Introduction

"Mr Swivett, approaching a facial lividity that would alarm a Physician, were one present, now proclaims, 'Not only did they insult the God-given structure of the Year, they also put us on Catholic Time. French Time. We've been fighting France all our Lives, all our Fathers' Lives, France is the Enemy eternal, —why be rul'd by their Calendar?' "

"Because their Philosophers and ours," explains Mr. Hailstone, "are all in League, with those in other States of Europe, and the Jesuits too, among them possessing Machines, Powders, Rays, Elixirs and such, none less than remarkable, —one, now and then, so daunting that even the Agents of Kings must stay their Hands."

"Time, ye see," says the Landlord, "is the money of Science, isn't it. The Philosophers need a Time, common to all, as Traders do a common Coinage."

"Suggesting as well an Interest, in those Events which would occur in several Parts of the Globe at the same Instant."

—Thomas Pynchon, *Mason & Dixon*

Facts are but the Play-things of lawyers—Tops and Hoops, forever a-spin. . . . Alas, the Historian may indulge no such idle Rotating. History is no Chronology, for that is left to lawyers—nor is it Remembrance, for Remembrance belongs to the People. History can as little pretend to the Veracity of the one, as claim the Power of the other, —her Practitioners, to survive, must soon learn the arts of the quidnunc, spy, and Taproom Wit, —that there may ever continue more than one life-line back into a Past we risk, each day, losing our forebears in forever, —not a Chain of single Links, for one broken Link could lose us All, —rather, a great disorderly Tangle of Lines, long and short, weak and strong, vanishing into the Mnemonick Deep, with only their Destination in common.

The Revd Wicks Cherrycoke, Christ and History.

—Thomas Pynchon, *Mason & Dixon*

Epigraphs: Thomas Pynchon, *Mason & Dixon* (New York: Henry Holt, 1997), p. 192; Thomas Pynchon, *Mason & Dixon* (New York: Henry Holt, 1997), p. 349; Paolo Levi, "The Ravine," in *The Oxford Book of Detective Stories,* ed. P. Craig (Oxford: Oxford University Press), p. 316.

You will find that for every kind of occurrence there are at least three explanations. The most likely, the absolutely certain one . . . and the true one.

—Paolo Levi, "The Ravine"

In the course of human (and nonhuman) history, it is rare enough for a significant new regime of memory practices to develop. M. T. Clanchy (1993) explores one such in England a millennium or so ago, arguing that "the shift from habitually memorizing things to writing them down and keeping records was necessarily prior to the shift from script to print, and was as profound a change in its effects on the individual intellect and on society" (3).

Looking out from the year 1000, then, one can go back to the invention of writing and a subsequent uneven shift to organizational reliance on written records over several thousand years up to the turn of the first millennium after the Christian era. One can also look forward to the propagation of print culture some few hundred years afterward (Eisenstein 1979) and then several centuries after that to the development of the Internet. This book offers a reading of the ways in which information technology in all its forms has become imbricated in the nature and production of knowledge over the past two hundred years.

The starting point will be the Industrial Revolution in England, with the development of new archival forms consequent on the expanded scope of the British state and accompanying new scientific memory practices—for example, in the then central science of geology. The culmination will be a new form of scientific product, the digital database, within a current central scientific arena: biodiversity science.

The story I tell is not a linear, chronological narrative—that artifact of a previous memory regime. My story weaves a path between the Landlord's time and the Reverend Wicks Cherrycoke's "Mnemonick Deep"; between the social and political work of creating an explicit, indexical memory for science and knowledge and the variety of ways in which we continually reconfigure, lose, and regain the past. The interest in the Landlord's expostulation goes beyond its brute equation of time and money. The Landlord is talking about how infrastructures form.

The mnemonic deep. At the extremes sit dance and play, two ways of reading it, and on the plateau wander an infinite number of ways of writing it. One way of reading it is to see ourselves as at any one moment completely able to escape our history, thanks to that little piece of time which is the present, together with motive force, emergence. Hope, desire, creativity, will are projected onto this little piece of time stuff, the present (ever-present, never in reach). This little object, the numinous present, holds our dreams. The past

is a thing that you escape at all costs. It has a heavy hand. A hand with a long reach, as many a politician has found—the politician being the concentrated symbol of the person whose past is completely knowable: prurience combined with moral fervor set up a powerful continuing (and ever incomplete) inquisition into the politician's past, the same inquisition that we carry out daily on confessional shows on daytime television with its smorgasbord of choices for redemption. Our past explains who we are; we stand here publicly before you to receive absolution for that past and to follow emergence into a spangly future. . . . The other way of reading it is as a palimpsest, as in Proust's description of Albertine's face as a palimpsest. The infinite faces of the past can be read off the present face. The mnemonic deep lies deep in the eyes of the beloved. We should remember the past and celebrate it. For how else will we savor, texture, explore, adore the real? Evoking the past is a joy and a solace in the present; through it we constitute a narrative ideal present. The timeless present—ever felt more richly, ever receding into the past. For how can we know the past without taking time for it, mortgaging the present to savor the past? In this reading, we learn from the past, seeing the multiple ways it can lead, and we observe ourselves choosing some of those ways (never a single decision; rarely consciously a decision). This numinous present will lead us to the question of money. As Michel Serres (1982) has noted, money is the degree zero of information. It circulates in an ever more ideal space and time (we have gone from gold to silver to base metals to paper to digits) and is exchanged, duly laundered, as something that is without history. Money is the ultimate token of emergence.

Within this metaphorical economy, time as the money of science is constituted of both the mnemonic deep and the numinous present. The time that scientists create has three main features. First is the time of the experiment/field study itself. Scientists play with much longer time scales than most of us (going back billions of years); with much shorter time scales (down to divisions of the nanosecond, to quantum units of time); and with time series and cycles of great complexity—registering, for example, patterns in time series analyses of proxy measures for past climate (tree rings, peat mosses, fossil seeds, astronomical cycles ranging over tens of thousands of years up to millions of years). Agreements about time and timing are fundamental to all science, so a good time standard operates as a gold standard. Second is the time of the scientific enterprise. Much writing in science is historical—opening a scientific paper with an account of the recent relevant history of one's subdiscipline; continuing with what happened in a particular day at a given laboratory. Particular constellations of historiographical stances that are shared among sets of disciplines, or between practitioners of a given discipline.

Finally, there is the ultimate product—the law of nature. All contingency has been removed from the law of nature—it is true over all time and in any place. In the same way, we will see, our globalizing ethnos is without a past and apparent everywhere. The common time that the Landlord refers to is used to create a universe in which the constructed fact is eternally true.[1] In this sense, the past that scientists create can be read as an eternal present.

The institution of the sciences is one of very few modern institutions that claim a perfect memory of the past (law, through precedents, and theology, through heresies, are others). Even tax records decay over time. This book is about the work that goes into creating this avowedly perfect memory—about its textures and discontinuities; about the technologies and techniques that subtend it, and about ways of thinking about it with a view to designing robust scientific databases that contain traces of the past that are currently cast into oblivion. But to get from here to there—or rather from now to then—we will first look at the array of traces of the past that we leave.

What Traces Do We Leave?

In Which It Is Argued that We Leave a Lot of Traces

I rarely think about the traces that I leave in the world as an ecology. I tend to think of them (when at all) quite concretely. First, my library. It operates as a form of external memory for me (when I, rarely, use it) and as a commemoration of things I have read. Its probable fate after my death is its dispersal into a hundred homes. Marginal notes that I have written will lower the selling price rather than attract attention. Second, on the Web. It is interesting to track dead people on the Web. My friends and acquaintances who died before Mosaic are sparsely represented, and when they are it is generally in a classical, canonical academic style (footnote references, bibliographies, etc.). Or in a Mormon database. Those who died more recently carry on a rich afterlife. They often still receive email messages; links to their Web sites rot very slowly; their informal thoughts are often captured on listserv archives, on comments they have left on a Web site (signing the visitors' books). Some people even have "eternal flame" Web sites[2]—where the problem of maintenance is as live as it is for the Olympic torch or the refrigerated truck. Each of these modes of memory was in place before Mosaic, but it is now possible to articulate it

1. B. Latour, B., *Petite réflexion sur le culte moderne des dieux faitiches* (Paris: Les Empecheurs de Penser en Rond, 1996c). This is the double nature that Latour explores.

2. See http://www.venus.co.uk/gordonpask/.

in ways that were previously unworkable. It would take a researcher a lifetime to track down my written traces—where I have signed guest books in weird museums and twee hostels, people with whom I have carried on informal correspondence. Those of us enjoying and being irritated by post-Mosaic syndrome (PMS), leave legible traces across a wide range of our activities in electronic form. Everyone their own Boswell.

When I, rarely, think about the articulation of the set of traces that I am leaving, I have the immediate apprehension that it's not the real me that's out there on the Web. I know the times when I've censored myself (oh problematic concept!) and when I have performed actions to complement—and frequently to confound—a trace. Thus I might write a positive review of a friend's book and then offer close colleagues a different reading.

Taken globally, the set of traces that we leave in the world does without doubt add up to something. It is through operations on sets of traces that I understand an event in which I take part. Tolstoy wrote about the foot soldier in the Napoleonic wars. The soldier he describes cannot have the experience of the war he is waging or the battle he is fighting because the only "global" traces of the war are inscriptions—notably, maps and statistics. There is no scaleable observation that moves from "I was in a copse hiding behind a tree and was terribly confused" to "I took part in Napoleon's bold attack on the left flank." In this case, where is the experience of the war? When we experience a war, we are relying on the aggregations of other experience to ground and shape our experience.

In general, we use scientific representational forms to fashion our experience. Hacking writes about this at the personal level in terms of learning to be a child abuser or a multiple personality by reading the accounts of others (Hacking 1992, 1995). We internalize these accounts and experience them as our own. Žižek claims that there are no pure patients in psychoanalysis now, there are only Jungian patients, Lacanian patients, and so forth: the stuff of our experience (our symptom) is the aggregated experience of others (Žižek 2000). This has always been the case. History was just as multivectorial then as it is now, and our individuality was just as vectored in archives.

With digital archiving in all its forms, a new regime of technologies for holding and shaping experience has emerged. Our past has always been malleable, but now it is malleable with a new viscosity. The new texture of our past is that we can go from the global to the local and back again with great speed. The new analytic objects that emerge are different if we look at the transition of the local through the global (the unit local-global-local, to paraphrase Marx) or the transition of the global through the local (the unit global-local-global). The former will lead into the new, rich interiority that is emerging

with faster global exchange of information, people, flora, fauna, and things. We now have so many identities available to us—just geographically I can reasonably lay claim to Celtic, Isle of Man, Australian, French, English, and so forth. The latter leads into a new form of exteriority, in which the map and the statistic are richer than the territory and govern the territory. It is not that we have the ability to aggregate brute numbers—that has been available since the early nineteenth century at least in a number of domains. It is rather that we can aggregate that data along multiple different dimensions and perform complex operations over that set of dimensions. It is the pleats and the folds of our data rather than their number that constitute their texture.

What This Book Is About

The paradox of digits lies in this. The best possible analog representations are produced by digital computers. If you want a flowing sea of lava oozing from a volcano spuming smoke (as doubtless many of us do), then you don't go to the people who produce analog computers. You go binary. The situation is strictly analogous to that of the moving picture we call cinema being constituted of a sequence of still pictures, recreated anew each fraction of a second just like Descartes' discontinuous universe. Does it make any difference that our best apprehensions of data, past viewscapes, and encapsulated memory are brute numbers, binary and static? For they are also folded, fractal, and febrile.

In order to tackle that question, we need to start with the questions of (1) how our personal memories are technically, socially, and formally mediated (local-global-local) as well as in our heads, and (2) how the socionatural world we operate in is produced locally (formally, technically, socially) to be global (global-local-global). Clearly a vast amount has been written about these questions.

In this book, I examine two questions that are fractal subsets of these two:

1. How do scientists figure their own pasts—both as creatures on earth and in terms of disciplinary lineage?

2. How do scientists figure the past of their entities—the earth, the climate, the extinction event?

A central *aporia*[3] that I explore is constituted by the very general condition that what we leave traces of is not the way we were, but a tacit negotiation

3. See the discussion of aporia in G. Agamben Agamben, *Infancy and History: The Destruction of Experience* (London and New York: Verso, 1993). Aporia is a figure whereby the Speaker sheweth that he doubteth, either where to begin for the multitude of matters, or what to do or say in some strange or ambiguous thing (from OED). Etymologically, it derives from a tropos—without path, or without road.

between ourselves and our imagined auditors (whether in the sense of listeners, readers, or moral or economic watchdogs); yet we also need at some level an understanding of what actually happened in order to forge our futures. The aporia takes many forms. When Bill Gates came up against the U.S. government in the antitrust suit against Microsoft, much was made of some internal email correspondence that laid out his company's predatory strategies. This is a standard tale from the early days of email. Now, there are numerous companies that specialize in searching out and destroying all traces of possibly damaging email correspondence; and many organizations have laid down strict rules about what can be said in an electronic conversation. A similar move was made in the 1930s by the Schlumberger company, when it realized that its internal records could be scrutinized by a court—the company shifted very quickly from writing detailed accounts of their practices in French to writing highly sanitized versions in English (Bowker 1994). Similarly, Ed Hutchins (1995, 20) observes that records kept of navigation on navy ships are written with an eye to a future legal enquiry should there be a disaster. Scientific texts are written not to record what actually happened in the laboratory, but to tell the story of an ideal past in which all the protocols were duly followed: the past that is presented should be impregnable—thus perpetual worrying over whether the Millikan oil-drop experiment (he discarded partial charge values for his particles) was fraudulent, whether Pasteur misrepresented his findings or Mendel messed with his peas. It takes a great deal of hard work to erect a past beyond suspicion. When I tell my life story to a boss or a coworker, there are many things that I unmention, discontinuities that I skate over (Linde 1993). It is very rare to commit a story to paper with a view to telling it "wie es eigentlich gewesen ist." Stories are told in a context, under a description (Hacking 1995). The aporia to which we will return is that despite this central fact about record keeping, there is still a need to keep good records. Microsoft Corporation still needs to retain and propagate a memory of how to be a predator; Schlumberger still wants to know how to work around regulations; scientists want to be able to pass on knowledge about how an experiment really works to their students. This brings us centrally to the question of memory practices. Acts of committing to record (such as writing a scientific paper) do not occur in isolation; they are embedded within a range of practices (technical, formal, social) that collectively I define as memory practices. Taken as a loosely articulated whole, these practices allow (to some extent) useful/interesting descriptions of the past to be carried forward into the future.

What Is Memory, that a Person May Practice One?

Memory is often, and wrongly, conceived of as an act of consciousness and associated with what can be called to mind. By this light, it is often seen as the act of deciphering traces from the past. We don't analyze the movements of icebergs by studying the bit that appears above the surface of the sea; nor should we study memory in terms of that which fires a certain set of neurons at a determinate time. We as social and technical creatures engage in a vast span of memory practices, from the entirely non-conscious to the hyperaware.

Consider the total institution. Mary Douglas (1986) argues that "when everything is institutionalized, no history or other storage devices are necessary" (48). If I get processed into a prison, I can survive there as just a number (as the Count of Monte Cristo discovered). There is no need for the institution to hold any information about me other than that I exist and that I am subject to its regulations for such and such a time period; there is no need for me to remember anything about my own past, or any sets of skills beyond a fairly simple motor set. Why I am there and who I am just don't matter to the institution itself; it "remembers" all it needs to know through the complex set of procedures that it puts into place. Sima Qian, a Chinese historian (ca. 145–86 BCE), made a similar observation about the burning of the books in 213 BCE. Qian (1994) writes:

> Approving his proposals, the First Emperor collected up and got rid of the *Songs*, the *Documents*, and the saying of the hundred schools in order to make the people stupid and ensure that in all under Heaven there should be no rejection of the present by using the past. The clarification of laws and regulations and the settling of statutes and ordinances all started with the First Emperor. He standardized documents. (31) [The translator notes that this refers to the standardization of bureaucratic practices, not of the script.]

This replacement of memory by procedures extends to a formal information processing argument that Ross Ashby made about closed systems all kinds. He argued that if we completely know a system in the present, and we know its rules of change (how a given input leads to a given output), then we don't need to bring to mind anything about the past. Memory, he said, is a metaphor needed by a "handicapped" observer who cannot see a complete system, and "the appeal to memory is a substitute for his inability to observe" (Ashby 1956, 115). Now no institution is ever total, nor is any system totally closed. However, it remains true that there are modes of remembering that have very little to do with consciousness. These modes tend to abstract away individuality (extension of a person back in time) by substituting rules and constraints on the behavior of types of people for active recall.

At the other end of the spectrum is the hypermemory of Funes, the Memorious, discussed by Jorge Luis Borges. As the result of a riding accident, Funes had a perfect memory; however, it was so good that it took him far longer to recall an instant than it had to experience it:

> Funes remembered not only every leaf on every tree of every wood, but every one of the times he had perceived or imagined it. He determined to reduce all of his experience to some seventy thousand recollections, which he would later define numerically. Two considerations dissuaded him: the thought that the task was interminable and the thought that it was useless. He knew that at the hour of his death he would scarcely have finished classifying even all the memories of his childhood. (Borges 1998, 135–136)

Funes's memory repeats the past; it is sequential; in this way it is like the memory of Luria's mnemonist. He has no random access to different parts of his youth, though he tries to create the same by classifying and enumerating his experiences. This is a fractal memory—each act of remembering calls up worlds of experience, and each world calls up new acts as complex as the first. Operating socially, this non-discriminatory memory is often a political tool; Baudrillard (1995) writes that the deluge of information about the Gulf War was "to produce consensus by flat encephalogram" (68). At this end of the spectrum, we get total individuality: there is no such thing as a generalized bin in which to store selected past data, with the only possible redemptive act being classification.

Across this span from no active recall to hyperawareness there is a dazzling array of memory practices that we engage in on a daily basis; there are few censuses of these practices. What is really interesting is not so much the individual practices and how they articulate a given set of memory technologies. Rather, it is how sets of memory practices get articulated into memory regimes, which articulate technologies and practices into relatively historically constant sets of memory practices that permit both the creation of a continuous, useful past and the transmission sub rosa of information, stories, and practices from our wild, discontinuous, ever-changing past.

This possible object of interest (and obscure object of my desire), memory practices, extends in space into a unit I will call the archive and into time in units I will call the epochs of memory.

The Catalog of Traces: The Archive

Just What Is the Archive? The Landlord tells us that time is the money of science. It is indeed one of the coins. To carry on philosophical and scientific commerce, we have historically needed to agree on units of measurement of

time, space and process. Sometimes this takes the form of agreeing to very precise units of measurement. Mr Swivett, for example, is complaining about the establishment of the Gregorian calendar in the United Kingdom. To talk to each other (or a forteriori to work in parallel), two computers generally need to share a common clock; my own gets its time from the atomic clock server in Denver, Colorado, so that it can communicate effectively with some boxes in Santa Clara, California. Rather less precisely, geologists need to fix their epochs in order to be able to translate results from one corner of the earth to the other. Further, they have had, historically, to negotiate the kinds of packages that time comes bundled in: is time basically a formless line or does it have a shape, so that our planet was once young and thrusting but is now middle-aged and flat? When I swap stories with my colleagues at the university, I know that there are various well-accepted patterns to time; a current obsession among many of my kind is the ever-receding (never proven) golden age when universities were universities and there was no need to be constantly on the make as one produced theories. Although these seem like heterogeneous examples, I do not see in principle much difference between them: in order to carry out effective communication, we need to be able to share units and shapes of time.

The Landlord points to scientists being interested in events that occur at different points of the earth at the same instant. What he does not say—it is so obvious perhaps—is that a structure of record keeping will subtend this common time, rendering it useful through permitting the collocation of accounts of said events. Scientists make (im)mutable mobiles (Latour 1987). Let us refer to this structure of record keeping as the archive. "Arkhe," Derrida (1996) notes, "names at once the *commencement* and the *commandment*. This name apparently coordinates two principles in one: the principle according to nature or history, *there* where things *commence*—physical, historical or ontological principle—but also the principle according to the law, *there* where men and gods *command*, *there* where authority, social order are exercised, *in this place* from which order is given" (1). He names these two orders sequential and jussive; and he asserts that from this point on (from the inception of the *arkhe*), "a series of cleavages will incessantly divide every atom of our lexicon" (ibid.).

We will come back to beginnings at numerous points in this book, but let me point out at the start that in the beginning is the inaugural act: the moment from which memory is assumed to be perfect and time to begin. In his exploration of the history of writing, Clanchy (1979) tells us quite bluntly that the 'fixed limit' of the validity of written agreements of September 3, 1189: "which continued for the rest of the Middle Ages, marked the formal beginning of the era of artificial memory" (123). He has told a complex story in three times—first, it came to be recognized in England that written documents could be

trusted as well as printed ones; second, it came to recognized that one had not only to generate documents but also to store them in an archive; and third, it was seen that techniques of reference access to the library were needed in order to render them useful. For there was, he points out, no great reason to think that the written record should be preferred over the memory of trusted witnesses. What we would call forgeries could be conceived of as documents written to justify the ways of God to men (ibid., 148). Patrick Geary, telling a similar story over a different time period in France, argues that what happens with the development of a written memory was the supplanting of the role of women as memory keepers by men in monasteries. He argues for a similar inaugural act—the keeping of written memories was part of a move to consolidate new power relations by partly by creating false continuities and discontinuities with the past: "Arnold of St. Emmeram compared the process of sorting through the past to the process of clearing the arable, cutting down groves once sacred to the gods so that the land could be made useful for the present. This same pruning was going on in archives across the continent. Both he and Paul of St. Père de Chartres emphasized that not everything was to be preserved, only that which was useful" (Geary 1994, 114). Geary points out that future generations of historians have been held to the documents produced by this inaugural act of winnowing and fashioning, and so have tended to see the first millennium as a more radical break with the past than it probably was.

Each major change of storage medium over the past several centuries has engendered proclamation of similar inaugural acts. As we will see in chapter 1, Charles Babbage (1837) proclaimed that until the invention of printing, "the mass of mankind were in many respects almost the creatures of instinct" (59). Now, the great were encouraged to write, knowing that "they may accelerate the approaching dawn of that day which shall pour a flood of light over the darkened intellects of their thankless countrymen," seeking "that higher homage, alike independent of space and time, which their memory shall for ever receive from the good and the gifted of all countries and all ages" (ibid., 54) . For him, this marked the true commencement of our species. There are more than enough kinds of time here to keep the Landlord happy. There is the inauguration, which we today would put at 1453, of the era of intelligence for the mass of mankind. There is acceleration (things moving fast) and timelessness (homage being outside of space and time). In print mediated communication, this latter timelessness has often been seen as a central feature—marked, for example, by Landor's imaginary conversations (1824), which juxtaposed quotes from the great and wordy in such a way as to form fluent conversations across time and space.

We are perhaps not quite at the point of witnessing the inaugural act for the archive of computer-mediated communication, but its prophets are many. One relatively sober form comes from Avi Silberschatz and Jeff Ullman (1994): "There is now effectively one worldwide telephone system and one worldwide computer network. Visionaries in the field of computer networks speak of a single world-wide file system. Likewise, we should now begin to contemplate the existence of a single, worldwide database system from which users can obtain information on any topic covered by data made available by purveyors, and on which business can be transacted in a uniform way" (929). Computer scientists have frequently announced the dawning of a new age. In chapter 2, I explore Auger's claim (1960) that "now, after the age of materials and stuff, after the age of energy, we have begun to live the age of form" (ii). The old age, he argued, was one of diachrony and materialism: it gave us the historicist visions of Darwin and Marx. This age, he argued, is that of synchrony and form. When such an epistemic break is operated, the knowledge of the previous age becomes irrelevant; when the break is constituted by the move from diachrony to synchrony, the past is doubly deleted. There are many analogous inaugural acts for perfect memory systems woven into the fabric of our history. Lavoisier's chemistry textbook inaugurates the modern era of chemistry by forging discontinuities with past chemistry (changing the names of substances to remove relationships with alchemy; not mentioning continuities with previous work (Bensaude-Vincent 1989)). Lyell's *Principles of Geology* (1830–1833) does much the same—attaching a catastrophic time (schools of thought erupting onto the landscape but then going nowhere) to prior geology and a uniformitarian time to his own. The rhetoric goes that there is nothing worth remembering from chemistry or geology beyond these inaugural acts; but that after these acts each chemical or geological contribution will be remembered time out of mind.

For Derrida, the archive is not only sequential back to an origin, it is also jussive. It tells us what we can and cannot say: "The archive is first the law of what can be said, the system that governs the appearance of statements as unique events" (Foucault 1982, 129). My reading of these claims is not particularly Derridean or Foucaultian. The jussive nature of the archive comes down to the question of what can and cannot be remembered. The archive, by remembering all and only a certain set of facts/discoveries/observations, consistently and actively engages in the forgetting of other sets. This exclusionary principle is, I argue, the source of the archive's jussive power.

Three examples indicate the nature of my claim. In an article called "Setting Limits to Culture," Ian Hunter argues that the academic field of cultural studies has tended to fall into an aesthico-ethical reading of culture, even when

it was avowedly materialist. He notes that administrative change of the type carried out by Kay-Shuttleworth in the mid-nineteenth century (he was a leading advocate of universal education) tends to get written out of the cultural histories—even though his work had a lot more to do with the founding of the state, say, than the arguments held by political economists. Hunter (1988) asks: "Why then are we predisposed to ascribe thinkers like Engels and his more famous partner—or, for that matter, prophets of culture like William Morris or Matthew Arnold—central roles in the process of cultural development, and to consign administrative intellectuals like Kay-Shuttleworth to the relative obscurity of educational history?" (105). His response is that on the whole, academic attempts to look at the forging of organizations and the framing of cultural attributes are carried out "in the shadow of a single general process of contradiction, mediation and overcoming at whose end lies the 'fully developed' human being" (ibid., 106). Putting this in a completely different way, the memory of infrastructural change is not held overtly—if it is held at all, it is held in the most abstract forms furthest away from it (in the form of a memory of intellectual manifestoes epiphenomenal to the infrastructural change).

Mary Douglas describes the consistent institutional forgetting by the discipline of psychology of a number of independent discoveries of the social or collective nature of memory. Following Donald Campbell, she asserts that "it is professionally impossible in psychology to establish the notion that institutional constraints can be beneficial to the individual. The notion can be scouted, but it cannot enter the memorable corpus of facts" (Douglas 1986, 83). She goes on to note that, ironically but naturally, Campbell forgot his own insight and turned to biological determinants. Douglas claims that this eminent forgettability is due to the discovery not fitting in with the institutional commitment to individualistic methodologies—in other words, there was no place for the facts to be pigeonholed.

Finally, Yrjo Engestrom (1990) points to the difficulty that ethnography has in examining the concept of memory: since in general ethnographies deal in very thin time slices, but memory is accreted over months, years, generations; equally, ecological studies have often been limited by the career span of the ecologist, who finds it difficult to further a career with a one-hundred-year experiment, say. Not so much "man" as the measure of all things but our careers. The set of stories that we can tell about the past strings together facts and fancies that we can justify collecting in the present. The gaps are wide—as we will see in chapter 3, the set of stories we can tell about life and its history are massively weighted by the difficulty of getting grants to study parasites and viruses. Indeed, one of the chief problems in relating political economy to

scientific thought is that we hold our knowledge of the two in such impermeable containers—both in terms of data bins and people.

Hunter and Douglas point to a somewhat idealized feature of the jussive nature of the archive: the fact that what ought to be remembered is all and only that which fits in with the worldview legitimated by the inaugural act. Typically, Engestrom is somewhat more mundane; he tells us how this forgetting or overlooking can take place in practice. He notes that the archive contains a set of methodological rules for the accretion of facts and theories, and that certain kinds of facts and theories just cannot fit. The edict (thou shalt not write about social memory) is translated into a fact about the world (there is no way in which such and such a kind of data can be gathered). The archive's jussive force, then, operates through being invisibly exclusionary. The invisibility is an important feature here: the archive presents itself as being the set of all possible statements, rather than the law of what can be said.

But as I write this, I am aware of the hypostatization that is going on here. There is of course no single archive; we as a society operate multiple sets, far more heterogeneous than functionalists like Douglas could ever see from behind the walls of their archive. The motivation for the singular designation of the archive is twofold. I do want to talk about it in the singular, first, because I am trying to describe features common over the set of archives that we construct. And I do believe (though this remains to be shown) that there are sets of dependencies between archives that lead to regularities among the exclusions (and commonalities among the inaugural acts). This is a degree zero of the archive. Patrick Tort's study (1989) of the rise of genetic classification systems in the nineteenth century demonstrates how there has been a filiation between archival principals operating across a wide range of fields; he traces links between the fields of the classification of writing, linguistic typologies, race classifications, and criminal physiognomy, for example. A second motivation is that this locution points to the fact that memory can be highly diffuse and so it can be useful to think in terms of a generalized archive. It is only in pathological cases that the memory of how to perform a given organizational task is fully held in one person's head, in one computer or filing system, or even fully within that organization. Organizations delegate memory tasks to the environment. I delegate to my tax accountant the memory of my previous years' tax records; to my employer the tasks of remembering exactly what my income has been and of sending me an appropriate form; to my filing system a set of possible deductions; to my head a rough idea of how much I can afford to claim on various dubious items (working out what my notional budget with the Internal Revenue Service is); to a tax guide for college

professors a list of esoteric deductions that I should consider. This highly diffuse, technologically mediated memory is the stuff of memory practices.

The Act of Remembering So one would imagine that one of the first things to do in this singular archive is to stock things in memory. Indeed, the fact that they are being stored in memory is absolutely no indication that they will ever be recalled from memory. Clanchy, we have seen, made this point about medieval archival practices. However we operate much the same relative autonomy between the act of remembering and the act of recall ourselves in daily life. Thus Serge Tisseron (1996) has written eloquently about the act of taking a photograph. We often see this as a memory act. Looking at it this way alone, Tisseron writes, does no justice to the countless thousands of undeveloped films there are in the world, or the similarly numberless set of developed photos that get jammed into a drawer or tossed into a box without ever being looked at again. Rather than see this as a failed memory act, he suggests that we devote more attention to what happens when we record something for the archive. What happens, he says, is that we frame the present moment through the act of consigning it to another medium for storage. We compose a picture that expresses something about the way we are. The act of taking a photograph is an act of conceptualizing the present: this is an important moment; this is how I see my brother; this is my friend. The act of remembering frames the present in a particular way: it is a tool with which to think.

Much archival practice involves an isolated act of recording. I share the academic passion for photocopying and filing away articles, which I have no real intention of ever reading. I filter listserv discussions into huge email files that I imagine I will get to some day, but whose usefulness times out well before I ever do. I take notes at meetings and at lectures, knowing full well that I'll probably just throw them away afterward. Am I an archival misfit, a broken record keeper? I think not (though I'll have to check my notes). This litany can be repeated again and again for collective memory practices—though it rarely finds itself in the official literature of any particular archive. John Gillis (1994) writes that we have as a society reached a frenetic pitch with our multiplied acts of remembering: "Every attic is an archive, every living room a museum. Never before has so much been recorded, collected; and never before has remembering been so compulsive" (14).

Doctors incessantly take medical histories when they greet patients, refusing to accept previous histories from other doctors or from themselves: the act of taking the history does a great deal of communicative work in the present; the notes are frequently incidental. Generations of data have been lost with changes of information technology. The John Rylands library at the

University of Manchester in England houses, for example, a collection from the Jodrell Bank radio telescope of basically unreadable printouts of data from early computers. We collect vast amounts of biodiversity information about the planet (terabytes per day; from satellites, ground observations, aerial photography) that are dutifully archived but never actually analyzed—there are not enough people on earth or techniques to look at it all. Al Gore memorably referred to this as data rotting in an information silo. These collective cases, as in the case of the individual photographer, constitute a way of framing the present. They often indicate a drive to render the world memorable and thus governable (Foucault 1991)—a way of acting on the present rather than recalling the past. The League of Nations deliberately archived inaccurate data in the 1920s while in the process of setting up a procedure for keeping mortality and morbidity data across the world. The early record keeping constituted a form of disciplining doctors and citizens to the need for this data to be systematically collected. The act of rendering memorable does not mean that at any stage it will be remembered.

The Scope of the Archive In a working archive, facts are among the last things that are actually stored—both for individual archives in the form of memories stored to meat and for social archives in the form of file folders, journals of record, and so forth.

In a notable experiment, psychologist Edouard Clarapède had a "masked and disguised individual" break into his lecture theater, spout some nonsense words, wave his arms about, and then head for the door. Two weeks later, students had a very fuzzy recall of what had transpired; Clarapède inferred that the spectacular and the isolated cannot easily be stored in memory—we are best at stocking the routine and the mundane. He concluded that the past "even of a simple event—is less a record than a sort of taxonomy. Not perceptions, but categorization of familiar types was the major function of the memory. Our testimony depends much less on our memory, than on the mental image that we possess of a type or a class in which we arrange facts" (Matsuda 1996, 109; cf. pp. 95–98 on Bergson).

Similarly, Daniel Schachter (1996, 103–104) describes experiments to determine recall of items on a list—a generic category like "sweet" might not be on the list containing "chocolate, sugar, good, taste, tooth and bitter," but it will be remembered as being a member. The only people who score well on excluding it are amnesiacs!

Transitioning to the public sphere, the classificatory dimension of memory can be seen clearly in the memory theater of Guido Camillo described by Frances Yates (1966). The mnemonic device that Camillo used is the

partitioning of all possible events into the rows and tiers of a notional theater, with mythological, Christian, and astrological registers vying together in a synthetic classificatory rage. The effect is a verbal version of a yantra, wherein architectural, Buddhist, and mythical registers imploded to hold massive amounts of knowledge in a single painting.

James Fentress and Chris Wickham (1992), in a work reminiscent of Frances Yates's, argue that artificial memory systems waned after Descartes: "Instead of a search for the perfectly proportioned image containing the 'soul' of the knowledge to be remembered, the emphasis was on the discovery of the right logical category. The memory of this system of logical categories and scientific causes would exempt the individual from the necessity of remembering everything in detail. . . . The problem of memorizing the world, characteristic of the sixteenth century, evolved into the problem of classifying it scientifically" (13).

A. J. Cain (1958) demonstrates that Linnaeus's binomial classification system took the form it did (specifically the number of genera; Linnaeus argued that botanists should be able to recall the names of all genera) in order to be easily memorable. He did not believe that botanists could remember all species names. However, some of the earliest incunabula were field guides for botanists—and one can speculate that this classificatory turn in the seventeenth and eighteenth centuries was directly linked to the expansion of artificial memory systems with the rise of the book.

One of the main jobs that paper archives do is to consolidate a classification system that makes it possible to forget the particular. Auguste Comte ([1830–1845] 1975) speaks of this directly in his *Cours de philosophie positive*, where he states that in this current positive age, we no longer need to remember precisely the turns in the trail that led to a specific scientific discovery—any facts can be unambiguously classified into his unchanging, complete schema, and so the personal details can drop away in any account one might wish to concoct. Indeed, he argues, they *must* fall away for else there is too much drain on our memory faculties: "The constant tendency of the human spirit, as regards the exposition of knowledge, is therefore to progressively substitute the dogmatic order, which alone can suity the perfected state of our intelligence, for the historical order. . . . It would be certainly impossible to reach the desired end, if one wanted to make each individual spirit submit to passing successively through the intermediate stages which the collective genius of the human species necessarily passed through (ibid., 65). We are not in general able to remember complete stories about the past. There is an overwhelming amount of evidence both individual and social that this is not what we do well. What we do well is to disaggregate a fact about the past

into a number of standard elements, and then set in train a procedure for reassembling the specific out of the general. This sets in motion a system of memory recall that is able at any given moment to create a working version of the past.

What is stored in the archive is not facts, but disaggregated classifications that can at will be reassembled to take the form of facts about the world. (We will look later at processes of commemoration and memorialization, which are special cases that do seek to save the particular.)

The Place of the Archive In a wonderful passage in his *Principles of Geology*, Charles Lyell discusses the earth as an archive commissioner. He was working from the position that there was no sign of the origin of the earth, or any portent of its end: what we have access to is a set of records in the landscape that leave the impression of massive upheaval and discontinuity in the past. This was strongly at odds with his picture of the earth as being subject now to the same forces as ever—with the appearance of massive change being wrought by a vast increase in the amount of time afforded the geologist to account for the face of the earth. The gap between appearance and reality was the record-keeping process:

> Let the mortality of the population of a large country represent the successive extinction of species, and the births of new individuals the introduction of new species. While these fluctuations are gradually taking place everywhere, suppose commissioners to be appointed to visit each province of the country in succession, taking an exact account of the number, names, and individual peculiarities of all the inhabitants, and leaving in each district a register containing a record of this information. If, after the completion of one census, another is immediately made after the same plan, and then another, there will, at last, be a series of statistical documents in each province. . . . the commissioners are supposed to visit the different provinces in rotation, whereas the commemorating process by which organic remains become fossilized, although they are always shifting from one area to another, are yet very irregular in their movements [so that] . . . the want of continuity in the series may become indefinitely great. (Lyell 1830–1833, 3:31–32)

This passage prefigures a major theme of this book: the tools that we have to think about the past with are the tools of our own archive—so that we generally project onto nature our modes of organizing our own affairs (just as we tend to understand the brain in terms of the dominant infrastructural technology of the day—from nineteenth-century hydraulics in Freud to the telephone switchboard in the 1920s to network infrastructure today). However, we will not dwell on that for the time being. Rather, let us look at what this text says about record keeping.

First and foremost, Lyell is saying that the earth itself is a sort of record keeper—perhaps not a very good one, but a record keeper nonetheless. Geologists today have expanded this record-keeping function enormously, seeing traces of the distance past (beyond revolutions in the earth's surface and even before the creation of the earth) in various isotope ratios. Our earth weaves its own history into its texture. Similarly, life itself writes its history into the earth. The very oxygen that we breathe has been freed through the metabolic processes of cyano-bacteria to enter the atmosphere. Massive hard sea floors have been created by the disaggregated exoskeletons of planktons; these floors have fostered the development of new forms of life. Without life, the earth would be an inhospitable place for life: with the positive feedback loop in place, it has become more and more livable for an increasingly complex set of organisms. Inversely, without the earth as it is, life might well be simpler; the current relative peak of biodiversity (abstracting away anthropogenic extinction) is sometimes argued to be a feature of the more complex geology of the shattered supercontinent Pangea (Huggett 1997, 299). The lesson here is that, with the introduction of life, the traces that we leave of the past are neither other from us nor passive: they render life more livable.

This brings us to the parable of the ants on the beach, adumbrated by Simon and commented on by Ed Hutchins. Simon's original story runs that if we look at ants moving on a beach, we might impute their complex trajectories to internal programming, rather than being a fact about the beach. Hutchins (1995) invites us to go outside of the normal time constraints of the psychologist (shades of the exclusionary principle) and look at the beach over a several-month period:

> Generations of ants comb the beach. They leave behind them short-lived chemical trails, and where they go they inadvertently move grains of sand as they pass. Over months, paths to likely food sources develop as they are visited again and again by ants following first the short-lived chemical trails of their fellows and later the longer-lived roads produced by a history of heavy ant traffic. After months of watching, we decide to follow a particular ant on an outing. We may be impressed by how cleverly it visits every high-likelihood food location. This ant seems to work so much more efficiently than did its ancestors of weeks ago. Is this a smart ant? Is it perhaps smarter than its ancestors? No, it is just the same dumb sort of ant, reacting to its environment in the same ways its ancestors did. But the environment is not the same. (169)

This seems to me a good reading; it evokes the generalization that one of the things that all life does is to transform its environment by leaving memory traces in it, thereby increasing its chances for success. Further, Hutchins suggests, a snapshot view of this complex will have a given organism reacting

relatively intelligently against a passive backdrop, whereas the complex {environment + entity}, mediated by archival practice, is in fact the seat of intelligence. Bruno Latour (1996) has playfully suggested that a difference between people and animals is that the former accrete memories from the past in technology: this is how he distinguishes between the perpetual reassertion of rank among baboons and the more placid acceptance of a given social order among humans. To the contrary, it is a characteristic of life itself to leverage its work practices through engineering its archive.

Let us move from the ridiculous to the mundane. Maurice Halbwachs (1968, 52) put it beautifully: "most groups . . . engrave their form in some way upon the soil and retrieve their collective remembrances within the spatial framework thus defined" (Halbwachs 1968). James Walsh and Gerardo Ungson (1991, 65–66) spoke of "ecology," or physical design, being one of five "storage bins" for organizational memory—the other four being individuals, culture, transformations (procedures), and structures (roles). A few examples of such engraving will help. Imagine you are alone in a forest—take the forêt de Fontainebleau outside of Paris. You want to go on a walk through the wilderness. You could get a map, and rely on the paper archive to provide your trail through the area. On the other hand, you might equally well choose a color (yellow for the easy walks, and black for the difficult ones, where you have to scramble) and follow the ribbons attached to trees and the streaks painted on rocks full circle. And if a few of the ribbons or streaks are missing, you just follow the track of the footprints (you would be wise to do so where they indicate that the majority of the people have gone off the trail for a distance, possibly to avoid an obstacle). Simon Schama (1995, 546–560) writes at length about this reworking of the Fontainebleau wilds as the first set of guided walks in Europe, though of course from Hansel and Gretel on into historical time we have reworked our natural landscape to leave a memory trace. We often don't think of such trails in memory terms, because it is not our own personal memory that is being engraved—it is the collective memory of our culture. We operate such changes a fortiori in the built environment. If you visit a Catholic church, you don't have to remember the order of the Stations of the Cross. They are laid out for you in a standard fashion. Our reorderings can be evanescent. I constantly litter my morning path with objects that I want to remember to take to work—books to go to work in a pile next to the bathroom; clothes for dry cleaning on the hood of my car; things I really must do today on my computer keyboard. The generic trick I am using here is putting matter out of place as a form of aide-mémoire. (I have given here a trio of somewhat functional examples: the memory that we hold in the built environment is by no means necessarily useful memory—as

indicated by the well-known saga of the carriages on Roman roads making ruts of a certain size that propagate through to the nineteenth century along with axle design, since a nonstandard axle will always be straddling ruts. Then onto train tracks, since that is the axle size that smiths were used to building, and so forth).

On this wide reading of the archive, I am folding distributed, diffuse archival practice into the sets of specialized archival technologies: the list, the file folder, the computer database, and so forth. These latter constitute one small subset of an extremely large set of memory practices that we engage in from day to day, from century to century.

Why All This Folding? So I have partially removed the act of remembering from the telos of recall and folded it into a reading of ways of being in the present; I have partially removed the operation of the archive from the telos of the storage of useful facts (the scope of the archive); and I have partially removed archival practice from any set of specialized storage technologies (the place of the archive). In each case, I have folded the archive into our sets of actions in the present and in the built and shaped environment. Taken together, these three work to decenter analysis of the archive from the rather terse *Oxford English Dictionary* definition: "A place in which public records or other important historic documents are kept." The central reason for this decentering has been to suggest that if we want to look at memory practices, we should not look at cases of the good or bad recall of facts stored in specialized media (brains, files, or disks). Recall is frequently irrelevant; when it is, the facts of the matter are frequently irrelevant; and even when we have recall of facts as the goal, specialized media are frequently beside the point. If we want to understand memory practices in the sciences or in other spheres, I am suggesting, then we need to look elsewhere. My goal in this book is to begin to trace some delineations of this elsewhere.

It is clear from this folding that a lot of our memory practices are about the present: we should not be looking for them in dusty archives. Consider the first. This generalizes to the observation that classification systems come into being at the site of a memory trace (a play on Freud's remark, developed by Benjamin, that "consciousness comes into being at the site of a memory trace" and thus "becoming conscious and leaving behind a memory trace are processes incompatible with each other within one and the same system" (Benjamin and Arendt 1986)). One way to put it would be to say that we classify in order to be able to forget: we impose a classification in the present at the site of a fact that we would otherwise have to remember. With the grand imperial bureaucracies that developed in the nineteenth century, innumerable

ways were developed of classifying people into sets so that rather than having to "remember" that such and such a person was, say, a criminal, one could reconstruct the fact at will from their classificatory pigeonhole, as offered by criminal physiognomy or phrenology, for example (Tort 1989).

Patrick Geddes, writing at the height of Victorian certainty, provides a typical expression of this imperial drive. He broke the world of knowledge down into Sciences (not historical or statistical), with the sole member being Logic; Sciences (statistical but not historical), namely, Chemistry, Physics, and Mathematics; and Historical and Statistical, which includes Ethics, Sociology, Psychology, Biology, Geology, and Astronomy. The territory of a given society—a fraction of the scheme—would be broken down as follows:

A. Territory of given society
Quantity at given time.
Persistent since last unit time.
Added since last unit time
By geologic agency (upheaval, deposition, etc)
By social agency (discovery, conquest, reclamation, purchase, etc.).

II. Quality at given time.
Unused.
Used.
Unspecialized (for such and such functions).
Specialized (for such and such functions).

Decrease since last unit time.
By geologic agency
By social agency. (Geddes 1880–1882, 305)

Many such classification systems were produced during the nineteenth century. Geddes gives the following justification:

The scheme is scientific throughout—in accordance with the known truths of physical and biological science—is capable on the one hand of complete specialization by the aid of minor tables, into the most trivial details of common life, and on the other, or generalization into a colossal balance-sheet. Its systematic and generalized character appears clearly from a survey of the whole sheet of tables. It will be observed in the first place that the successive sets of tables, three each, may be read in horizontal rows, thus—Territory, Production, Organisms, Occupations, Partition, User, Result. Secondly, that these sets of tables are related to each other: Organisms being treated on the same plan as Territory; the tables of Occupations being derived largely from those of Production, and the tables of Partition, User, and Result, being in such close relation to those of Occupations that the ruling of each of the latter is exactly copied in all the four lower series; while the third, and by far the most important general view is obtained by looking at the left hand and middle vertical series (at least as far down as Occupations inclusive, and in some respects all the way), as entries on the debtor side of the balance-sheet, and similarly at the right hand vertical series as entries on the

creditor side. Again, the scheme is universal in application—the tables will serve equally well for arranging our knowledge concerning any society—animal or human, civilized or savage: for savage and animal societies, some columns here and there of course simply remaining blank. (ibid., 310–311)

The move here is double. First, we will create a huge balance sheet, wherein outputs and inputs can be fully squared away, between the natural and social worlds and within both. Second, with the balance sheet in place, we will be able to read off laws about nature and about societies—the more complete the classification scheme, the less we will need to know about a particular case, the less we will need to hold in memory.[4] (The balance sheet was also the trick that allowed Lyell to get beyond the historicism of his uniformitarian vision into a set of general laws.)

Whereas the first folding encourages us ultimately to look to the relationship among classification, forgetting, and memory practices; the second encourages us to look at standardization, forgetting and memory practices. I introduced it earlier in terms of our shaping of the physical environment. Two central facts about such shaping—be it done by bacteria, ants, or people—are that it is socially negotiated and that it comes in standard packages. We can only draw off the wealth of archival practices we inscribe into the landscape efficiently to the extent that we share a set of conventions about their meaning—it is for this reason that Leroi-Gourhan (1965, 64) referred to the natural unit for memory as not the brain but the ethnic collective.

A significant part of the setup work for networked information infrastructures is putting into place a set of agreements, which should be remembered from that moment on—the jussive aspect of Derrida's archive. As the Landlord said: "The Philosophers need a Time, common to all, as Traders do a common Coinage" (Pynchon 1997, 192). Ontologies flow from these agreements. Thus, for example, there really is no single model of just how the Internet works and what should be done at the physical level and what should be left to programs. In an early edition of Tanenbaum's *Computer Networks*, a typical passage reads: "Although Section 1–3 is called 'Network Software' it is worth pointing out that the lower layers of a protocol hierarchy are frequently implemented in hardware or firmware. Nevertheless, complex protocol algorithms are involved, even if they are embedded (in whole or in part) in hardware" (1996, 20). "Protocols" is a key word here. The earliest use of the word, according to the *Oxford English Dictionary*, is in 1541 and its central

4. And this classification can have formative dimension. See the classifications of science by Comte and Ampere and the science of Zetetics developed by Tykociner in the twentieth century: a hole in the balance sheet means knowledge is missing.

meaning is as follows: "The original note or minute of a transaction, negotiation, agreement or the like, drawn up by a recognized public official, notary, etc. and duly attested, which forms the legal authority for any subsequent deed, agreement, or the like based on it." Internet protocols carry this meaning; they are records of a transaction between negotiating bodies at the same time as they are formal procedures for communication between parts of a network. Any given standard sits along a continuum. It can be inscribed into the world in such a way that one's affordances for action are constrained to its observation; it can operate as a verbal commitment; or it can be "hardwired" into institutional or informational technologies. But whatever the form, it needs to be shared.

Standards are not only jussive—by virtue of their inaugural act, they are also sequential. When a radically new standard is introduced, there is a new starting point for history; from now on, everyone who adopts the new standard will be compatible with each other adopter. Within the information world, there is generally some attempt to make new standards backward-compatible (so that, say, your new version of Microsoft Word can read documents created by previous versions). However, the general point remains that the new standard word processor marks a point around which new applications can be developed, new training courses be designed, and so forth. The power of thinking about standards as memory practices like any other lies not so much in what it tells us about standards per se, but in what it tells us about memory. It is clearly only through a very artificial set of divides that we can separate analytically the domains of classification and standardization from the field of memory practices. If we accept the divides, then we cannot hope to understand memory practices of our species—how we configure the world and ourselves to maintain an active memory of the past. If we reject them, then we can start to significantly widen our understanding of the nature and workings of memory. As a general rule, memory operates in the present and socially through a variety of "dispositifs techniques" whose principal tools are classification and standardization. The recording of individual facts about the past in an individual brain is not foreign to this process; it is, however, but a small part. Equally, the recording of facts garnered in laboratory experiments constitutes but a tiny fraction of memory practices in the sciences.

Which brings us back to the frenzy of memory practices that motivated the first folding. We should not think of the archive as an organized set of data to which we desire random access. This puts too much emphasis on the noun, on the site. Rather, one of our chief ways of dealing with the world is to remember things. The act of remembering sometimes coalesces into more or

less complete classifications, more or less rigorous standards. But more generally, it is one of our chief ways of being in the world as effective creatures: it is a way of framing the present; a mode of acting. We exude, sketch, form, design memory traces of all kinds; these work together in complex ecologies. Our task is not to track the site of memory (to the Ark), but to describe the circulation of memories through the multifarious media we have developed.

The Epochs of Memory

In 1832 Eugène Sue published a novel about Ahasuerus, the wandering Jew whose refusal to offer succor to Jesus on the road to his crucifixion translated into the doom of walking the face of the earth, unable to stop, unable to die. Ahasuerus had taken it upon himself to save his family: he tried to arrange for a huge fortune to go to his final descendants in industrializing Paris (Sue 1844). Unfortunately, the Jesuits had known about this money for some two hundred years, and they had been tracking these same descendants, trying to either ensnare them in the church or otherwise neutralize their presence. Three kinds of memory are pitted against one another in the novel: the recollection by Ahasuerus of his own past; the voracious record keeping of the Jesuits, described in loving detail; and Christ's memory of the original crime (perhaps held by St. Peter the record keeper and finally resolved in the death of his descendants). Sue's story weaves its way through these three memory registers, exploring in beautiful detail the features and fragrances of each.

Ahasuerus's goal is sweet oblivion—a rest from his tireless, endless state of consciousness and the memories that assail him. When justice has been done—when his line becomes extinct through the cruelty of the Jesuits—then Christ releases him (betimes) from his curse. The theme is a common one; we have seen in the West the development of a trope that when justice has been done the aborigines in Australia or the Native Americans and African Americans in the United States, through an act of apology, then the past can be laid to rest. Past iniquities will be forgotten by most people and institutions: when justice has been done in the present, then their memorialization will be complete (and they can be pushed out of consciousness). Is it possible, Yosef Yerushalmi (1996) asks, referring to the trial in France of Klaus Barbie for war crimes, "that the antonym of 'forgetting' is not 'remembering,' but justice?" (117).

At issue here is the periodization of memory. The Christian church has created a very long present, in which we are held responsible for the sins of Adam and Eve: the inaugural act of eating from the tree of knowledge has affected all subsequent generations. Other practices are more forgiving, though the line of demarcation is generally hard to draw. In the case of a nation, what needs to

be remembered can stretch for hundreds of years (e.g., in Ireland, where the politics of the sixteenth century live today) or can be legislated to be as short as the previous week. David Cressey (1994) writes that "during the 1670s there was a memorial calendar for the Tories and a competing regime for the Whigs, each with its high cultural and popular dimensions. At the same time there were counter-memories, suppressed memories, even legislated Acts of Oblivion, to extinguish the deeds of the revolution" (69). And certainly nowadays most English hold no memory of their revolution. Matt Matsuda (1996) cites French historian Renan's observation that "forgetting, and I would even say historical error, are essential factors in the creation of a nation; in this, the progress of historical studies is often a danger for *nationality.* Historical investigation, in effect, brings to light facts of violence which took place at the origin of all political formations, even those whose consequences were the most beneficial. Unity is always brutally created" (206). Scientific disciplines range from considering any paper that has already been published as significantly out of date (high-energy physics, where preprints are the coin of the natural philosopher) to requiring the month and day of publications from the eighteenth century in order to determine naming priority (systematics).

We have seen earlier that archives begin with inaugural acts that wipe out a past and define a period "from now on" as the present. It is possible to distinguish a set of memory epochs emerging from new media of record keeping. Jacques LeGoff (1992), following André Leroi-Gourhan, refers to five epochs: "The history of collective memory can be divided into five periods: oral transmission, written transmission with tables or indices, simple file cards, mechanical writing, and electronic sequencing" (54). The boundaries between the epochs are rarely clear—Homer's epics were consigned to writing and then print, Ugaritic texts have made it to the World Wide Web, and the canon of classical Greek literature is on CD-ROM (in the form of the *Thesaurus Linguae Graecae*). These remain real boundaries, however, in two ways. First, every act of migration across media is a conscious act in the present: unless there is a contemporary constituency for a book, for example, it will not find its way onto the Web. Most never make it across—just as, in small, most government archives never make it across a new filing system. Second, the migration itself changes the document: a given rendering of *The Odyssey* could only become definitive with the new medium of print—it was highly "fluid"; a sprawling nineteenth-century novel can be read in new ways in electronic form, where we can create automatic concordances and character searches on the fly.

Each new medium imprints its own special flavor to the memories of that epoch. In *L'homme nu,* Lévi-Strauss (1971) contrasts the time of myths and the time of novels, attaching the former to the oral medium and the latter to the

printed word. In a myth, he argues, episodes can occur in almost any order in different versions of the same story; it is only with the novel that we get the fixed sequencing of linear time. Eisenstein (1979) goes so far as to forge a causal link between our conception of linear universal time (time moving onward along a continuum at the rate of one per second) and the rise of the printing press—with the sequential ordering of facts on a page itself opening our imagination to a new conception of time. The causal argument has to be refined, for Sohn-Rethel's attachment (1975) of absolute time to the creation of the commodity form is much more compelling; however, there certainly is an apposition between the printing press and the efflorescence of a new kind of temporal framework within which information could be readily stored and easily accessed. And it is certainly true that such a new temporal (or spatial) framework for documents of itself bears a significant degree of the ideological load. Thus Arthur Miller (1991), writing about sixteenth- and seventeenth-century temporal and spatial frameworks in Oaxac, Mexico, notes: "The colonial calendars inscribed a new political and economic significance on the Zapotec conception of temporality. Incorporation of European writing into the form of the ancient calendar perpetuated the concealing of sacred knowledge, while at the same time it undermined the ancient structures of authority. Similarly, the native map tradition was a response to the European secularization of land ownership, while it also tended to destroy land ownership's ancient sacred connotations" (143). Equally, there is an apposition between the new media for communicating goods and information of the nineteenth century—the railway and the telegraph—and the imposition of standard time reckoning across Britain and America (Chandler 1977): "philosophers," as the Landlord said, needed to be able to create a unified archive for a vast expanse of territory. With this new time, events can be sorted into archives operating with new temporal and spatial units: they can be processed very differently.

A further periodization of memory and memory practices can be generated from changing attitudes to the archive. It is generally accepted (though the details still require better elucidation) that there was a rise of historical consciousness in industrializing Europe in the early nineteenth century. By the middle of the century, Nietzsche (1957) was referring to this as a crisis: "I am trying to represent something of which the age is rightly proud—its historical culture—as a fault and a defect in our time, believing as I do that we are all suffering from a malignant historical fever and should at least recognize the fact" (4). Ever the iconoclast, Nietzsche is one of a small group of writers who have written paeans to the virtues of forgetting[5] (Yerushalmi 1988, 9).

5. We return to this theme later.

Two somewhat independent sources select the period 1870–1914 as being particularly significant in the recent history of memory practices. The first is constituted by historians such as Eric Hobsbawm and David Cannadine. Hobsbawm (1992) argues: "Once we are aware how commonly traditions are invented, it can easily be discovered that one period which saw them spring up with particular assiduity was in the thirty or forty years before the first world war. One hesitates to say *with greater assiduity* than at other times, since there is no way of making realistic quantitative comparisons. Nevertheless, the creation of traditions was enthusiastically practiced in numerous countries and for various purposes" (263).

Cannadine (1992), in a study of British monarchy and the invention of tradition between 1820 and 1977, points to "an efflorescence of 'invented' ritual and tradition in Wilhelmine Germany and the French Third Republic" (103) and to a renewed ceremonial and putatively traditional configuration of the British monarchy in the period between 1870 and 1914, a period when "in London, as in other great cities, monumental, commemorative statues proliferated" (128). This was also the period of the invention of the Mafia out of a mixture of whole cloth and puppet theater, and of its projection onto a distant past (Fentress and Wickham 1992, 173–199). This period can be characterized, then, as one of fervid creation in Western Europe of a particularistic past (marked by commemorative plaques, statues, rituals). It is also, argues Ian Hacking (1995), the period of the situation of "memoro-politics" at the heart of intellectual discourse: "Today, when we wish to have a moral dispute about spiritual matters, we democratically abjure subjective facts. We move to objective facts, science. The science is memory, a science crafted in my chosen span of time, 1874–1886" (220). Pointing to the political role of memory, Hacking questions its scientific certainty. Two figures who are greatly admired by Hacking are Freud and Proust. LeGoff (1992) accuses Freudian psychoanalysis of being part of "a vast anti-historical movement which tends to deny the importance of the past/present relation" (16)—this around the issue of Freud's concentration on perceptions of the past over what actually happened. Hacking makes a similar charge. Over this period, Proust's stunning, particularist memory continually replays the history of the aristocracy (from the name of the country to the name of the people); his Charlus both stands most on the ceremony of this history and is most vulnerable to an uncovering of his own personal, masochistic story (Proust 1989); Charlus chooses an aristocratic tradition to hide what he is doing in the present. The new memoro-politics uncovered by Hacking in the science of psychology takes the same form as the manipulation of tradition discussed by Hobsbawm.

This apposition of Hobsbawm and Hacking prompts a highly tentative generalization. There was, perhaps, something going on toward the turn of the twentieth century concerning the deliberate texturing of the past in order to work in the present. True representations of the past are irrelevant for both streams—the invented tradition is about the assertion of a current emergent political reality; for Freud, especially, the past may be lost but it needs to be reworked in order for the client to be able to live in the present. There are, of course, many invented traditions that one can point to, spanning the centuries. If the marking of the period from the 1870s holds, it is as one where memoropolitics took central stage in artistic and social scientific representations of the individual and in representations of the state.

It is, integrally, a period when massive new waves of information classification and standardization took place—international classifications were developed for diseases, work, criminal physiognomy, and so forth: facts could be split apart, sorted into pigeonholes, and reassembled in new ways. It is a direct outgrowth of this work at the turn of the twentieth century that we get the emergence of the database as a central cultural form. Lev Manovich (2001) puts it beautifully when he writes: "As a cultural form, database represents the world as a list of items and it refuses to order this list. In contrast, a narrative creates a cause-and-effect trajectory of seemingly unordered items (events). Therefore, database and narrative are natural enemies. Competing for the same territory of human culture, each claims an exclusive right to make meaning out of the world" (225). Manovich develops a syntagm/paradigm couple, where the syntagm represents a statement that is made, and the paradigm represents the set of possible statements. He argues that with the new technology, "database (the paradigm) is given material existence, while narrative (the syntagm) is dematerialized. Paradigm is privileged, syntagm is downplayed. Paradigm is real, syntagm is virtual" (ibid., 231). The observation obtains, but its inception should not be attached to the new computing technology. Rather, the current status of databases completes the movement begun in the nineteenth century of universalizing classification systems.

One can see Manovich's argument becoming true in fine in the development of database technology this century. The first commercially available computer databases were organized hierarchically. If you wanted to get to a particular piece of information, then you went to the overarching category and made a series of choices as this category broke down into groups, then subgroups, until you got to the specific piece of information that you required. This mode of traveling through a database was called "navigation." The next generation, network databases, followed the same logic. The user had to follow

one of a number of predefined pathways in order to get to the data—it was more ordered than a straight narrative archive but still pre-imposed a set of narrative structures on the data. The following generation, relational databases, began to break this mold. The underlying database structure is a set of relations or tables, each table having rows and columns. This matrix form allowed a new form of enquiry to be made: you no longer had to travel the preset pathways, you just had to declare what you wanted to know in a controlled language. Finally, object-oriented databases operate on the principle that you don't need to know either pathways or relationships beforehand: each data "object" carries its salient history with it, and pathways and relationships can be in principle reconfigured at will (Khoshafian 1993, 114–121). Frances Yates begins her *Art of Memory* (1966) with a contrast between the great geniuses of two different ages—Aquinas and Einstein. Aquinas was recognized a genius, she claims, because of his prodigious memory; Einstein because of his brilliant thinking. We can add a third term to this sequence, with the development of the human genome database. The canonical scientific act for our times (sequencing the genome) resonates with the social and technical turn to non-narrative memory described by Manovich.

I will give a name to the current epoch, the site of the memory practices explored in this book, by calling it the epoch of potential memory. To continue Manovich's trope, this is an epoch in which narrative remembering is typically a post hoc reconstruction from an ordered, classified set of facts that have been scattered over multiple physical data collections. The question is not what the state "knows" about a particular individual, say, but what it can know *should the need ever arise*. A good citizen of the modern state is a citizen who can be well counted—along numerous dimensions, on demand. We live in a regime of countability with a particular spirit of quantification. Foucault (1991) pointed out that this is one of the principles of governmentality: a modern state needs to conjure its citizens into such a form that they can be enumerated. The state may then decide what kind of public health measures to take, where to provide schooling, what kind of political representation should be afforded, and so forth. Uncountables in the West are our version of the untouchables in India: a caste that can never aspire to social wealth and worth. In order to be fully countable and thus remembered by the state, a person needs first to fit into well-defined classification systems. At the start of this epoch, the state would typically, where deemed necessary, gain information on its citizens through networks of spies and informers writing narrative reports; such information gathering continues but is swamped by the effort to pull people apart along multiple dimensions and reconfigure the information at will.

But that seems to be quite a jump, from the way in which databases work to the operation of the state. The jump is possible because our way of organizing information inside a machine is typically a meditation on and development of the way we organize it in the world. When the first object-oriented language, Simula, was invented, it was perceived as a way of modeling the way that things were actually done in the world. The claim today is still that you take a simple English-language description of system requirements and turn the nouns into objects and the verbs into operations, and you are up and running. Object oriented programming, by this claim, is the transparent language bar none. At the same time, and from the other end, numerous management theorists claim that now that we have object oriented programming, we can reconfigure the organization so that it matches the natural purity and form of the programming language. No longer do we need hierarchical modes of communication; we can organize according to teams with their own sets of interfaces with management, but where management does not need to know how any particular job is carried out by the team. Thus a programming language that operates as part of an organizational infrastructure can have potentially large effects on the nature of the organization, through the medium of organization theory. So object orientation is on the one hand a model of the world, and on the other hand the world is learning how to model itself according to object orientation. This kind of bootstrapping process is common when you deal with infrastructures. Generally, I would describe it as the programming language and organization theory converging on a particular instantiation of the organization in which object-oriented programming will furnish the natural, transparent language. This convergence is central to information infrastructures. We make an analytical error when we say that there is programming on the one side with its internal history, and organization theory on the other with its own dynamic. The programming language is very much part of the organizational history and vice versa. James Beniger (1986) made this kind of connection in his work. Following a robust tradition in cybernetics, he noted that in the late nineteenth century many things came together to make process control a key factor in management and technology.

Ours is certainly not the first society to hold memory primarily in nonsequential form—indeed, this is precisely the point that Lévi-Strauss made about myth; or that one could make about the memory devices of the Luba (Roberts et al. 1996) or about Tibetan yantras. However, I would argue that it is this turn, begun in the nineteenth century in the office and in government agencies, that takes us out of the age of the book. JoAnne Yates (1989) traces this transition beautifully in her work on late-nineteenth-century office technology. The earliest correspondence books, she notes, held painstaking

transcriptions (or, later, blotted copies) of outgoing letters in chronological sequence. The two great revolutions in office technology, she noted, were the manila folder and the hanging file drawer—these together permitted the rearranging of data into subject files. Later copying technology (notably the invention of carbon paper) allowed a single piece of information to be stored in multiple places. As this technological work was going on, she notes, there was also a withering away of the greetings and salutations in internal correspondence—so that the new genre of the office memorandum was created, which in turn gave rise to the genre of email. And at the same time, information that previously had been collected in narrative form (if at all) was now distributed into statistical tables (Chandler 1977).

We have seen, then, two characteristics of the current memory epoch: greatly increased centrality of the reworking of the past for the operation of the state (Hobsbawm and Hacking) and greatly increased technical facilities for such reworking with the development of database technology. We are getting to be very good at reconfiguring the past as a tool for exploring/supporting the present. The past that we are colonizing in order to do this work is not "wie es eigentlich gewesen ist." To the contrary, the canonical archival forms of the present tell the past as it should have been. Comte, I think, sets the tone for this whole period with his assertion that we cannot afford to keep in our own minds (and to pour into the minds of children) what actually happened in the history of science. There is now, he said, too much science out there for this to be feasible. Rather, what we should do is classify the sciences completely and tell stories about each science that show the logical steps that brought us to our current state of knowledge—a move that nowadays we would call "rational reconstruction." When the new political tradition (the changing of the guards; the Mafia) is created, it tells the story of a past that should have been, in order for current political conditions to be justified.

We return here to the aporia spelled out previously, but this time with an understanding that it is characteristic of memory practices in the current epoch across a wide range of activities: from science to politics to business.

Conclusion

Discussing the daily life of the Greek gods, Sissa and Détienne (1989) write that the mythographers conjured a divine existence in which "time does not pass, it is frozen and collected into an eternal present." For, they argue, any external influence from events, people and so forth would pose the gods as incomplete. And yet, they note, poets such as Hesiod had no difficulty imagining densely packed works and days for the gods. One of the founding myths

of scientific practice is that science is carried out in an eternal present, from which all external influence has been banished. For, it is said, if a cat walks by a machine designed to detect gravity waves, then the measurement is invalid (Collins 1985). And yet this present is an outcome of densely packed daily practice by scientists—a practice that has its chroniclers in the sociology of science.

The time that is the coin of the philosopher is, in Tanaka's words (2004), a time "synchronized" over many disciplines and practices. It is the outcome of a massive work of building organizations, classifying the world and its inhabitants, and integrating material from multiple domains. The resulting eternal present and linear chronology are imperfect products. The time of mitochondrial DNA has at times conflicted with that of evolutionary theory, the time of physics has clashed with the time of geology (Burchfield 1990). However, in a messy, sprawling, gargantuan sort of a way it is a towering achievement. An achievement that beetles over its own particular mnemonic deep. The memory practices that are the subject of this book require an analysis of the textures of this time and of that deep. These practices constitute a space out of which the former and the latter are generated in all their generality and idiosyncrasy.

This book constitutes an attempt to chart out that space. Chapter 1 deals with the nineteenth century and with synchronization. It demonstrates the mapping of both the social and the natural world into a single time package: located in the eternal present of the proximate future (social time) and deep reality (natural time). Through the temporal mapping, mediated by the metaphor and the materiality of information technology, a pure second nature was created that was fully archivable despite apparent discontinuity. Chapter 2 explores cybernetics in the mid-twentieth century. I uncover a different mapping of nature and second nature through the evacuation of memory—there is no particular past, only kinds of past. I argue that both cybernetics in the 1950s and geology in the 1830s packaged time in ways indexed by their information technology so as to permit a traffic between the social and the natural worlds. I foreshadow the argument that attributes these disparate disciplines and epochs share—an eternal present, an evacuated past, synchronization through temporal packaging—are features of the longue durée of knowledge in the West over the past few hundred years. Chapter 3 celebrates and excoriates the database as a central symbolic artifact of the past few centuries. I endeavor to show how the very material substrate of the archive can play a central role in our understanding of the past. Chapter 4 evokes the spaces, entities, and times that are excluded from the synchronization effort in the sciences of biodiversity today. The basic argument there is that this

mnemonic deep is a textured mnemonic deep; the hope is (following Michel Serres) that my contribution will be to open up other possible spaces and times for human enquiry. Chapter 5 asserts, as baldly as may be, that the stories we (the globalizing "we") tell about the past through our dizzying array of scientific practices are simultaneously a representation of our political economy through the prism of our information technology and a denial of that representation in an attempt to universalize as we globalize. A concluding chapter consigns this book to oblivion.