concrete situations of dialogue, were preserved by the phonograph of the written word for abstract situations of dissemination in Plato's dialogues, the New Testament, and the *Analects*. At the most basic level, the texts of all three figures are riddled with mystery. No one knows precisely what the most central terms or teachings mean, what is a joke or serious, what is a scribal error, or even who wrote the text and why. It is perhaps this "failure" of communication at the heart of all three traditions that makes their lasting influence and resonance possible.

At the heart of each of their teachings was: Do not be afraid to die. Socrates died joking and learning music and poetry; Jesus died in awful agony but still in full command of his fate; Confucius died of old age. The best proof of their freedom from fear was the willingness to let what they regarded as the greatest truth remain untagged. They were okay with their decay, and at home in a universe in which everything eventually disappears. Detachment, not documentation, was their watchword. Of course they believed in immortality of various kinds; but they, like the dolphins, sought no archive to cling to. Like that of the Buddha, their choice not to write was an ethical one. They saw media as a moral choice of gravest consequence. In noting the strangeness that none of them chose to write, we should note the even stranger fact that hardly anyone in history, including most women, even had the choice of whether to write or not write. Civilizationally understood, these sages took the feminine option of action and natality over the masculine option of work and worldliness. In contrast to the tagging frenzy of our moment, they were not afraid of disappearance—which meant that they also knew how to be born and to give birth, the most marvelous of all things. And is it like-

lier that their teachings or the accumulations of our digital moment will be alive and flourishing two thousand years from now? The weak forces win in history.

Google may claim to do birth, but it will never know how until it learns to do death. Could it let its tags go?[122] In 2013 Google started a company aiming to "solve death," putting it on the wrong side of the sages. What would we be without death and forgetting, and without the willingness to abandon all our carefully accumulated material vessels of memory and immortality? Could our storage-crazy moment grasp the lesson that the worst thing to happen would be to lose loss?

122. As this book goes to press, there are more than thirty million petitions asking Google to wipe old or unflattering data from the web. The "right to be forgotten," taken seriously in the European Union, promises to be a source of controversy in the coming years.

Conclusion

The Sabbath of Meaning

> ". . . whooping and stomping as sane people ought to do when they encounter a thing so miraculous as water."—Marilynne Robinson, *Gilead*

This book was written with two audiences in mind: scholars of media and communication, and general readers interested in the human condition in our time. I conclude with a few parting words for each.

For traditional media scholars, the vision of infrastructure advocated here would encourage us to see media practices and institutions as embedded in relations with both the natural and the human worlds. The digital changes of our times are impossible without mines and minerals, clouds and electrical grids, habits of human want and labor, and global patterns of human inequality and abuse. The mass media of television and radio, journalism and cinema are likewise anchored in human size and shape, optical and acoustic bandwidth, forestry and plastics. If our evolutionary history had not produced the feet, spines, and skulls that we have, our media—and our world—would look very different. Media old and new are embedded in cycles of day and night, weather and climate, energy and culture, and they presuppose large populations of domesticated plants, animals, and humans, to say nothing of an old and cold universe. The digital implies basic facts of biology. We should make a greener media studies that appreciates our long natural history of shaping and being shaped by our habitats as a process of mediation.

For scholars interested in news and journalism, my arguments against

content as the essence of communication might at first seem discouraging. But these arguments follow a lineage back to James W. Carey, who saw news as drama and story, habit and ritual.[1] Indeed, survey evidence shows that people are most attached to news about the natural rather than the human world: the weather report. As currently practiced, news is already heavily environmental, perhaps without claiming it, and weather reporting is perhaps the biggest investment in daily science communication that exists. If this book had one policy proposal to make, it would be to call for a vastly enhanced weather report that moved beyond the daily *kairos* of the weather to the generational *chronos* of the climate. Like most good policy proposals, this one is wildly idealistic, especially as it faces one of the best-known facts in the sociology of news production: its daily short-term bias. As slow-moving stories of all kinds tend to fall out of the diurnal round of journalistic attention, this proposal joins other calls that tie the well-being of democracy to a shift in the culture and business of news. Nonetheless, the pieces are in place: we have a vast weather-watching and -reporting infrastructure that daily puts a human face on complex nonhuman data and could deepen into public drama and information about our climate, atmosphere, and latest co-evolutionary tinkering with our geohabitat.[2] The weather report of the future could cultivate the best attachments to our earth and world. The public sphere has always needed nature as its condition, but today it needs it as content as well.[3]

Media studies has excelled in cultural, social, political, and economic analysis, but this book pushes in an existential direction toward "being," a grand word that encompasses everything (and probably also nothing) without regard to its humanoid stamp. More concretely, this book has invited media studies to be friendlier to the natural sciences as well as to theology and philosophy. This proposal, too, pushes against deeply engrained habits of education and knowledge politics, and my own efforts at crossing disciplinary borders in both directions have caused me plenty of fear and trembling. A link with the natural sciences is ready-made in

1. *Communication as Culture* (Boston: Unwin Hyman, 1989), chapter 1.

2. As the Marxists would say, the climate report exists *an sich* but not yet *für sich*, in itself but not yet for itself.

3. Thanks to Risto Kunelius for conversations.

recent work in the history of science about the centrality of instrumentation, showing that the natural sciences are already rampant with media of various kinds, from cloud chambers to writing protocols. Though the link to theology is less obvious, much in the history of media theory (McLuhan and Kittler at least) has been theology by other means. But media studies has much to learn in both directions, especially a different or broader understanding of meaning.

The humanities have long claimed a monopoly on meaning. Since the nineteenth-century distinction of *Geisteswissenschaften* and *Naturwissenschaften*, thinkers defending the humanities claimed a special relation to meaning. A rainbow could be explained, but a poem was understood. There is much of nobility in the interpretive sciences, which came to include much of the social sciences as well, but they did not help us see meaning on nature's side too. They were typically defensive against natural science and mathematics for their "disenchantment of the world." This story, in broad strokes, positions the humanities, especially art and poetry, as saviors of meaning by rescuing its habitat, subjectivity, against the onslaught of objects.[4] As indispensably great as art and poetry are, and as unquestionably oppressive as much of the Gradgrind culture of calculation has been, the cure, deeply in debt to romantic thought, rested on two boundaries that this book has sought to put into congress: subject-object and humanities-sciences. What a strange idea that humanity was not embedded in nature, or that there was no poetry in science or science in poetry! How odd to protect meaning! Meaning was only fragile because it was anchored to the flimsiest and ficklest of all things, subjectivity, which made meaning vulnerable to the depressive whims of mood. Real meaning is not fragile: it is exuberantly abundant, overwhelmingly so.

Ralph Waldo Emerson once wrote of seeing a sunset so beautiful that it was painful to come indoors. "What was it that nature would say?" he asked. "Was there no meaning in . . . the mute music?" Emerson can be read as saying that nature has a mind, the Oversoul, and that it is some kind of subject that we could encounter, but he is much subtler than that. One of nature's greatest services is precisely not to care about our concerns. Nature has meaning, but not for us. It is blissfully, damnably blank

4. Of course hermeneutics saw text and tradition as robust *inter*subjective networks.

to our projects. Bathed in the sky's serene, exasperating sunlight, clouds will never call you by name or tell you that they care, and that, precisely, is what makes them marvelous. Nature's lesson is that meaning does not require a subject. Nature is not a subject, but it does not thereby lose its meaning or glory. Emerson's point is not the ease of projecting mind onto nature, but its futility. The hard task was to hear nature's mute music, which it might express in urea or stalactites as much as in sunsets. That "all mean egotism vanishes" is one of the great benefits of the study of nature.[5]

The notion of elemental media advanced in this book is more than an interdisciplinary gesture; it is also a bid in a long philosophical, religious, and political debate about the nature and location of meaning. To posit media of nature is to deny the human monopoly of meaning. Media can be rich in semiotic stuff without being the sole property of humans; indeed, as Peirce understood it, semiotics was the study of all signifying activity, from protoplasm to God. Not all that is meaningful comes from minds; and not all that comes from creatures with minds is intentional, either, as the study of nonverbal communication among humans and other animals shows. This brings up my final suggestion for my fellow scholars: We need a better name for the infrastructural aesthetics and ethics of being alive with others in the cosmos. Currently *nonverbal* signifies the remainder that is left when you take away language from human communication, but it ignores the meaningfulness found in nonhuman nature. How odd to describe that part of communication that most ties us to nature as lacking! The privative notion of *non*verbal continues culture's reign as the source of meaning. We make meanings, but do not so in media of our own making; our bodies are embedded in climate history, fire regimes, the spin of the earth, north and south, and relations with plants, artifacts, and organisms of all kinds, especially each other. Whatever nonverbal communication might be, it is certainly richer than our bodies' hints and gestures, rich though they are.

Few might be willing to follow me so far, but what if we took nature as the epitome of meaning rather than mind? What if the fecundity of meanings in nature provided our model of communication? Nature abounds in

5. *Nature*, *Selected Writings of Emerson*, ed. Donald McQuade (New York: Modern Library, 1981), 10, 6.

meaning, most of which we have no idea how to read or even acknowledge that it is there. There is an exquisite pattern in DNA and the neurons of sea slugs, in photons and the red shift, in the bonds of the carbon atom and the fortuitously odd behavior of water. Causes and correlations are significant too. There is clear intelligence of some kind in planetary, physiological, and genetic feedback loops. We do not need to posit some kind of superintending mind that keeps the operation afloat, but rather should understand intelligence at all scales, as the dynamic, restless, inarticulate genius of life-forms evolving in their environments. The most intelligent thing in the universe is the totality of life in all its forms, with human brain intelligence just one glorious outpost of organic evolution, one of the most exquisite things it has yet brought forth. Like the pragmatists, on whom I build, I regard mind and evolution as facets of the same process of experimentation and adaptation ("abduction" in Peirce's term). Both mind and nature reach toward the future, intelligently sorting options and seeing what works.

If it is a mistake to think that nature is a subject that speaks intentionally, might it not also often be a mistake to think the same of humans? They who find personal messages in nature are bound for disappointment—and the same is very often true in culture. We rarely know what we mean until we say it, and often saying it reveals meanings that we didn't know we had. The future contains and reveals the present. The story of the disenchantment of the world as a loss needs rethinking. For equally religious and scientific reasons, I do not want to live in a world in which every falling of a leaf or shape in the sky is the sign of some dark divinity. The dialectic of enlightenment has a good side too: disenchantment is a loss, but also a relief from the burden of too much significance. Almost everything that occurs does so without intention or deeper meaning, including much of what people say. (This is not to say that listening is not important: it is to intensify the imperative to listen.) That cognition depends upon a refusal to read the world as signs of the intention to communicate may be the basis of scientific, religious, and interpersonal sanity. We best work out our mutual relations not by reading every possible meaning, but by moving into the future to see what meanings we can produce. Before a word is spoken, our togetherness is already supersaturated with meaning. The world does not need to be re-enchanted; it is already wondrous. The universe is full of data; why should we attend

only to the narrow bandwidth of data made by humans, exceedingly fascinating and creative through it be? Science at its best is not the foe of wonder, but its vehicle.

To say that nature is full of meanings is not just a metaphysical leap; it is, I believe, empirically justified. I am not saying that nature contains something like the human mind in small doses, but rather that whatever mind is starts in life's experiments and grows from there. An evolutionary philosophy gets us all that objective idealism did—a sense of real global meaning—without any need for a subjective location of mind. For Peirce, feeling is the key factor linking matter and mind. All life feels beauty, however inchoate. Biochemistry senses fitness in form and function, and aesthetic concerns for harmony and diversity drive evolution, as Charles Hartshorne argued. The apple trees in bloom have nothing to say and everything to mean: they witness fertility, a habitation on earth, and eons of history. Our sense of beauty is not just some kind of cultural imposition, but a deep part of the infrastructure of natural history on this globe. Wrote Peirce to James: "Living in this beautiful country, I cannot but be overwhelmed by the lovableness of the universe, as everybody is. Every mortal who stops to consider it is penetrated with love. It is irresistible."[6] We see and feel beauty because we are part of the cosmos and part of others.

There is an objection. Birds hear beauty in bird song, and we can too, but it rarely moves us as a human song does. There are no letters in nature.[7] The fact is that there is a gap between humans and things. Vagueness is the price of biohistorically rampant meanings. Nature's signs are vague—like clouds or stars, faces or bodies, or the richest terms, such as *love* or *liberty*. (Taking vague signs as addressed is almost always a guarantee of paranoia or delusion, though there are terrifying exceptions.)[8] As Charles Ives said, "Vagueness is at times an indication of nearness to a perfect truth."[9] Sometimes it is hard to get a full meal from natural mean-

6. Peirce to William James, quoted in Joseph Brent, *Charles Sanders Peirce: A Life* (Bloomington: Indiana University Press, 1993), 302.

7. Jorge Luis Borges, "La busca de Averroes," *El Aleph* (Madrid: Alianza Editorial, 2007), 104–17, at 108, and Friedrich Kittler, *Aufschreibesysteme 1800–1900* (1985; Munich: Fink, 1995), 39.

8. See Jorge Luis Borges, "El jardín de los senderos que se bifurcan," *Ficciones* (Madrid: Alianza, 1985), 101–16.

9. Charles Ives, *Essays before a Sonata*, ed. Howard Boatwright (New York: Norton, 1961), 21.

ings: nature can wear a blank face and the *tempus* can be dull. There is the miracle in the common, but also the common in the miracle. There can be nothing so boring as being. Mindfulness is never a fully sustainable program. You can't stay giddy with infrastructure forever; something else is always in the queue. Some afternoons you just need to keep chugging along; sometimes you just want to check your e-mail or see a movie. Any ecstatic philosophy needs to make friends with the inevitable fading of wonder and our inevitable hunger for the candy of human content. Signs from our fellows are different than those from nature, and we need them, rare though they are. We need to transcend the subject-object but we cannot; as Hans Jonas remarks, "The subject-object relation . . . is not a lapse but the privilege, burden, and duty of man."[10] Indeed, this has been a central argument of this book: that human crafts reveal nature. I probably would not love the clouds so much if they had not been painted so well. For our species, nature's meaning only comes via the ships we use to navigate its being.

Another objection to a theory of natural meaningfulness is ethical. Nature's exquisite order is founded on death. Both zoology, the study of living beings, and theology, the study of otherness and the media of its revelation, can inure you to nihilism. Their views can be so vast that the merely human must finally wince to nothing at all. Philosophers and theologians destroy and rebuild the universe for their daily bread. I once rented a room from a theology student who adorned his desk with a human skull, as if that relic would help qualify him for the guild. Thomas Hobbes wanted his gravestone to read: "This is the true philosopher's stone." For the philosophy of media it is a fitting motto, since all recording media are efforts both to stave off the grave and to grab its alchemical power to turn back time. I am not saying anything new in noting that death is a profound moral puzzle. Nothing is so ordinary or so extraordinary. Death can feel completely normal, dull, and expected, as blank as boredom, and also unbearably bitter and impossible, as hard as thoughts of falling. Death is a great revealer of infrastructures, and, like them, it partakes of the habit of coming out of hiding traumatically.

In the time frame in which Alps and Andes come and go like rain-

10. Hans Jonas, "Heidegger and Theology," *Review of Metaphysics* 18, no. 2 (1964): 207–33, at 230.

bows, we are all dead already. The sublime amorality of geological history puts our anthropocentric moralities to shame, cataclysmically extinguishing almost every species that ever lived. Contemplation of the eons is perhaps not so good for your tenderness. Consider some lines from Thoreau's *Walden*: "I love to see that Nature is so rife with life that myriads can be afforded to be sacrificed and suffered to prey on one another; that tender organizations can be so serenely squashed out of existence like pulp,—tadpoles which herons gobble up, and tortoises and toads run over in the road; and that sometimes it has rained flesh and blood!"[11] Thoreau, tuning to the same wavelength as Darwin, celebrates apocalyptic destruction as the sign of nature's recuperative vitality. He is not celebrating death (though most transcendentalists have an icy, antisocial side), but presenting a hard fact in nineteenth-century dress, red in tooth and claw: that life depends on death. The extremity of his rhetoric is perhaps necessary to stun us into recognition.

Happy cosmic nihilism was always part of what the defenders of the humanities fought against. *Sub specie aeternitatis*, nothing really matters. But in the rush of the *kairos*, there is plenty to worry about. There is an old clash between the ethic of detachment, which calms the soul so well, and the ethic of commitment, which calls us to upsetting action. Old-style humanists wanted to keep death tragic, as if science would reduce people to nothing. William James saw philosophical idealism as the effort to hold on, desperately, to whatever it is that humans have brought forth:

> That is the sting of it, that in the vast driftings of the cosmic weather, though many a jewelled shore appears, and many an enchanted cloud-bank floats away, long lingering ere it be dissolved—even as our world now lingers, for our joy—yet when these transient products are gone, nothing, absolutely *nothing* remains, to represent those particular qualities, those elements of preciousness which they may have enshrined. Dead and gone are they, gone utterly from the very sphere and room of being. Without an echo; without a memory; without an influence on aught that may come after, to make it care for similar ideals. This utter final wreck and tragedy is of the essence of scientific materialism as at present understood.

11. Thoreau, *Walden* (New York: Norton, 2008), 262.

Even death will be dead and forgotten.[12]

So should we take our ease in the cosmic relaxation, the culmination of the latest kalpa? An odd peace can be found in the certainty that nothing lasts forever. Even God rested on the seventh day. Climate change would just go down as one more episode in earth history, the eons wiping away our guilty carbon consciences. But the serenity of contemplating the universe while people are dying has always been obscene to anyone who feels the suffering of the world. We have seen repeatedly how transcendental visions of sea, sky, or clouds are funded by military-technical projects. It's good to rejoice in the earth as a blue marble, but also to remember that it was "Whitey" who took the picture, as Gil Scott-Heron put it.[13] An interest in social justice seems to require a relatively small (i.e., humanoid) imaginative compass and a relatively short temporal compass.

But cosmic appreciation and neighborliness are not incompatible. A long view can encourage care for climate and long-term processes. As Peirce suggested, the beauty of the universe makes an ethical claim. The evolutionary and geological view shows how rare another person is, the culmination of impossible odds. This is what the universe has yielded: another being in your same form, improbable and precious, with whom you may be able to contribute to the ongoing history of life. Love and beauty are the meaning of the universe, and such meaning is not a human fiat imposed on raw and unfeeling matter by the effort of our will, but rather the product of cosmic history.

That the beauty of the cosmos teaches ethics is also what the ancients thought about watching the stars, and I end with one last look to the sky. Though we understand the stars very differently now than in antiquity, they remain singularly sublime and beautiful; why a black field spangled with small lights of subtly varying colorings and intensities should be so captivating remains an open question. Dante ends all three parts of his *Divine Comedy* with the word *stelle*, stars. As Dante and Virgil exit hell in the *Inferno*, it is as if they are coming up for air from a long dive, dying to get back to the world as we know it. They see the beautiful things in the

12. William James, *Pragmatism*, 76.

13. See Lynn Spigel, *Welcome to the Dreamhouse: Popular Media and Postwar Suburbs* (Durham, NC: Duke University Press, 2001), 141–83.

sky, and go out to see the stars that welcome their homecoming to terra firma. For Dante, the stars (which included the sun, of course) were signs of the ultimate divine sphere which enveloped the earth at the center of the universe. The stars were both divine and cozy blessings marking our home in the cosmos.

Since Copernicus, we live in an open universe, which continues to get bigger and weirder all the time. We know we can never touch or visit the stars. They exist at distances for which we have no real language, and are separated by space that is so empty that no sound can carry, so stretched by the ongoing momentum of the Big Bang that old light is distorted beyond recognition, and so cold that an unprotected human would instantly crack and break into microscopic pieces of stardust, leaving an unusual concentration of chemicals to drift like a lazy cloud in the interstellar emptiness. Stars can make us crazy with the absolute vastness and relative puniness of earth, with a vertigo that no other sight can match. They have always had the ability to drive people mad; stars are the ultimate *appel du vide*.

If Dante and Virgil returned from hell today, it might be a return from outer space to the warmth, water, and mud of Earth beneath the sun and the clouds.[14] Looking up to the sky, they would know they were home in the cosmos by the clouds that blow and scatter and carry the otherwise invisible water vapor from the sea that has always been the medium in which we move and have our being. The skies may not rain flesh and blood, but they do, like the seas, harbor the specific ingredients that make our flesh and blood possible. The beautiful Finnish word for world, *maailma*, in combining two words, earth or land (*maa*) and atmosphere or air (*ilma*), catches the right spirit. We cannot return to Dante's cosmology, but geocentricism, long castigated as the sign of a medieval outlook, might deserve a critical revival. This is my final proposal not only for scholars but for humankind: a ravenous gratitude for the Earth.

Clouds are one marker of our home, an atmosphere in which we can exist. They circulate the seas and play a role in regulating planetary temperatures. As Shelley saw, clouds are born by dying. We moderns have not lost touch with the sky but have simply shifted from the constants to the variables, from the stars to the clouds. Climate change asks us to

14. Compare the film *Gravity* (dir. Cuarón, 2013).

do the hard work of seeing *chronos* as *kairos*. As we look to clouds we see the signs that we may have altered them forever, and nothing could hurt more. In one of his prose poems Charles Baudelaire imagines an interview with a homeless stranger who claims to hate people, God, and gold. But what do you love? "J'aime les nuages," the man replies; "les nuages qui passent . . . là-bas . . . là-bas . . . les merveilleux nuages!" I love the clouds . . . the clouds that pass by . . . over there . . . over there . . . the marvelous clouds! Here, finally, was one thing even the bitterest misanthrope could not help but love.

After the shipwreck of our species, which is as inevitable as our own individual deaths, everything in James's human cloud bank will go, but this blessed earth will live on, and the clouds and sun will continue to radiate for a season, and the beauty that pulses in our senses will continue to pulse to other senses or just to itself, and that will be enough. Knowing that this beauty will persist gives some comfort. When we go, natality might well bring something new forth. There might be long periods of anoxic oceans and arid wastelands, but something will happen and eventually wildflowers might sprout in the ash we left behind. The end of the human species is a comic prospect, not only a tragic one, in the strict sense that comedy involves the regeneration of life. Melville wrote: "Yet there is hope. Time and tide flow wide."[15] Perhaps some other intelligent species will evolve after millions and millions of years, and will do a better job. Time and tide flow wide! As long as we have the clouds, we have hope and fight and love. Knowing that we have their beauty and each other now is too much to take. It is enough and to spare.

15. *Moby-Dick* (New York: Norton, 1967), 148.

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.

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