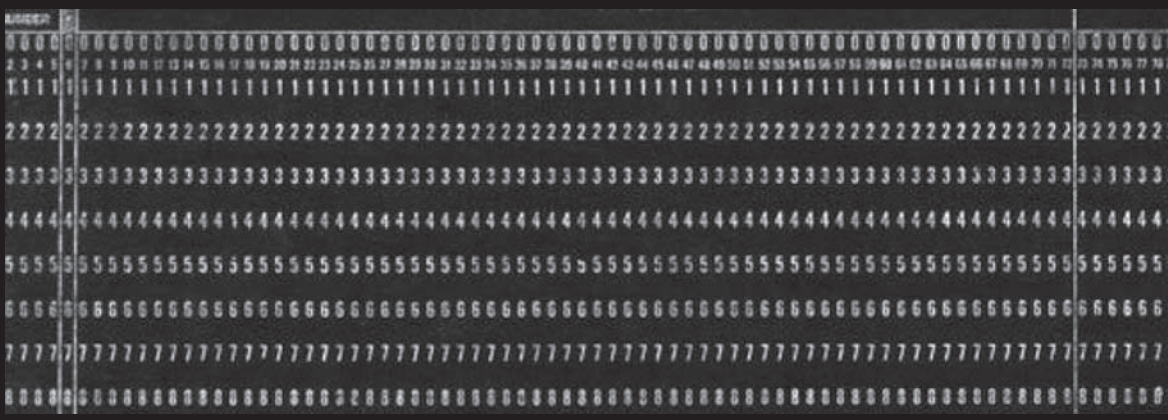
2008 DUKE UNIVERSITY PRESS DURHAM AND LONDON



© 2008 Duke University Press
Printed in the United States of America on acid-free paper ∞
Designed by C. H. Westmoreland
Typeset in Charis (an Open Source font) by Achorn International

Library of Congress Cataloging-in-Publication data and republication acknowledgments appear on the last printed pages of this book.

Licensed under the Creative Commons Attribution-NonCommercial-Share Alike License, available at http://creativecommons.org/licenses/by-nc-sa/3.0/ or by mail from Creative Commons, 559 Nathan Abbott Way, Stanford, Calif. 94305, U.S.A. "NonCommercial" as defined in this license specifically excludes any sale of this work or any portion thereof for money, even if sale does not result in a profit by the seller or if the sale is by a 501(c)(3) nonprofit or NGO.

Duke University Press gratefully acknowledges the support of HASTAC (Humanities, Arts, Science, and Technology Advanced Collaboratory), which provided funds to help support the electronic interface of this book.

Two Bits is accessible on the Web at twobits.net.

Introduction

Around 1998 Free Software emerged from a happily subterranean and obscure existence stretching back roughly twenty years. At the very pinnacle of the dotcom boom, Free Software suddenly populated the pages of mainstream business journals, entered the strategy and planning discussions of executives, confounded the radar of political leaders and regulators around the globe, and permeated the consciousness of a generation of technophile teenagers growing up in the 1990s wondering how people ever lived without e-mail. Free Software appeared to be something shocking, something that economic history suggested could never exist: a practice of creating software—good software—that was privately owned, but freely and publicly accessible. Free Software, as its ambiguous moniker suggests, is both free from constraints and free of charge. Such characteristics seem to violate economic logic and the principles of private ownership and individual autonomy, yet there are tens of

millions of people creating this software and hundreds of millions more using it. Why? Why now? And most important: how?

Free Software is a set of practices for the distributed collaborative creation of software source code that is then made openly and freely available through a clever, unconventional use of copyright law.[1] But it is much more: Free Software exemplifies a considerable reorientation of knowledge and power in contemporary society—a reorientation of power with respect to the creation, dissemination, and authorization of knowledge in the era of the Internet. This book is about the cultural significance of Free Software, and by *cultural* I mean much more than the exotic behavioral or sartorial traits of software programmers, fascinating though they be. By *culture*, I mean an ongoing experimental system, a space of modification and modulation, of figuring out and testing; culture is an experiment that is hard to keep an eye on, one that changes quickly and sometimes starkly. Culture as an experimental system crosses economies and governments, networked social spheres, and the infrastructure of knowledge and power within which our world functions today—or fails to. Free Software, as a cultural practice, weaves together a surprising range of places, objects, and people; it contains patterns, thresholds, and repetitions that are not simple or immediately obvious, either to the geeks who make Free Software or to those who want to understand it. It is my goal in this book to reveal some of those complex patterns and thresholds, both historically and anthropologically, and to explain not just what Free Software is but also how it has emerged in the recent past and will continue to change in the near future.[2]

The significance of Free Software extends far beyond the arcane and detailed technical practices of software programmers and "geeks" (as I refer to them herein). Since about 1998, the practices and ideas of Free Software have extended into new realms of life and creativity: from software to music and film to science, engineering, and education; from national politics of intellectual property to global debates about civil society; from UNIX to Mac OS X and Windows; from medical records and databases to international disease monitoring and synthetic biology; from Open Source to open access. Free Software is no longer only about software—it exemplifies a more general reorientation of power and knowledge.

The terms *Free Software* and *Open Source* don't quite capture the extent of this reorientation or their own cultural significance. They

refer, quite narrowly, to the practice of creating software—an activity many people consider to be quite far from their experience. However, creating Free Software is more than that: it includes a unique combination of more familiar practices that range from creating and policing intellectual property to arguing about the meaning of "openness" to organizing and coordinating people and machines across locales and time zones. Taken together, these practices make Free Software distinct, significant, and meaningful both to those who create it and to those who take the time to understand how it comes into being.

In order to analyze and illustrate the more general cultural significance of Free Software and its consequences, I introduce the concept of a "recursive public." A recursive public is *a public that is vitally concerned with the material and practical maintenance and modification of the technical, legal, practical, and conceptual means of its own existence as a public; it is a collective independent of other forms of constituted power and is capable of speaking to existing forms of power through the production of actually existing alternatives*. Free Software is one instance of this concept, both as it has emerged in the recent past and as it undergoes transformation and differentiation in the near future. There are other instances, including those that emerge from the practices of Free Software, such as Creative Commons, the Connexions project, and the Open Access movement in science. These latter instances may or may not be Free Software, or even "software" projects per se, but they are connected through the same practices, and what makes them significant is that they may also be "recursive publics" in the sense I explore in this book. Recursive publics, and publics generally, differ from interest groups, corporations, unions, professions, churches, and other forms of organization because of their focus on the radical technological modifiability of their own terms of existence. In any public there inevitably arises a moment when the question of how things are said, who controls the means of communication, or whether each and everyone is being properly heard becomes an issue. A legitimate public sphere is one that gives outsiders a way in: they may or may not be heard, but they do not have to appeal to any authority (inside or outside the organization) in order to have a voice.[3] Such publics are not inherently modifiable, but are made so—and maintained—through the practices of participants. It is possible for Free Software as we know it to cease to be public, or to become just one more settled

form of power, but my focus is on the recent past and near future of something that is (for the time being) public in a radical and novel way.

The concept of a recursive public is not meant to apply to any and every instance of a public—it is not a replacement for the concept of a "public sphere"—but is intended rather to give readers a specific and detailed sense of the non-obvious, but persistent threads that form the warp and weft of Free Software and to analyze similar and related projects that continue to emerge from it as novel and unprecedented forms of publicity and political action.

At first glance, the thread tying these projects together seems to be the Internet. And indeed, the history and cultural significance of Free Software has been intricately mixed up with that of the Internet over the last thirty years. The Internet is a unique platform—an environment or an infrastructure—for Free Software. But the Internet looks the way it does because of Free Software. Free Software and the Internet are related like figure and ground or like system and environment; neither are stable or unchanging in and of themselves, and there are a number of practical, technical, and historical places where the two are essentially indistinguishable. The Internet is not itself a recursive public, but it is something vitally important to that public, something about which such publics care deeply and act to preserve. Throughout this book, I will return to these three phenomena: the Internet, a heterogeneous and diverse, though singular, infrastructure of technologies and uses; Free Software, a very specific set of technical, legal, and social practices that now require the Internet; and recursive publics, an analytic concept intended to clarify the relation of the first two.

Both the Internet and Free Software are historically specific, that is, not just any old new media or information technology. But the Internet is many, many specific things to many, many specific people. As one reviewer of an early manuscript version of this book noted, "For most people, the Internet is porn, stock quotes, Al Jazeera clips of executions, Skype, seeing pictures of the grandkids, porn, never having to buy another encyclopedia, MySpace, e-mail, online housing listings, Amazon, Googling potential romantic interests, etc. etc." It is impossible to explain all of these things; the meaning and significance of the proliferation of digital pornography is a very different concern than that of the fall of the print encyclopedia

and the rise of Wikipedia. Yet certain underlying practices relate these diverse phenomena to one another and help explain why they have occurred at this time and in this technical, legal, and social context. By looking carefully at Free Software and its modulations, I suggest, one can come to a better understanding of the changes affecting pornography, Wikipedia, stock quotes, and many other wonderful and terrifying things.[4]

Two Bits has three parts. Part I of this book introduces the reader to the concept of recursive publics by exploring the lives, works, and discussions of an international community of geeks brought together by their shared interest in the Internet. Chapter 1 asks, in an ethnographic voice, "Why do geeks associate with one another?" The answer—told via the story of Napster in 2000 and the standards process at the heart of the Internet—is that they are making a recursive public. Chapter 2 explores the words and attitudes of geeks more closely, focusing on the strange stories they tell (about the Protestant Reformation, about their practical everyday polymathy, about progress and enlightenment), stories that make sense of contemporary political economy in sometimes surprising ways. Central to part I is an explication of the ways in which geeks argue about technology but also argue with and through it, by building, modifying, and maintaining the very software, networks, and legal tools within which and by which they associate with one another. It is meant to give the reader a kind of visceral sense of why certain arrangements of technology, organization, and law—specifically that of the Internet and Free Software—are so vitally important to these geeks.

Part II takes a step back from ethnographic engagement to ask, "What is Free Software and why has it emerged at this point in history?" Part II is a historically detailed portrait of the emergence of Free Software beginning in 1998–99 and stretching back in time as far as the late 1950s; it recapitulates part I by examining Free Software as an exemplar of a recursive public. The five chapters in part II tell a coherent historical story, but each is focused on a separate component of Free Software. The stories in these chapters help distinguish the figure of Free Software from the ground of the Internet. The diversity of technical practices, economic concerns, information technologies, and legal and organizational practices is huge, and these five chapters distinguish and describe the specific practices in their historical contexts and settings: practices of

proselytizing and arguing, of sharing, porting, and forking source code, of conceptualizing openness and open systems, of creating Free Software copyright, and of coordinating people and source code.

Part III returns to ethnographic engagement, analyzing two related projects inspired by Free Software which modulate one or more of the five components discussed in part II, that is, which take the practices as developed in Free Software and experiment with making something new and different. The two projects are Creative Commons, a nonprofit organization that creates copyright licenses, and Connexions, a project to develop an online scholarly textbook commons. By tracing the modulations of practices in detail, I ask, "Are these projects still Free Software?" and "Are these projects still recursive publics?" The answer to the first questions reveals how Free Software's flexible practices are influencing specific forms of practice far from software programming, while the answer to the second question helps explain how Free Software, Creative Commons, Connexions, and projects like them are all related, strategic responses to the reorientation of power and knowledge. The conclusion raises a series of questions intended to help scholars looking at related phenomena.

Recursive Publics and the Reorientation of Power and Knowledge

Governance and control of the creation and dissemination of knowledge have changed considerably in the context of the Internet over the last thirty years. Nearly all kinds of media are easier to produce, publish, circulate, modify, mash-up, remix, or reuse. The number of such creations, circulations, and borrowings has exploded, and the tools of knowledge creation and circulation—software and networks—have also become more and more pervasively available. The results have also been explosive and include anxieties about validity, quality, ownership and control, moral panics galore, and new concerns about the shape and legitimacy of global "intellectual property" systems. All of these concerns amount to a *reorientation of knowledge and power* that is incomplete and emergent, and whose implications reach directly into the heart of the legitimacy, certainty, reliability and especially the finality and temporality of

the knowledge and infrastructures we collectively create. It is a reorientation at once more specific and more general than the grand diagnostic claims of an "information" or "network" society, or the rise of knowledge work or knowledge-based economies; it is more specific because it concerns precise and detailed technical and legal practices, more general because it is a *cultural* reorientation, not only an economic or legal one.

Free Software exemplifies this reorientation; it is not simply a technical pursuit but also the creation of a "public," a collective that asserts itself as a check on other constituted forms of power—like states, the church, and corporations—but which remains independent of these domains of power.[5] Free Software is a response to this reorientation that has resulted in a novel form of democratic political action, a means by which publics can be created and maintained in forms not at all familiar to us from the past. Free Software is a public of a particular kind: a recursive public. Recursive publics are publics concerned with the ability to build, control, modify, and maintain the infrastructure that allows them to come into being in the first place and which, in turn, constitutes their everyday practical commitments and the identities of the participants as creative and autonomous individuals. In the cases explored herein, that specific infrastructure includes the creation of the Internet itself, as well as its associated tools and structures, such as Usenet, e-mail, the World Wide Web (www), UNIX and UNIX-derived operating systems, protocols, standards, and standards processes. For the last thirty years, the Internet has been the subject of a contest in which Free Software has been both a central combatant and an important architect.

By calling Free Software a recursive public, I am doing two things: first, I am drawing attention to the democratic and political significance of Free Software and the Internet; and second, I am suggesting that our current understanding (both academic and colloquial) of what counts as a self-governing public, or even as "the public," is radically inadequate to understanding the contemporary reorientation of knowledge and power. The first case is easy to make: it is obvious that there is something political about Free Software, but most casual observers assume, erroneously, that it is simply an ideological stance and that it is anti–intellectual property or technolibertarian. I hope to show how geeks do not start with ideologies, but instead come to them through their involvement in the

practices of creating Free Software and its derivatives. To be sure, there are ideologues aplenty, but there are far more people who start out thinking of themselves as libertarians or liberators, but who become something quite different through their participation in Free Software.

The second case is more complex: why another contribution to the debate about the public and public spheres? There are two reasons I have found it necessary to invent, and to attempt to make precise, the concept of a recursive public: the first is to signal the need to include within the spectrum of political activity the creation, modification, and maintenance of software, networks, and legal documents. Coding, hacking, patching, sharing, compiling, and modifying of software are forms of political action that now routinely accompany familiar political forms of expression like free speech, assembly, petition, and a free press. Such activities are expressive in ways that conventional political theory and social science do not recognize: they can both express and "implement" ideas about the social and moral order of society. Software and networks can express ideas in the conventional written sense as well as create (express) infrastructures that allow ideas to circulate in novel and unexpected ways. At an analytic level, the concept of a recursive public is a way of insisting on the importance to public debate of the unruly technical materiality of a political order, not just the embodied discourse (however material) about that order. Throughout this book, I raise the question of how Free Software and the Internet are themselves a public, as well as what that public actually makes, builds, and maintains.

The second reason I use the concept of a recursive public is that conventional publics have been described as "self-grounding," as constituted only through discourse in the conventional sense of speech, writing, and assembly.[6] Recursive publics are "recursive" not only because of the "self-grounding" of commitments and identities but also because they are concerned with the depth or strata of this self-grounding: the layers of technical and legal infrastructure which are necessary for, say, the Internet to exist as the infrastructure of a public. Every act of self-grounding that constitutes a public relies in turn on the existence of a medium or ground through which communication is possible—whether face-to-face speech, epistolary communication, or net-based assembly—and recursive publics relentlessly question the status of these media, suggesting

that they, too, must be independent for a public to be authentic. At each of these layers, technical and legal and organizational decisions can affect whether or not the infrastructure will allow, or even ensure, the continued existence of the recursive publics that are concerned with it. Recursive publics' independence from power is not absolute; it is provisional and structured in response to the historically constituted layering of power and control within the infrastructures of computing and communication.

For instance, a very important aspect of the contemporary Internet, and one that has been fiercely disputed (recently under the banner of "net neutrality"), is its *singularity*: there is only one Internet. This was not an inevitable or a technically determined outcome, but the result of a contest in which a series of decisions were made about layers ranging from the very basic physical configuration of the Internet (packet-switched networks and routing systems indifferent to data types), to the standards and protocols that make it work (e.g., TCP/IP or DNS), to the applications that run on it (e-mail, www, ssh). The outcome of these decisions has been to privilege the singularity of the Internet and to champion its standardization, rather than to promote its fragmentation into multiple incompatible networks. These same kinds of decisions are routinely discussed, weighed, and programmed in the activity of various Free Software projects, as well as its derivatives. They are, I claim, decisions embedded in imaginations of order that are simultaneously moral and technical.

By contrast, governments, corporations, nongovernmental organizations (NGOs), and other institutions have plenty of reasons—profit, security, control—to seek to fragment the Internet. But it is the check on this power provided by recursive publics and especially the practices that now make up Free Software that has kept the Internet whole to date. It is a check on power that is by no means absolute, but is nonetheless rigorously and technically concerned with its legitimacy and independence not only from state-based forms of power and control, but from corporate, commercial, and nongovernmental power as well. To the extent that the Internet is public and extensible (including the capability of creating private subnetworks), it is because of the practices discussed herein and their culmination in a recursive public.

Recursive publics respond to governance by directly engaging in, maintaining, and often modifying the infrastructure they seek, as a

public, to inhabit and extend—and not only by offering opinions or protesting decisions, as conventional publics do (in most theories of the public sphere). Recursive publics seek to create what might be understood, enigmatically, as a constantly "self-leveling" level playing field. And it is in the attempt to make the playing field self-leveling that they confront and resist forms of power and control that seek to level it to the advantage of one or another large constituency: state, government, corporation, profession. It is important to understand that geeks do not simply want to level the playing field to their advantage—they have no affinity or identity as such. Instead, they wish to devise ways to give the playing field a certain kind of agency, effected through the agency of many different humans, but checked by its technical and legal structure and openness. Geeks do not wish to compete qua capitalists or entrepreneurs unless they can assure themselves that (qua public actors) that they can compete fairly. It is an ethic of justice shot through with an aesthetic of technical elegance and legal cleverness.

The fact that recursive publics respond in this way—through direct engagement and modification—is a key aspect of the reorientation of power and knowledge that Free Software exemplifies. They are reconstituting the relationship between liberty and knowledge in a technically and historically specific context. Geeks create and modify and argue about licenses and source code and protocols and standards and revision control and ideologies of freedom and pragmatism not simply because these things are inherently or universally important, but because they concern the relationship of governance to the freedom of expression and nature of consent. Source code and copyright licenses, revision control and mailing lists are the pamphlets, coffeehouses, and salons of the twenty-first century: Tischgesellschaften become Schreibtischgesellschaften.[7]

The "reorientation of power and knowledge" has two key aspects that are part of the concept of recursive publics: availability and modifiability (or adaptability). Availability is a broad, diffuse, and familiar issue. It includes things like transparency, open governance or transparent organization, secrecy and freedom of information, and open access in science. Availability includes the business-school theories of "disintermediation" and "transparency and accountability" and the spread of "audit culture" and so-called neoliberal regimes of governance; it is just as often the subject of suspicion as it is a kind of moral mandate, as in the case of open

access to scientific results and publications.[8] All of these issues are certainly touched on in detailed and practical ways in the creation of Free Software. Debates about the mode of availability of information made possible in the era of the Internet range from digital-rights management and copy protection, to national security and corporate espionage, to scientific progress and open societies.

However, it is modifiability that is the most fascinating, and unnerving, aspect of the reorientation of power and knowledge. Modifiability includes the ability not only to access—that is, to reuse in the trivial sense of using something without restrictions—but to transform it for use in new contexts, to different ends, or in order to participate directly in its improvement and to redistribute or recirculate those improvements within the same infrastructures while securing the same rights for everyone else. In fact, the core practice of Free Software is the practice of reuse and modification of software source code. Reuse and modification are also the key ideas that projects modeled on Free Software (such as Connexions and Creative Commons) see as their goal. Creative Commons has as its motto "Culture always builds on the past," and they intend that to mean "through legal appropriation and modification." Connexions, which allows authors to create online bits and pieces of textbooks explicitly encourages authors to reuse work by other people, to modify it, and to make it their own. Modifiability therefore raises a very specific and important question about *finality*. When is something (software, a film, music, culture) finished? How long does it remain finished? Who decides? Or more generally, what does its temporality look like, and how does that temporality restructure political relationships? Such issues are generally familiar only to historians and literary scholars who understand the transformation of canons, the interplay of imitation and originality, and the theoretical questions raised, for instance, in textual scholarship. But the contemporary meaning of modification includes both a vast increase in the speed and scope of modifiability and a certain automation of the practice that was unfamiliar before the advent of sophisticated, distributed forms of software.

Modifiability is an oft-claimed advantage of Free Software. It can be updated, modified, extended, or changed to deal with other changing environments: new hardware, new operating systems, unforeseen technologies, or new laws and practices. At an infrastructural level, such modifiability makes sense: it is a response to

and an alternative to technocratic forms of planning. It is a way of *planning in* the ability to *plan out*; an effort to continuously secure the ability to deal with surprise and unexpected outcomes; a way of making flexible, modifiable infrastructures like the Internet as safe as permanent, inflexible ones like roads and bridges.

But what is the cultural significance of modifiability? What does it mean to plan in modifiability to culture, to music, to education and science? At a clerical level, such a question is obvious whenever a scholar cannot recover a document written in WordPerfect 2.0 or on a disk for which there are no longer disk drives, or when a library archive considers saving both the media and the machines that read that media. Modifiability is an imperative for building infrastructures that can last longer. However, it is not only a solution to a clerical problem: it creates new possibilities and new problems for long-settled practices like publication, or the goals and structure of intellectual-property systems, or the definition of the finality, lifetime, monumentality, and especially, the identity of a work. Long-settled, seemingly unassailable practices—like the authority of published books or the power of governments to control information—are suddenly confounded and denaturalized by the techniques of modifiability.

Over the last ten to fifteen years, as the Internet has spread exponentially and insinuated itself into the most intimate practices of all kinds of people, the issues of availability and modifiability and the reorientation of knowledge and power they signify have become commonplace. As this has happened, the significance and practices associated with Free Software have also spread—and been modulated in the process. These practices provide a material and meaningful starting point for an array of recursive publics who play with, modulate, and transform them as they debate and build new ways to share, create, license, and control their respective productions. They do not all share the same goals, immediate or long-term, but by engaging in the technical, legal, and social practices pioneered in Free Software, they do in fact share a "social imaginary" that defines a particular relationship between technology, organs of governance (whether state, corporate, or nongovernmental), and the Internet. Scientists in a lab or musicians in a band; scholars creating a textbook or social movements contemplating modes of organization and protest; government bureaucrats issuing data or journalists investigating corruption; corporations that manage

personal data or co-ops that monitor community development—all these groups and others may find themselves adopting, modulating, rejecting, or refining the practices that have made up Free Software in the recent past and will do so in the near future.

Experiment and Modulation

What exactly is Free Software? This question is, perhaps surprisingly, an incredibly common one in geek life. Debates about definition and discussions and denunciations are ubiquitous. As an anthropologist, I have routinely participated in such discussions and debates, and it is through my immediate participation that *Two Bits* opens. In part I I tell stories about geeks, stories that are meant to give the reader that classic anthropological sense of being thrown into another world. The stories reveal several general aspects of what geeks talk about and how they do so, without getting into what Free Software is in detail. I start in this way because my project started this way. I did not initially intend to study Free Software, but it was impossible to ignore its emergence and manifest centrality to geeks. The debates about the definition of Free Software that I participated in online and in the field eventually led me away from studying geeks per se and turned me toward the central research concern of this book: what is the cultural significance of Free Software?

In part II what I offer is not a definition of Free Software, but a history of how it came to be. The story begins in 1998, with an important announcement by Netscape that it would give away the source code to its main product, Netscape Navigator, and works backward from this announcement into the stories of the UNIX operating system, "open systems," copyright law, the Internet, and tools for coordinating people and code. Together, these five stories constitute a description of how Free Software works as a practice. As a cultural analysis, these stories highlight just how experimental the practices are, and how individuals keep track of and modulate the practices along the way.

Netscape's decision came at an important point in the life of Free Software. It was at just this moment that Free Software was becoming aware of itself as a coherent *movement* and not just a diverse amalgamation of projects, tools, or practices. Ironically, this

recognition also betokened a split: certain parties started to insist that the movement be called "Open Source" software instead, to highlight the practical over the ideological commitments of the movement. The proposal itself unleashed an enormous public discussion about what defined Free Software (or Open Source). This enigmatic event, in which a movement became aware of itself at the same time that it began to question its mission, is the subject of chapter 3. I use the term *movement* to designate one of the five core components of Free Software: the practices of argument and disagreement about the meaning of Free Software. Through these practices of discussion and critique, the other four practices start to come into relief, and participants in both Free Software and Open Source come to realize something surprising: for all the ideological distinctions at the level of discourse, they are *doing exactly the same thing* at the level of practice. The affect-laden histrionics with which geeks argue about the definition of what makes Free Software free or Open Source open can be matched only by the sober specificity of the detailed practices they share.

The second component of Free Software is just such a mundane activity: sharing source code (chapter 4). It is an essential and fundamentally routine practice, but one with a history that reveals the goals of software portability, the interactions of commercial and academic software development, and the centrality of source code (and not only of abstract concepts) in pedagogical settings. The details of "sharing" source code also form the story of the rise and proliferation of the UNIX operating system and its myriad derivatives.

The third component, conceptualizing openness (chapter 5), is about the specific technical and "moral" meanings of openness, especially as it emerged in the 1980s in the computer industry's debates over "open systems." These debates concerned the creation of a particular infrastructure, including both technical standards and protocols (a standard UNIX and protocols for networks), and an ideal market infrastructure that would allow open systems to flourish. Chapter 5 is the story of the failure to achieve a market infrastructure for open systems, in part due to a significant blind spot: the role of intellectual property.

The fourth component, applying copyright (and copyleft) licenses (chapter 6), involves the problem of intellectual property as it faced programmers and geeks in the late 1970s and early 1980s. In this

chapter I detail the story of the first Free Software license—the GNU General Public License (GPL)—which emerged out of a controversy around a very famous piece of software called EMACS. The controversy is coincident with changing laws (in 1976 and 1980) and changing practices in the software industry—a general drift from trade secret to copyright protection—and it is also a story about the vaunted "hacker ethic" that reveals it in its native practical setting, rather than as a rarefied list of rules.

The fifth component, the practice of coordination and collaboration (chapter 7), is the most talked about: the idea of tens or hundreds of thousands of people volunteering their time to contribute to the creation of complex software. In this chapter I show how novel forms of coordination developed in the 1990s and how they worked in the canonical cases of Apache and Linux; I also highlight how coordination facilitates the commitment to adaptability (or modifiability) over against planning and hierarchy, and how this commitment resolves the tension between individual virtuosity and the need for collective control.

Taken together, these five components make up Free Software—but they are not a definition. Within each of these five practices, many similar and dissimilar activities might reasonably be included. The point of such a redescription of the practices of Free Software is to conceptualize them as a kind of *collective technical experimental system*. Within each component are a range of differences in practice, from conventional to experimental. At the center, so to speak, are the most common and accepted versions of a practice; at the edges are more unusual or controversial versions. Together, the components make up an experimental system whose infrastructure is the Internet and whose "hypotheses" concern the reorientation of knowledge and power.

For example, one can hardly have Free Software without source code, but it need not be written in C (though the vast majority of it is); it can be written in Java or perl or TeX. However, if one stretches the meaning of source code to include music (sheet music as source and performance as binary), what happens? Is this still Free Software? What happens when both the sheet and the performance are "born digital"? Or, to take a different example, Free Software requires Free Software licenses, but the terms of these licenses are often changed and often heatedly discussed and vigilantly policed by geeks. What degree of change removes a license

from the realm of Free Software and why? How much flexibility is allowed?

Conceived this way, Free Software is a system of thresholds, not of classification; the excitement that participants and observers sense comes from the modulation (experimentation) of each of these practices and the subsequent discovery of where the thresholds are. Many, many people have written their own "Free Software" copyright licenses, but only some of them remain within the threshold of the practice as defined by the system. Modulations happen whenever someone learns how some component of Free Software works and asks, "Can I try these practices out in some other domain?"

The reality of constant modulation means that these five practices do not define Free Software once and for all; they define it with respect to its constitution in the contemporary. It is a set of practices defined "around the point" 1998–99, an intensive coordinate space that allows one to explore Free Software's components prospectively and retrospectively: into the near future and the recent past. Free Software is a machine for charting the (re)emergence of a problematic of power and knowledge as it is filtered through the technical realities of the Internet and the political and economic configuration of the contemporary. Each of these practices has its own temporality of development and emergence, but they have recently come together into this full house called either Free Software or Open Source.[9]

Viewing Free Software as an experimental system has a strategic purpose in *Two Bits*. It sets the stage for part III, wherein I ask what kinds of modulations might no longer qualify as Free Software per se, but still qualify as recursive publics. It was around 2000 that talk of "commons" began to percolate out of discussions about Free Software: commons in educational materials, commons in biodiversity materials, commons in music, text, and video, commons in medical data, commons in scientific results and data.[10] On the one hand, it was continuous with interest in creating "digital archives" or "online collections" or "digital libraries"; on the other hand, it was a conjugation of the digital collection with the problems and practices of intellectual property. The very term *commons*—at once a new name and a theoretical object of investigation—was meant to suggest something more than simply a collection, whether of

digital objects or anything else; it was meant to signal the public interest, collective management, and legal status of the collection.[11]

In part III, I look in detail at two "commons" understood as modulations of the component practices of Free Software. Rather than treating commons projects simply as metaphorical or inspirational uses of Free Software, I treat them as modulations, which allows me to remain directly connected to the changing practices involved. The goal of part III is to understand how commons projects like Connexions and Creative Commons breach the thresholds of these practices and yet maintain something of the same orientation. What changes, for instance, have made it possible to imagine new forms of free content, free culture, open source music, or a science commons? What happens as new communities of people adopt and modulate the five component practices? Do they also become recursive publics, concerned with the maintenance and expansion of the infrastructures that allow them to come into being in the first place? Are they concerned with the implications of availability and modifiability that continue to unfold, continue to be figured out, in the realms of education, music, film, science, and writing?

The answers in part III make clear that, so far, these concerns are alive and well in the modulations of Free Software: Creative Commons and Connexions each struggle to come to terms with new ways of creating, sharing, and reusing content in the contemporary legal environment, with the Internet as infrastructure. Chapters 8 and 9 provide a detailed analysis of a technical and legal experiment: a modulation that begins with source code, but quickly requires modulations in licensing arrangements and forms of coordination. It is here that *Two Bits* provides the most detailed story of figuring out set against the background of the reorientation of knowledge and power. This story is, in particular, one of *reuse*, of modifiability and the problems that emerge in the attempt to build it into the everyday practices of pedagogical writing and cultural production of myriad forms. Doing so leads the actors involved directly to the question of the existence and ontology of norms: norms of scholarly production, borrowing, reuse, citation, reputation, and ownership. These last chapters open up questions about the stability of modern knowledge, not as an archival or a legal problem, but as a social and normative one; they raise questions about the invention and control of norms, and the forms of life that may emerge from these

practices. Recursive publics come to exist where it is clear that such invention and control need to be widely shared, openly examined, and carefully monitored.

Three Ways of Looking at *Two Bits*

Two Bits makes three kinds of scholarly contributions: empirical, methodological, and theoretical. Because it is based largely on fieldwork (which includes historical and archival work), these three contributions are often mixed up with each other. Fieldwork, especially in cultural and social anthropology in the last thirty years, has come to be understood less and less as one particular tool in a methodological toolbox, and more and more as distinctive mode of epistemological encounter.[12] The questions I began with emerged out of science and technology studies, but they might end up making sense to a variety of fields, ranging from legal studies to computer science.

Empirically speaking, the actors in my stories are figuring something out, something unfamiliar, troubling, imprecise, and occasionally shocking to everyone involved at different times and to differing extents.[13] There are two kinds of figuring-out stories: the contemporary ones in which I have been an active participant (those of Connexions and Creative Commons), and the historical ones conducted through "archival" research and rereading of certain kinds of texts, discussions, and analyses-at-the-time (those of UNIX, EMACS, Linux, Apache, and Open Systems). Some are stories of technical figuring out, but most are stories of figuring out a problem that appears to have emerged. Some of these stories involve callow and earnest actors, some involve scheming and strategy, but in all of them the figuring out is presented "in the making" and not as something that can be conveniently narrated as obvious and uncontested with the benefit of hindsight. Throughout this book, I tell stories that illustrate what geeks are like in some respects, but, more important, that show them in the midst of figuring things out—a practice that can happen both in discussion and in the course of designing, planning, executing, writing, debugging, hacking, and fixing.

There are also myriad ways in which geeks narrate their own actions to themselves and others, as they figure things out. Indeed,

there is no crisis of representing the other here: geeks are vocal, loud, persistent, and loquacious. The superalterns can speak for themselves. However, such representations should not necessarily be taken as evidence that geeks provide adequate analytic or critical explanations of their own actions. Some of the available writing provides excellent description, but distracting analysis. Eric Raymond's work is an example of such a combination.[14] Over the course of my fieldwork, Raymond's work has always been present as an excellent guide to the practices and questions that plague geeks—much like a classic "principal informant" in anthropology. And yet his analyses, which many geeks subscribe to, are distracting. They are fanciful, occasionally enjoyable and enlightening—but they are not about the cultural significance of Free Software. As such I am less interested in treating geeks as natives to be explained and more interested in arguing with them: the people in *Two Bits* are a *sine qua non* of the ethnography, but they are not the objects of its analysis.[15]

Because the stories I tell here are in fact recent by the standards of historical scholarship, there is not much by way of comparison in terms of the empirical material. I rely on a number of books and articles on the history of the early Internet, especially Janet Abbate's scholarship and the single historical work on UNIX, Peter Salus's *A Quarter Century of Unix*.[16] There are also a couple of excellent journalistic works, such as Glyn Moody's *Rebel Code: Inside Linux and the Open Source Revolution* (which, like *Two Bits*, relies heavily on the novel accessibility of detailed discussions carried out on public mailing lists). Similarly, the scholarship on Free Software and its history is just starting to establish itself around a coherent set of questions.[17]

Methodologically, *Two Bits* provides an example of how to study *distributed phenomena* ethnographically. Free Software and the Internet are objects that do not have a single geographic site at which they can be studied. Hence, this work is multisited in the simple sense of having multiple sites at which these objects were investigated: Boston, Bangalore, Berlin, Houston. It was conducted among particular people, projects, and companies and at conferences and online gatherings too numerous to list, but it has not been a study of a single Free Software project distributed around the globe. In all of these places and projects the geeks I worked with were randomly and loosely affiliated people with diverse lives and histories. Some

identified as Free Software hackers, but most did not. Some had never met each other in real life, and some had. They represented multiple corporations and institutions, and came from diverse nations, but they nonetheless shared a certain set of ideas and idioms that made it possible for me to travel from Boston to Berlin to Bangalore and pick up an ongoing conversation with different people, in very different places, without missing a beat.

The study of distributed phenomena does not necessarily imply the detailed, local study of each instance of a phenomenon, nor does it necessitate visiting every relevant geographical site—indeed, such a project is not only extremely difficult, but confuses map and territory. As Max Weber put it, "It is not the 'actual' interconnection of 'things' but the *conceptual* inter-connection of *problems* that define the scope of the various sciences."[18] The decisions about where to go, whom to study, and how to think about Free Software are arbitrary in the precise sense that because the phenomena are so widely distributed, it is possible to make any given node into a source of rich and detailed knowledge about the distributed phenomena itself, not only about the local site. Thus, for instance, the Connexions project would probably have remained largely unknown to me had I not taken a job in Houston, but it nevertheless possesses precise, identifiable connections to the other sites and sets of people that I have studied, and is therefore recognizable as part of *this* distributed phenomena, rather than some other. I was actively looking for something like Connexions in order to ask questions about what was becoming of Free Software and how it was transforming. Had there been no Connexions in my back yard, another similar field site would have served instead.

It is in this sense that the ethnographic object of this study is not geeks and not any particular project or place or set of people, but Free Software and the Internet. Even more precisely, the ethnographic object of this study is "recursive publics"—except that this concept is also the *work* of the ethnography, not its preliminary object. I could not have identified "recursive publics" as the object of the ethnography at the outset, and this is nice proof that ethnographic work is a particular kind of epistemological encounter, an encounter that requires considerable conceptual work during and after the material labor of fieldwork, and throughout the material labor of writing and rewriting, in order to make sense of and reorient it into a question that will have looked deliberate and

answerable in hindsight. Ethnography of this sort requires a long-term commitment and an ability to see past the obvious surface of rapid transformation to a more obscure and slower temporality of cultural significance, yet still pose questions and refine debates about the near future.[19] Historically speaking, the chapters of part II can be understood as a contribution to a history of scientific infrastructure—or perhaps to an understanding of large-scale, collective experimentation.[20] The Internet and Free Software are each an important practical transformation that will have effects on the practice of science and a kind of complex technical practice for which there are few existing models of study.

A methodological note about the peculiarity of my subject is also in order. The Attentive Reader will note that there are very few fragments of conventional ethnographic material (i.e., interviews or notes) transcribed herein. Where they do appear, they tend to be "publicly available"—which is to say, accessible via the Internet—and are cited as such, with as much detail as necessary to allow the reader to recover them. Conventional wisdom in both anthropology and history has it that what makes a study interesting, in part, is the work a researcher has put into gathering that which is not already available, that is, primary sources as opposed to secondary sources. In some cases I provide that primary access (specifically in chapters 2, 8, and 9), but in many others it is now literally impossible: *nearly everything is archived*. Discussions, fights, collaborations, talks, papers, software, articles, news stories, history, old software, old software manuals, reminiscences, notes, and drawings—it is all saved by someone, somewhere, and, more important, often made instantly available by those who collect it. The range of conversations and interactions that count as private (either in the sense of disappearing from written memory or of being accessible only to the parties involved) has shrunk demonstrably since about 1981.

Such obsessive archiving means that ethnographic research is stratified in time. Questions that would otherwise have required "being there" are much easier to research after the fact, and this is most evident in my reconstruction from sources on USENET and mailing lists in chapters 1, 6, and 7. The overwhelming availability of quasi-archival materials is something I refer to, in a play on the EMACS text editor, as "self-documenting history." That is to say, one of the activities that geeks love to participate in, and encourage, is the creation, analysis, and archiving of their own roles in the

development of the Internet. No matter how obscure or arcane, it seems most geeks have a well-developed sense of possibility—their contribution could turn out to have been transformative, important, originary. What geeks may lack in social adroitness, they make up for in archival hubris.

Finally, the theoretical contribution of *Two Bits* consists of a refinement of debates about publics, public spheres, and social imaginaries that appear troubled in the context of the Internet and Free Software. Terminology such as *virtual community*, *online community*, *cyberspace*, *network society*, or *information society* are generally not theoretical constructs, but ways of designating a subgenre of disciplinary research having to do with electronic networks. The need for a more precise analysis of the kinds of association that take place on and through information technology is clear; the first step is to make precise which information technologies and which specific practices make a difference.

There is a relatively large and growing literature on the Internet as a public sphere, but such literature is generally less concerned with refining the concept through research and more concerned with pronouncing whether or not the Internet fits Habermas's definition of the bourgeois public sphere, a definition primarily conceived to account for the eighteenth century in Britain, not the twenty-first-century Internet.[21] The facts of technical and human life, as they unfold through the Internet and around the practices of Free Software, are not easy to cram into Habermas's definition. The goal of *Two Bits* is not to do so, but to offer conceptual clarity based in ethnographic fieldwork.

The key texts for understanding the concept of recursive publics are the works of Habermas, Charles Taylor's *Modern Social Imaginaries*, and Michael Warner's *The Letters of the Republic* and *Publics and Counterpublics*. Secondary texts that refine these notions are John Dewey's *The Public and Its Problems* and Hannah Arendt's *The Human Condition*. Here it is not the public sphere per se that is the center of analysis, but the "ideas of modern moral and social order" and the terminology of "modern social imaginaries."[22] I find these concepts to be useful as starting points for a very specific reason: to distinguish the meaning of moral order from the meaning of *moral and technical order* that I explore with respect to geeks. I do not seek to test the concept of social imaginary here, but to build something on top of it.

If recursive public is a useful concept, it is because it helps elaborate the general question of the "reorientation of knowledge and power." In particular it is meant to bring into relief the ways in which the Internet and Free Software are related to the political economy of modern society through the creation not only of new knowledge, but of new infrastructures for circulating, maintaining, and modifying it. Just as Warner's book *The Letters of the Republic* was concerned with the emergence of the discourse of republicanism and the simultaneous development of an American republic of letters, or as Habermas's analysis was concerned with the relationship of the bourgeois public sphere to the democratic revolutions of the eighteenth century, this book asks a similar series of questions: how are the emergent practices of recursive publics related to emerging relations of political and technical life in a world that submits to the Internet and its forms of circulation? Is there still a role for a republic of letters, much less a species of public that can seriously claim independence and autonomy from other constituted forms of power? Are Habermas's pessimistic critiques of the bankruptcy of the public sphere in the twentieth century equally applicable to the structures of the twenty-first century? Or is it possible that recursive publics represent a reemergence of strong, authentic publics in a world shot through with cynicism and suspicion about mass media, verifiable knowledge, and enlightenment rationality?

Part I THE INTERNET

The concept of the state, like most concepts which are introduced by "The," is both too rigid and too tied up with controversies to be of ready use. It is a concept which can be approached by a flank movement more easily than by a frontal attack. The moment we utter the words "The State" a score of intellectual ghosts rise to obscure our vision. Without our intention and without our notice, the notion of "The State" draws us imperceptibly into a consideration of the logical relationship of various ideas to one another, and away from the facts of human activity. It is better, if possible, to start from the latter and see if we are not led thereby into an idea of something which will turn out to implicate the marks and signs which characterize political behavior.

—JOHN DEWEY, *The Public and Its Problems*

1. Geeks and Recursive Publics

Since about 1997, I have been living with geeks online and off. I have been drawn from Boston to Bangalore to Berlin to Houston to Palo Alto, from conferences and workshops to launch parties, pubs, and Internet Relay Chats (IRCs). All along the way in my research questions of commitment and practice, of ideology and imagination have arisen, even as the exact nature of the connections between these people and ideas remained obscure to me: what binds geeks together? As my fieldwork pulled me from a Boston start-up company that worked with radiological images to media labs in Berlin to young entrepreneurial elites in Bangalore, my logistical question eventually developed into an analytical concept: geeks are bound together as a recursive public.

How did I come to understand geeks as a public constituted around the technical and moral ideas of order that allow them to associate with one another? Through this question, one can start to understand the larger narrative of *Two Bits*: that of Free Software

as an exemplary instance of a recursive public and as a set of practices that allow such publics to expand and spread. In this chapter I describe, ethnographically, the diverse, dispersed, and novel forms of entanglements that bind geeks together, and I construct the concept of a recursive public in order to explain these entanglements.

A recursive public is a public that is constituted by a shared concern for maintaining the means of association through which they come together as a public. Geeks find affinity with one another because they share an abiding moral imagination of the technical infrastructure, the Internet, that has allowed them to develop and maintain this affinity in the first place. I elaborate the concept of recursive public (which is not a term used by geeks) in relation to theories of ideology, publics, and public spheres and social imaginaries. I illustrate the concept through ethnographic stories and examples that highlight geeks' imaginations of the technical and moral order of the Internet. These stories include those of the fate of Amicas, a Boston-based healthcare start-up, between 1997 and 2003, of my participation with new media academics and activists in Berlin in 1999–2001, and of the activities of a group of largely Bangalore-based information technology (IT) professionals on and offline, especially concerning the events surrounding the peer-to-peer file sharing application Napster in 2000–2001.

The phrase "moral and technical order" signals both technology—principally software, hardware, networks, and protocols—and an imagination of the proper order of collective political and commercial action, that is, how economy and society should be ordered collectively. Recursive publics are just as concerned with the moral order of markets as they are with that of commons; they are not anticommercial or antigovernment. They exist independent of, and as a check on, constituted forms of power, which include markets and corporations. Unlike other concepts of a public or of a public sphere, "recursive public" captures the fact that geeks' principal mode of associating and acting is through the medium of the Internet, and it is through this medium that a recursive public can come into being in the first place. The Internet is not itself a public sphere, a public, or a recursive public, but a complex, heterogeneous infrastructure that constitutes and constrains geeks' everyday practical commitments, their ability to "become public" or to compose a common world. As such, their participation qua recursive publics structures their identity as creative and autono-

mous individuals. The fact that the geeks described here have been brought together by mailing lists and e-mail, bulletin-board services and Web sites, books and modems, air travel and academia, and cross-talking and cross-posting in ways that were not possible before the Internet is at the core of their own reasoning about why they associate with each other. They are the builders and imaginers of this space, and the space is what allows them to build and imagine it.

Why recursive? I call such publics *recursive* for two reasons: first, in order to signal that this kind of public includes the activities of making, maintaining, and modifying software and networks, as well as the more conventional discourse that is thereby enabled; and second, in order to suggest the recursive "depth" of the public, the series of technical and legal layers—from applications to protocols to the physical infrastructures of waves and wires—that are the subject of this making, maintaining, and modifying. The first of these characteristics is evident in the fact that geeks use technology as a kind of argument, for a specific kind of order: they argue *about* technology, but they also argue *through* it. They express ideas, but they also express *infrastructures* through which ideas can be expressed (and circulated) in new ways. The second of these characteristics—regarding layers—is reflected in the ability of geeks to immediately see connections between, for example, Napster (a user application) and TCP/IP (a network protocol) and to draw out implications for both of them. By connecting these layers, Napster comes to represent the Internet in miniature. The question of where these layers stop (hardware? laws and regulations? physical constants? etc.) circumscribes the limits of the imagination of technical and moral order shared by geeks.

Above all, "recursive public" is a concept—not a thing. It is intended to make distinctions, allow comparison, highlight salient features, and relate two diverse kinds of things (the Internet and Free Software) in a particular historical context of changing relations of power and knowledge. The stories in this chapter (and throughout the book) give some sense of *how* geeks interact and what they do technically and legally, but the concept of a recursive public provides a way of explaining *why* geeks (or people involved in Free Software or its derivatives) associate with one another, as well as a way of testing whether other similar cases of contemporary, technologically mediated affinity are similarly structured.

Recursion

Recursion (or "recursive") is a mathematical concept, one which is a standard feature of any education in computer programming. The definition from the Oxford English Dictionary reads: "2. a. Involving or being a repeated procedure such that the required result at each step except the last is given in terms of the result(s) of the next step, until after a finite number of steps a terminus is reached with an outright evaluation of the result." It should be distinguished from simple iteration or repetition. Recursion is always subject to a limit and is more like a process of repeated deferral, until the last step in the process, at which point all the deferred steps are calculated and the result given.

Recursion is powerful in programming because it allows for the definition of procedures in terms of themselves—something that seems at first counter-intuitive. So, for example,

```
(defun (factorial n)          ; This is the name of the function and its input n.
(if (=n 1)                    ; This is the final limit, or recursive depth
1                             ; if n=1, then return 1
(* n (factorial (- n 1)))))   ; otherwise return n times factorial of n-1;
                              ; call the procedure from within itself, and
                              ; calculate the next step of the result before
                              ; giving an answer.[1]
```

In *Two Bits* a recursive public is one whose existence (which consists solely in address through discourse) is only possible through discursive and technical reference to the means of creating this public. Recursiveness is always contingent on a limit which determines the depth of a recursive procedure. So, for instance, a Free Software project may depend on some other kind of software or operating system, which may in turn depend on particular open protocols or a particular process, which in turn depend on certain kinds of hardware that implement them. The "depth" of recursion is determined by the openness necessary for the project itself.

James Boyle has also noted the recursive nature, in particular, of Free Software: "What's more, and this is a truly fascinating twist, when the production process does need more centralized coordination, some governance that guides how the sticky modular bits are put together, it is at least theoretically possible that we can come up with the control system *in exactly the same way*. In this sense, distributed production is potentially recursive."[2]

1. Abelson and Sussman, *The Structure and Interpretation of Computer Programs*, 30.

2. Boyle, "The Second Enclosure Movement and the Construction of the Public Domain," 46.

Boston, May 2003. Starbucks. Sean and Adrian are on their way to pick me up for dinner. I've already had too much coffee, so I sit at the window reading the paper. Eventually Adrian calls to find out where I am, I tell him, and he promises to show up in fifteen minutes. I get bored and go outside to wait, watch the traffic go by. More or less right on time (only post-dotcom is Adrian ever on time), Sean's new blue VW Beetle rolls into view. Adrian jumps out of the passenger seat and into the back, and I get in. Sean has been driving for a little over a year. He seems confident, cautious, but meanders through the streets of Cambridge. We are destined for Winchester, a township on the Charles River, in order to go to an Indian restaurant that one of Sean's friends has recommended. When I ask how they are doing, they say, "Good, good." Adrian offers, "Well, Sean's better than he has been in two years." "Really?" I say, impressed.

Sean says, "Well, happier than at least the last year. I, well, let me put it this way: forgive me father for I have sinned, I still have unclean thoughts about some of the upper management in the company, I occasionally think they are not doing things in the best interest of the company, and I see them as self-serving and sometimes wish them ill." In this rolling blue confessional Sean describes some of the people who I am familiar with whom he now tries very hard not to think about. I look at him and say, "Ten Hail Marys and ten Our Fathers, and you will be absolved, my child." Turning to Adrian, I ask, "And what about you?" Adrian continues the joke: "I, too, have sinned. I have reached the point where I can see absolutely nothing good coming of this company but that I can keep my investments in it long enough to pay for my children's college tuition." I say, "You, my son, I cannot help." Sean says, "Well, funny thing about tainted money . . . there just taint enough of it."

I am awestruck. When I met Sean and Adrian, in 1997, their start-up company, Amicas, was full of spit, with five employees working out of Adrian's living room and big plans to revolutionize the medical-imaging world. They had connived to get Massachusetts General Hospital to install their rudimentary system and let it compete with the big corporate sloths that normally stalked back offices: General Electric, Agfa, Siemens. It was these behemoths, according to Sean and Adrian, that were bilking hospitals

and healthcare providers with promises of cure-all technologies and horribly designed "silos," "legacy systems," and other closed-system monsters of corporate IT harkening back to the days of IBM mainframes. These beasts obviously did not belong to the gleaming future of Internet-enabled scalability. By June of 2000, Amicas had hired new "professional" management, moved to Watertown, and grown to about a hundred employees. They had achieved their goal of creating an alternative Picture Archiving and Communication System (PACS) for use in hospital radiology departments and based on Internet standards.

At that point, in the spring of 2000, Sean could still cheerfully introduce me to his new boss—the same man he would come to hate, inasmuch as Sean hates anyone. But by 2002 he was frustrated by the extraordinary variety of corner-cutting and, more particularly, by the complacency with which management ignored his recommendations and released software that was almost certainly going to fail later, if not sooner. Sean, who is sort of permanently callow about things corporate, could find no other explanation than that the new management was evil.

But by 2003 the company had succeeded, having grown to more than 200 employees and established steady revenue and a stable presence throughout the healthcare world. Both Sean and Adrian were made rich—not wildly rich, but rich enough—by its success. In the process, however, it also morphed into exactly what Sean and Adrian had created it in order to fight: a slothlike corporate purveyor of promises and broken software. Promises Adrian had made and software Sean had built. The failure of Amicas to transform healthcare was a failure too complex and technical for most of America to understand, but it rested atop the success of Amicas in terms more readily comprehensible: a growing company making profit. Adrian and Sean had started the company not to make money, but in order to fix a broken healthcare system; yet the system stayed broken while they made money.

In the rolling confessional, Sean and Adrian did in fact see me, however jokingly, as a kind of redeemer, a priest (albeit of an order with no flock) whose judgment of the affairs past was essential to their narration of their venture as a success, a failure, or as an unsatisfying and complicated mixture of both. I thought about this strange moment of confession, of the combination of recognition and denial, of Adrian's new objectification of the company as an

investment opportunity, and of Sean's continuing struggle to make his life and his work harmonize in order to produce good in the world. Only the promise of the next project, the next mission (and the ostensible reason for our dinner meeting) could possibly have mitigated the emotional disaster that their enterprise might otherwise be. Sean's and Adrian's endless, arcane fervor for the promise of new technologies did not cease, even given the quotidian calamities these technologies leave in their wake. Their faith was strong, and continuously tested.

Adrian's and Sean's passion was not for money—though money was a powerful drug—it was for the Internet: for the ways in which the Internet could replace the existing infrastructure of hospitals and healthcare providers, deliver on old promises of telemedicine and teleradiology, and, above all, level a playing field systematically distorted and angled by corporate and government institutions that sought secrecy and private control, and stymied progress. In healthcare, as Adrian repeatedly explained to me, this skewed playing field was not only unfair but malicious and irresponsible. It was costing lives. It slowed the creation and deployment of technologies and solutions that could lower costs and thus provide more healthcare for more people. The Internet was not part of the problem; it was part of the solution to the problems that ailed 1990s healthcare.

At the end of our car trip, at the Indian restaurant in Winchester, I learned about their next scheme, a project called MedCommons, which would build on the ideals of Free Software and give individuals a way to securely control and manage their own healthcare data. The rhetoric of commons and the promise of the Internet as an infrastructure dominated our conversation, but the realities of funding and the question of whether MedCommons could be pursued without starting another company remained unsettled. I tried to imagine what form a future confession might take.

Geeks and Their Internets

Sean and Adrian are geeks. They are entrepreneurs and idealists in different ways, a sometimes paradoxical combination. They are certainly obsessed with technology, but especially with the Internet, and they clearly distinguish themselves from others who are

obsessed with technology of just any sort. They aren't quite representative—they do not stand in for all geeks—but the way they think about the Internet and its possibilities might be. Among the rich story of their successes and failures, one might glimpse the outlines of a question: where do their sympathies lie? Who are they *with*? Who do they recognize as being like them? What might draw them together with other geeks if not a corporation, a nation, a language, or a cause? What binds these two geeks to any others?

Sean worked for the Federal Reserve in the 1980s, where he was introduced to UNIX, C programming, EMACS, Usenet, Free Software, and the Free Software Foundation. But he was not a Free Software hacker; indeed, he resisted my attempts to call him a hacker at all. Nevertheless, he started a series of projects and companies with Adrian that drew on the repertoire of practices and ideas familiar from Free Software, including their MedCommons project, which was based more or less explicitly in the ideals of Free Software. Adrian has a degree in medicine and in engineering, and is a serial entrepreneur, with Amicas being his biggest success—and throughout the last ten years has attended all manner of conferences and meetings devoted to Free Software, Open Source, open standards, and so on, almost always as the lone representative from healthcare. Both graduated from the MIT (Sean in economics, Adrian in engineering), one of the more heated cauldrons of the Internet and the storied home of hackerdom, but neither were MIT hackers, nor even computer-science majors.

Their goals in creating a start-up rested on their understanding of the Internet as an infrastructure: as a *standardized infrastructure* with certain extremely powerful properties, not the least of which was its flexibility. Sean and Adrian talked endlessly about open systems, open standards, and the need for the Internet to remain open and standardized. Adrian spoke in general terms about how it would revolutionize healthcare; Sean spoke in specific terms about how it structured the way Amicas's software was being designed and written. Both participated in standards committees and in the online and offline discussions that are tantamount to policymaking in the Internet world. The company they created was a "virtual" company, that is, built on tools that depended on the Internet and allowed employees to manage and work from a variety of locations, though not without frustration, of course: Sean waited years for broadband access in his home, and the hospitals they served

hemmed themselves in with virtual private networks, intranets, and security firewalls that betrayed the promises of openness that Sean and Adrian heralded.

The Internet was not the object of their work and lives, but it did represent in detail a kind of moral or social order embodied in a technical system and available to everyone to use as a platform whereby they might compete to improve and innovate in any realm. To be sure, although not all Internet entrepreneurs of the 1990s saw the Internet in the same way, Sean and Adrian were hardly alone in their vision. Something about the particular way in which they understood the Internet as representing a moral order—simultaneously a network, a market, a public, and a technology—was shared by a large group of people, those who I now refer to simply as geeks.

The term *geek* is meant to be inclusive and to index the problematic of a recursive public. Other terms may be equally useful, but perhaps semantically overdetermined, most notably *hacker*, which regardless of its definitional range, tends to connote someone subversive and/or criminal and to exclude geek-sympathetic entrepreneurs and lawyers and activists.[1] *Geek* is meant to signal, like the *public* in "recursive public," that geeks stand outside power, at least in some aspects, and that they are not capitalists or technocrats, even if they start businesses or work in government or industry.[2] *Geek* is meant to signal a mode of thinking and working, not an identity; it is a mode or quality that allows people to find each other, for reasons other than the fact that they share an office, a degree, a language, or a nation.

Until the mid-1990s, *hacker*, *geek*, and *computer nerd* designated a very specific type: programmers and lurkers on relatively underground networks, usually college students, computer scientists, and "amateurs" or "hobbyists." A classic mock self-diagnostic called the Geek Code, by Robert Hayden, accurately and humorously detailed the various ways in which one could be a geek in 1996—UNIX/Linux skills, love/hate of *Star Trek*, particular eating and clothing habits—but as Hayden himself points out, the geeks of the early 1990s exist no longer. The elite subcultural, relatively homogenous group it once was has been overrun: "The Internet of 1996 was still a wild untamed virgin paradise of geeks and eggheads unpopulated by script kiddies, and the denizens of AOL. When things changed, I seriously lost my way. I mean, all the 'geek' that was the Internet

was gone and replaced by Xfiles buzzwords and politicians passing laws about a technology they refused to comprehend."[3]

For the purists like Hayden, geeks were there first, and they understood something, lived in a way, that simply cannot be comprehended by "script kiddies" (i.e., teenagers who perform the hacking equivalent of spray painting or cow tipping), crackers, or AOL users, all of whom are despised by Hayden-style geeks as unskilled users who parade around the Internet as if they own it. While certainly elitist, Hayden captures the distinction between those who are legitimately allowed to call themselves geeks (or hackers) and those who aren't, a distinction that is often formulated recursively, of course: "You are a hacker when another hacker calls you a hacker."

However, since the explosive growth of the Internet, *geek* has become more common a designation, and my use of the term thus suggests a role that is larger than programmer/hacker, but not as large as "all Internet users." Despite Hayden's frustration, geeks are still bound together as an elite and can be easily distinguished from "AOL users." Some of the people I discuss would not call themselves geeks, and some would. Not all are engineers or programmers: I have met businessmen, lawyers, activists, bloggers, gastroenterologists, anthropologists, lesbians, schizophrenics, scientists, poets, people suffering from malaria, sea captains, drug dealers, and people who keep lemurs, many of whom refer to themselves as geeks, some of the time.[4] There are also lawyers, politicians, sociologists, and economists who may not refer to themselves as geeks, but who care about the Internet just as other geeks do. By contrast "users" of the Internet, even those who use it eighteen out of twenty-four hours in a day to ship goods and play games, are not necessarily geeks by this characterization.

Operating Systems and Social Systems

Berlin, November 1999. I am in a very hip club in Mitte called WMF. It's about eight o'clock—five hours too early for me to be a hipster, but the context is extremely cool. WMF is in a hard-to-find, abandoned building in the former East; it is partially converted, filled with a mixture of new and old furnishings, video projectors, speakers, makeshift bars, and dance-floor lighting. A crowd of around fifty people lingers amid smoke and Beck's beer bottles,

sitting on stools and chairs and sofas and the floor. We are listening to an academic read a paper about Claude Shannon, the MIT engineer credited with the creation of information theory. The author is smoking and reading in German while the audience politely listens. He speaks for about seventy minutes. There are questions and some perfunctory discussion. As the crowd breaks up, I find myself, in halting German that quickly converts to English, having a series of animated conversations about the GNU General Public License, the Debian Linux Distribution, open standards in net radio, and a variety of things for which Claude Shannon is the perfect ghostly technopaterfamilias, even if his seventy-minute invocation has clashed heavily with the surroundings.

Despite my lame German, I still manage to jump deeply into issues that seem extremely familiar: Internet standards and open systems and licensing issues and namespaces and patent law and so on. These are not businesspeople, this is not a start-up company. As I would eventually learn, there was even a certain disdain for *die Krawattenfaktor*, the suit-and-tie factor, at these occasional, hybrid events hosted by Mikro e.V., a nonprofit collective of journalists, academics, activists, artists, and others interested in new media, the Internet, and related issues. Mikro's constituency included people from Germany, Holland, Austria, and points eastward. They took some pride in describing Berlin as "the farthest East the West gets" and arranged for a group photo in which, facing West, they stood behind the statue of Marx and Lenin, who face East and look eternally at the iconic East German radio tower (*Funkturm*) in Alexanderplatz. Mikro's members are resolutely activist and see the issues around the Internet-as-infrastructure not in terms of its potential for business opportunities, but in urgently political and unrepentantly aesthetic terms—terms that are nonetheless similar to those of Sean and Adrian, from whom I learned the language that allows me to mingle with the Mikro crowd at WMF. I am now a geek.

Before long, I am talking with Volker Grassmuck, founding member of Mikro and organizer of the successful "Wizards of OS" conference, held earlier in the year, which had the very intriguing subtitle "Operating Systems and Social Systems." Grassmuck is inviting me to participate in a planning session for the next WOS, held at the Chaos Computer Congress, a hacker gathering that occurs each year in December in Berlin. In the following months I will meet a huge number of people who seem, uncharacteristically for artists

and activists, strangely obsessed with configuring their Linux distributions or hacking the http protocol or attending German Parliament hearings on copyright reform. The political lives of these folks have indeed mixed up operating systems and social systems in ways that are more than metaphorical.

The Idea of Order at the Keyboard

If intuition can lead one from geek to geek, from start-up to nightclub, and across countries, languages, and professional orientations, it can only be due to a shared set of ideas of how things fit together in the world. These ideas might be "cultural" in the traditional sense of finding expression among a community of people who share backgrounds, homes, nations, languages, idioms, ethnos, norms, or other designators of belonging and co-presence. But because the Internet—like colonialism, satellite broadcasting, and air travel, among other things—crosses all these lines with abandon that the shared idea of order is better understood as part of a public, or public sphere, a vast republic of letters and media and ideas circulating in and through our thoughts and papers and letters and conversations, at a planetary scope and scale.

"Public sphere" is an odd kind of thing, however. It is at once a concept—intended to make sense of a space that is not the here and now, but one made up of writings, ideas, and discussions—and a set of ideas that people have about themselves and their own participation in such a space. I must be able to imagine myself speaking and being spoken to in such a space and to imagine a great number of other people also doing so according to unwritten rules we share. I don't need a complete theory, and I don't need to call it a public sphere, but I must somehow share an idea of order with all those other people who also imagine themselves participating in and subjecting themselves to that order. In fact, if the public sphere exists as more than just a theory, then it has no other basis than just such a shared imagination of order, an imagination which provides a guide against which to make judgments and a map for changing or achieving that order. Without such a shared imagination, a public sphere is otherwise nothing more than a cacophony of voices and information, nothing more than a stream of data, structured and formatted by and for machines, whether paper or electronic.

Charles Taylor, building on the work of Jürgen Habermas and Michael Warner, suggests that the public sphere (both idea and thing) that emerged in the eighteenth century was created through practices of communication and association that reflected a moral order in which the public stands outside power and guides or checks its operation through shared discourse and enlightened discussion. Contrary to the experience of bodies coming together into a common space (Taylor calls them "topical spaces," such as conversation, ritual, assembly), the crucial component is that the public sphere "transcends such topical spaces. We might say that it knits a plurality of spaces into one larger space of non-assembly. The same public discussion is deemed to pass through our debate today, and someone else's earnest conversation tomorrow, and the newspaper interview Thursday and so on. . . . The public sphere that emerges in the eighteenth century is a meta-topical common space."[5]

Because of this, Taylor refers to his version of a public as a "social imaginary," a way of capturing a phenomena that wavers between having concrete existence "out there" and imagined rational existence "in here." There are a handful of other such imagined spaces—the economy, the self-governing people, civil society—and in Taylor's philosophical history they are related to each through the "ideas of moral and social order" that have developed in the West and around the world.[6]

Taylor's social imaginary is intended to do something specific: to resist the "spectre of idealism," the distinction between ideas and practices, between "ideologies" and the so-called material world as "rival causal agents." Taylor suggests, "Because human practices are the kind of thing that makes sense, certain ideas are internal to them; one cannot distinguish the two in order to ask the question Which causes which?"[7] Even if materialist explanations of cause are satisfying, as they often are, Taylor suggests that they are so "at the cost of being implausible as a universal principle," and he offers instead an analysis of the rise of the modern imaginaries of moral order.[8]

The concept of recursive public, like that of Taylor's public sphere, is understood here as a kind of social imaginary. The primary reason is to bypass the dichotomy between ideas and material practice. Because the creation of software, networks, and legal documents are precisely the kinds of activities that trouble this distinction—they are at once ideas and things that have material effects in the

world, both expressive and performative—it is extremely difficult to identify the properly material materiality (source code? computer chips? semiconductor manufacturing plants?). This is the first of the reasons why a recursive public is to be distinguished from the classic formulae of the public sphere, that is, that it requires a kind of imagination that includes the writing and publishing and speaking and arguing we are familiar with, as well as the making of new kinds of software infrastructures for the circulation, archiving, movement, and modifiability of our enunciations.

The concept of a social imaginary also avoids the conundrums created by the concept of "ideology" and its distinction from material practice. Ideology in its technical usage has been slowly and surely overwhelmed by its pejorative meaning: "The ideological is never one's own position; it is always the stance of someone else, always *their* ideology."[9] If one were to attempt an explanation of any particular ideology in nonpejorative terms, there is seemingly nothing that might rescue the explanation from itself becoming ideological.

The problem is an old one. Clifford Geertz noted it in "Ideology as a Cultural System," as did Karl Mannheim before him in *Ideology and Utopia*: it is the difficulty of employing a non-evaluative concept of ideology.[10] Of all the versions of struggle over the concept of a scientific or objective sociology, it is the claim of exploring ideology objectively that most rankles. As Geertz put it, "Men do not care to have beliefs to which they attach great moral significance examined dispassionately, no matter for how pure a purpose; and if they are themselves highly ideologized, they may find it simply impossible to believe that a disinterested approach to critical matters of social and political conviction can be other than a scholastic sham."[11]

Mannheim offered one response: a version of epistemological relativism in which the analysis of ideology included the ideological position of the analyst. Geertz offered another: a science of "symbolic action" based in Kenneth Burke's work and drawing on a host of philosophers and literary critics.[12] Neither the concept of ideology, nor the methods of cultural anthropology have been the same since. "Ideology" has become one of the most widely deployed (some might say, most diffuse) tools of critique, where critique is understood as the analysis of cultural patterns given in language and symbolic structures, for the purposes of bringing

to light systems of hegemony, domination, authority, resistance, and/or misrecognition.[13] However, the practices of critique are just as (if not more) likely to be turned on critical scholars themselves, to show how the processes of analysis, hidden assumptions, latent functions of the university, or other unrecognized features the material, non-ideological real world cause the analyst to fall into an ideological trap.

The concept of ideology takes a turn toward "social imaginary" in Paul Ricoeur's *Lectures on Ideology and Utopia*, where he proposes ideological and utopian thought as two components of "social and cultural imagination." Ricoeur's overview divides approaches to the concept of ideology into three basic types—the distorting, the integrating, and the legitimating—according to how actors deal with reality through (symbolic) imagination. Does the imagination distort reality, integrate it, or legitimate it vis-à-vis the state? Ricoeur defends the second, Geertzian flavor: ideologies integrate the symbolic structure of the world into a meaningful whole, and "only because the structure of social life is already symbolic can it be distorted."[14]

For Ricoeur, the very substance of life begins in the interpretation of reality, and therefore ideologies (as well as utopias—and perhaps conspiracies) could well be treated as systems that integrate those interpretations into the meaningful wholes of political life. Ricoeur's analysis of the integration of reality though social imagination, however, does not explicitly address how imagination functions: what exactly is the nature of this symbolic action or interpretation, or imagination? Can one know it from the outside, and does it resist the distinction between ideology and material practice? Both Ricoeur and Geertz harbor hope that ideology can be made scientific, that the integration of reality through symbolic action requires only the development of concepts adequate to the job.

Re-enter Charles Taylor. In *Modern Social Imaginaries* the concept of social imaginary is distinctive in that it attempts to capture the specific integrative imaginations of modern moral and social order. Taylor stresses that they are *imaginations*—not necessarily theories—of modern moral and social order: "By social imaginary, I mean something much broader and deeper than the intellectual schemes people may entertain when they think about social reality in a disengaged mode. I am thinking, rather, of the ways in

which people imagine their social existence, how they fit together with others, how things go on between them and their fellows, the expectations that are normally met, and the deeper normative notions and images that underlie these expectations."[15] Social imaginaries develop historically and result in both new institutions and new subjectivities; the concepts of public, market, and civil society (among others) are located in the imaginative faculties of actors who recognize the shared, common existence of these ideas, even if they differ on the details, and the practices of those actors reflect a commitment to working out these shared concepts.

Social imaginaries are an extension of "background" in the philosophical sense: "a wider grasp of our whole predicament."[16] The example Taylor uses is that of marching in a demonstration: the action is in our imaginative repertory and has a meaning that cannot be reduced to the local context: "We know how to assemble, pick up banners and march. . . . [W]e understand the ritual. . . . [T]he immediate sense of what we are doing, getting the message to our government and our fellow citizens that the cuts must stop, say, makes sense in a wider context, in which we see ourselves standing in a continuing relation with others, in which it is appropriate to address them in this manner."[17] But we also stand "internationally" and "in history" against a background of stories, images, legends, symbols, and theories. "The background that makes sense of any given act is wide and deep. It doesn't include everything in our world, but the relevant sense-giving features can't be circumscribed. . . . [It] draws on our whole world, that is, our sense of our whole predicament in time and space, among others and in history."[18]

The social imaginary is not simply the norms that structure our actions; it is also a sense of what makes norms achievable or "realizable," as Taylor says. This is the idea of a "moral order," one that we expect to exist, and if it doesn't, one that provides a plan for achieving it. For Taylor, there is such a thing as a "modern idea of order," which includes, among other things, ideas of what it means to be an individual, ideas of how individual passions and desires are related to collective association, and, most important, ideas about living in time together (he stresses a radically secular conception of time—secular in a sense that means more than simply "outside religion"). He by no means insists that this is the only such definition of modernity (the door is wide open to understanding alternative modernities), but that the modern idea of moral order is

one that dominates and structures a very wide array of institutions and individuals around the world.

The "modern idea of moral order" is a good place to return to the question of geeks and their recursive publics. Are the ideas of order shared by geeks different from those Taylor outlines? Do geeks like Sean and Adrian, or activists in Berlin, possess a distinctive social imaginary? Or do they (despite their planetary dispersal) participate in this common modern idea of moral order? Do the stories and narratives, the tools and technologies, the theories and imaginations they follow and build on have something distinctive about them? Sean's and Adrian's commitment to transforming healthcare seems to be, for instance, motivated by a notion of moral order in which the means of allocation of healthcare might become more just, but it is also shot through with technical ideas about the role of standards, the Internet, and the problems with current technical solutions; so while they may seem to be simply advocating for better healthcare, they do so through a technical language and practice that are probably quite alien to policymakers, upper management, and healthcare advocacy groups that might otherwise be in complete sympathy.

The affinity of geeks for each other is processed through and by ideas of order that are both moral *and* technical—ideas of order that do indeed mix up "operating systems and social systems." These systems include the technical means (the infrastructure) through which geeks meet, assemble, collaborate, and plan, as well as how they talk and think about those activities. The infrastructure—the Internet—allows for a remarkably wide and diverse array of people to encounter and engage with each other. That is to say, the idea of order shared by geeks is shared because they are geeks, because they "get it," because the Internet's structure and software have taken a particular form through which geeks come to understand the moral order that gives the fabric of their political lives warp and weft.

Internet Silk Road

Bangalore, March 2000. I am at another bar, this time on one of Bangalore's trendiest streets. The bar is called Purple Haze, and I have been taken there, the day after my arrival, by Udhay Shankar

N. Inside it is dark and smoky, purple, filled with men between eighteen and thirty, and decorated with posters of Jimi Hendrix, Black Sabbath, Jim Morrison (Udhay: "I hate that band"), Led Zeppelin, and a somewhat out of place Frank Zappa (Udhay: "One of my political and musical heroes"). All of the men, it appears, are singing along with the music, which is almost without exception heavy metal.

I engage in some stilted conversation with Udhay and his cousin Kirti about the difference between Karnatic music and rock-and-roll, which seems to boil down to the following: Karnatic music decreases metabolism and heart rate, leading to a relaxed state of mind; rock music does the opposite. Given my aim of focusing on the Internet and questions of openness, I have already decided not to pay attention to this talk of music. In retrospect, I understand this to have been a grave methodological error: I underestimated the extent to which the subject of music has been one of the primary routes into precisely the questions about the "reorientation of knowledge and power" I was interested in. Over the course of the evening and the following days, Udhay introduced me, as promised, to a range of people he either knew or worked with in some capacity. Almost all of the people I met appeared to sincerely love heavy-metal music.

I met Udhay Shankar N. in 1999 through a newsletter, distributed via e-mail, called *Tasty Bits from the Technology Front*. It was one of a handful of sources I watched closely while in Berlin, looking for such connections to geek culture. The newsletter described a start-up company in Bangalore, one that was devoted to creating a gateway between the Internet and mobile phones, and which was, according to the newsletter, an entirely Indian operation, though presumably with U.S. venture funds. I wanted to find a company to compare to Amicas: a start-up, run by geeks, with a similar approach to the Internet, but halfway around the world and in a "culture" that might be presumed to occupy a very different kind of moral order. Udhay invited me to visit and promised to introduce me to everyone he knew. He described himself as a "random networker"; he was not really a programmer or a designer or a Free Software geek, despite his extensive knowledge of software, devices, operating systems, and so on, including Free and Open Source Software. Neither was he a businessman, but rather described himself as the guy who "translates between the suits and the techs."

Udhay "collects interesting people," and it was primarily through his zest for collecting that I met all the people I did. I met cosmopolitan activists and elite lawyers and venture capitalists and engineers and cousins and brothers and sisters of engineers. I met advertising executives and airline flight attendants and consultants in Bombay. I met journalists and gastroenterologists, computer-science professors and musicians, and one mother of a robot scientist in Bangalore. Among them were Muslims, Hindus, Jains, Jews, Parsis, and Christians, but most of them considered themselves more secular and scientific than religious. Many were self-educated, or like their U.S. counterparts, had dropped out of university at some point, but continued to teach themselves about computers and networks. Some were graduates or employees of the Indian Institute of Science in Bangalore, an institution that was among the most important for Indian geeks (as Stanford University is to Silicon Valley, many would say). Among the geeks to whom Udhay introduced me, there were only two commonalities: the geeks were, for the most part, male, and they all loved heavy-metal music.[19]

While I was in Bangalore, I was invited to join a mailing list run by Udhay called Silk-list, an irregular, unmoderated list devoted to "intelligent conversation." The list has no particular focus: long, meandering conversations about Indian politics, religion, economics, and history erupt regularly; topics range from food to science fiction to movie reviews to discussions on Kashmir, Harry Potter, the singularity, or nanotechnology. Udhay started Silk-list in 1997 with Bharath Chari and Ram Sundaram, and the recipients have included hundreds of people around the world, some very well-known ones, programmers, lawyers, a Bombay advertising executive, science-fiction authors, entrepreneurs, one member of the start-up Amicas, at least two transhumanists, one (diagnosed) schizophrenic, and myself. Active participants usually numbered about ten to fifteen, while many more lurked in the background.

Silk-list is an excellent index of the relationship between the network of people in Bangalore and their connection to a worldwide community on the Internet—a fascinating story of the power of heterogeneously connected networks and media. Udhay explained that in the early 1990s he first participated in and then taught himself to configure and run a modem-based networking system known as a Bulletin Board Service (BBS) in Bangalore. In 1994 he heard about a book by Howard Rheingold called *The Virtual*

Community, which was his first introduction to the Internet. A couple of years later when he finally had access to the Internet, he immediately e-mailed John Perry Barlow, whose work he knew from *Wired* magazine, to ask for Rheingold's e-mail address in order to connect with him. Rheingold and Barlow exist, in some ways, at the center of a certain kind of geek world: Rheingold's books are widely read popular accounts of the social and community aspects of new technologies that have often had considerable impact internationally; Barlow helped found the Electronic Frontier Foundation and is responsible for popularizing the phrase "information wants to be free."[20] Both men had a profound influence on Udhay and ultimately provided him with the ideas central to running an online community. A series of other connections of similar sorts—some personal, some precipitated out of other media and other channels, some entirely random—are what make up the membership of Silk-list.[21]

Like many similar communities of "digerati" during and after the dot.com boom, Silk-list constituted itself more or less organically around people who "got it," that is, people who claimed to understand the Internet, its transformative potential, and who had the technical skills to participate in its expansion. Silk-list was not the only list of its kind. Others such as the *Tasty Bits* newsletter, the FoRK (Friends of Rohit Khare) mailing list (both based in Boston), and the Nettime and Syndicate mailing lists (both based in the Netherlands) ostensibly had different reasons for existence, but many had the same subscribers and overlapping communities of geeks. Subscription was open to anyone, and occasionally someone would stumble on the list and join in, but most were either invited by members or friends of friends, or they were connected by virtue of cross-posting from any number of other mailing lists to which members were subscribed.

/pub

Silk-list is public in many senses of the word. Practically speaking, one need not be invited to join, and the material that passes through the list is publicly archived and can be found easily on the Internet. Udhay does his best to encourage everyone to speak and to participate, and to discourage forms of discourse that he thinks

might silence participants into lurking. Silk-list is not a government, corporate, or nongovernmental list, but is constituted only through the activity of geeks finding each other and speaking to each other on this list (which can happen in all manner of ways: through work, through school, through conferences, through fame, through random association, etc.). Recall Charles Taylor's distinction between a topical and a metatopical space. Silk-list is not a conventionally topical space: at no point do all of its members meet face-to-face (though there are regular meet-ups in cities around the world), and they are not all online at the same time (though the volume and tempo of messages often reflect who is online "speaking" to each other at any given moment). It is a topical space, however, if one considers it from the perspective of the machine: the list of names on the mailing list are all assembled together in a database, or in a file, on the server that manages the mailing list. It is a stretch to call this an "assembly," however, because it assembles only the avatars of the mailing-list readers, many of whom probably ignore or delete most of the messages.

Silk-list is certainly, on the other hand, a "metatopical" public. It "knits together" a variety of topical spaces: my discussion with friends in Houston, and other members' discussions with people around the world, as well as the sources of multiple discussions like newspaper and magazine articles, films, events, and so on that are reported and discussed online. But Silk-list is not "The" public—it is far from being the only forum in which the public sphere is knitted together. Many, many such lists exist.

In *Publics and Counterpublics* Michael Warner offers a further distinction. "The" public is a social imaginary, one operative in the terms laid out by Taylor: as a kind of vision of order evidenced through stories, images, narratives, and so on that constitute the imagination of what it means to be part of the public, as well as plans necessary for creating the public, if necessary. Warner distinguishes, however, between a concrete, embodied audience, like that at a play, a demonstration, or a riot (a topical public in Taylor's terms), and an audience brought into being by discourse and its circulation, an audience that is not metatopical so much as it is a public that is concrete in a different way; it is concrete not in the face-to-face temporality of the speech act, but in the sense of calling a public into being through an address that has a different temporality. It is a public that is concrete in a media-specific

manner: it depends on the structures of creation, circulation, use, performance, and reuse of particular kinds of discourse, particular objects or instances of discourse.

Warner's distinction has a number of implications. The first, as Warner is careful to note, is that the existence of particular media is not sufficient for a public to come into existence. Just because a book is printed does not mean that a public exists; it requires also that the public take corresponding action, that is, that they read it. To be part of a particular public is to choose to pay attention to those who choose to address those who choose to pay attention . . . and so on. Or as Warner puts it, "The circularity is essential to the phenomenon. A public might be real and efficacious, but its reality lies in just this reflexivity by which an addressable object is conjured into being in order to enable the very discourse that gives it existence."[22]

This "autotelic" feature of a public is crucial if one is to understand the *function* of a public as standing outside of power. It simply cannot be organized by the state, by a corporation, or by any other social totality if it is to have the legitimacy of an independently functioning public. As Warner puts it, "A public organizes itself independently of state institutions, law, formal frameworks of citizenship, or preexisting institutions such as the church. If it were not possible to think of the public as organized independently of the state or other frameworks, the public could not be sovereign with respect to the state. . . . Speaking, writing, and thinking involve us—actively and immediately—in a public, and thus in the being of the sovereign."[23]

Warner's description makes no claim that any public or even The Public actually takes this form in the present: it is a description of a social imaginary or a "faith" that allows individuals to make sense of their actions according to a modern idea of social order. As Warner (and Habermas before him) suggests, the existence of such autonomous publics—and certainly the idea of "public opinion"—does not always conform to this idea of order. Often such publics turn out to have been controlled all along by states, corporations, capitalism, and other forms of social totality that determine the nature of discourse in insidious ways. A public whose participants have no faith that it is autotelic and autonomous is little more than a charade meant to assuage opposition to authority, to transform

political power and equality into the negotiation between unequal parties.

Is Silk-list a public? More important, is it a sovereign one? Warner's distinction between different media-specific forms of assembly is crucial to answering this question. If one wants to know whether a mailing list on the Internet is more or less likely to be a sovereign public than a book-reading public or the nightly-news-hearing one, then one needs to approach it from the specificity of the form of discourse. This specificity not only includes whether the form is text or video and audio, or whether the text is ASCII or Unicode, or the video PAL or NTSC, but it also includes the means of creation, circulation, and reuse of that discourse as well.

For example, consider the differences between a book published in a conventional fashion, by a conventional, corporate press, distributed to bookstores or via Amazon.com, and a book published by an Internet start-up which makes an electronic copy freely available with a copyleft license, yet charges (a lower price) for a print-on-demand hardcopy. Both books might easily enter the metatopical space of The Public: discussed in homes, schools, on mailing lists, glowingly reviewed or pilloried, perhaps having effects on corporate behavior, state, or public policy. The former, however, is highly constrained in terms of who will author such a book, how it will be distributed, marketed, edited, and revised, and so on. Copyright law will restrict what readers can do with it, including how they might read it or subsequently circulate it or make derivative use of it. However, a traditionally published book is also enriched by its association with a reputable corporation: it is treated more or less immediately as authoritative, perhaps as meeting some standard of accuracy, precision, or even truth, and its quality is measured primarily by sales.

The on-demand, Internet-mediated book, by contrast, will have a much different temporality of circulation: it might languish in obscurity due to lack of marketing or reputable authority, or it might get mentioned somewhere like the *New York Times* and suddenly become a sensation. For such a book, copyright law (in the form of a copyleft license) might allow a much wider range of uses and reuses, but it will restrict certain forms of commercialization of the text. The two publics might therefore end up looking quite different, overlapping, to be sure, but varying in terms of their control

and the terms of admittance. What is at stake is the power of one or the other such public to appear as an independent and sovereign entity—free from suspect constraints and control—whose function is to argue with other constituted forms of power.

The conventionally published book may well satisfy all the criteria of being a public, at least in the colloquial sense of making a set of ideas and a discourse widely available and expecting to influence, or receive a response from, constituted forms of sovereign power. However, it is only the latter "on-demand" scheme for publishing that satisfies the criteria of being a *recursive* public. The differences in this example offer a crude indication of why the Internet is so crucially important to geeks, so important that it draws them together, in its defense, as an infrastructure that enables the creation of publics that are thought to be autonomous, independent, and autotelic. Geeks share an idea of moral and technical order when it comes to the Internet; not only this, but they share a commitment to maintaining that order because it is what allows them to associate as a recursive public in the first place. They discover, or rediscover, through their association, the power and possibility of occupying the position of independent public—one not controlled by states, corporations, or other organizations, but open (they claim) through and through—and develop a desire to defend it from encroachment, destruction, or refeudalization (to use Habermas's term for the fragmentation of the public sphere).

The recursive public is thus not only the book and the discourse around the book. It is not even "content" expanded to include all kinds of media. It is also the technical structure of the Internet as well: its software, its protocols and standards, its applications and software, its legal status and the licenses and regulations that govern it. This captures both of the reasons why recursive publics are distinctive: (1) they include not only the discourses of a public, but the ability to make, maintain, and manipulate the infrastructures of those discourses as well; and (2) they are "layered" and include both discourses and infrastructures, to a specific technical extent (i.e., not all the way down). The meaning of which layers are important develops more or less immediately from direct engagement with the medium. In the following example, for instance, Napster represents the potential of the Internet in miniature—as an application—but it also connects immediately to concerns about the core protocols that govern the Internet and the process of stan-

dardization that governs the development of these protocols: hence recursion through the layers of an infrastructure.

These two aspects of the recursive public also relate to a concern about the fragmentation or refeudalization of the public sphere: *there is only one Internet*. Its singularity is not technically determined or by any means necessary, but it is what makes the Internet so valuable to geeks. It is a contest, the goal of which is to maintain the Internet as an infrastructure for autonomous and autotelic publics to emerge as part of The Public, understood as part of an imaginary of moral and technical order: operating systems and social systems.

From Napster to the Internet

On 27 July 2000 Eugen Leitl cross-posted to Silk-list a message with the subject line "Prelude to the Singularity." The message's original author, Jeff Bone (not at the time a member of Silk-list), had posted the "op-ed piece" initially to the FoRK mailing list as a response to the Recording Industry Association of America's (RIAA) actions against Napster. The RIAA had just succeeded in getting U.S. district judge Marilyn Hall Patel, Ninth Circuit Court of Appeals, to issue an injunction to Napster to stop downloads of copyrighted music. Bone's op-ed said,

> Popular folklore has it that the Internet was designed with decentralized routing protocols in order to withstand a nuclear attack. That is, the Internet "senses damage" and "routes around it." It has been said that, on the 'Net, censorship is perceived as damage and is subsequently routed around. The RIAA, in a sense, has cast itself in a censor's role. Consequently, the music industry will be perceived as damage—and it will be routed around. There is *no doubt* that this will happen, and that technology will evolve more quickly than businesses and social institutions can; there are numerous highly-visible projects already underway that attempt to create technology that is invulnerable to legal challenges of various kinds. Julian Morrison, the originator of a project (called Fling) to build a fully anonymous/untraceable suite of network protocols, expresses this particularly eloquently.[24]

Bone's message is replete with details that illustrate the meaning and value of the Internet to geeks, and that help clarify the concept

of a recursive public. While it is only one message, it nonetheless condenses and expresses a variety of stories, images, folklore, and technical details that I elaborate herein.

The Napster shutdown in 2000 soured music fans and geeks alike, and it didn't really help the record labels who perpetrated it either. For many geeks, Napster represented the Internet in miniature, an innovation that both demonstrated something on a scope and scale never seen before, and that also connected people around something they cared deeply about—their shared interest in music. Napster raised interesting questions about its own success: Was it successful because it allowed people *to develop new musical interests* on a scope and scale they had never experienced before? Or was it successful because it gave people with already existing musical interests a way *to share music* on a scope and scale they had never experienced before? That is to say, was it an innovation in marketing or in distribution? The music industry experienced it as the latter and hence as direct competition with their own means of distribution. Many music fans experienced it as the former, what Cory Doctorow nicely labeled "risk-free grazing," meaning the ability to try out an almost unimaginable diversity of music before choosing what to invest one's interests (and money) in. To a large extent, Napster was therefore a recapitulation of what the Internet already meant to geeks.

Bone's message, the event of the Napster shutdown, and the various responses to it nicely illustrate the two key aspects of the recursive public: first, the way in which geeks argue not only about rights and ideas (e.g., is it legal to share music?) but also about the infrastructures that allow such arguing and sharing; second, the "layers" of a recursive public are evidenced in the immediate connection of Napster (an application familiar to millions) to the "decentralized routing protocols" (TCP/IP, DNS, and others) that made it possible for Napster to work the way it did.

Bone's message contains four interrelated points. The first concerns the concept of autonomous technical progress. The title "Prelude to the Singularity" refers to a 1993 article by Vernor Vinge about the notion of a "singularity," a point in time when the speed of autonomous technological development outstrips the human capacity to control it.[25] The notion of singularity has the status of a kind of colloquial "law" similar to Moore's Law or Metcalfe's Law, as well as signaling links to a more general literature with roots in

libertarian or classically liberal ideas of social order ranging from John Locke and John Stuart Mill to Ayn Rand and David Brin.[26]

Bone's affinity for transhumanist stories of evolutionary theory, economic theory, and rapid innovation sets the stage for the rest of his message. The crucial rhetorical gambit here is the appeal to inevitability (as in the emphatic "there is *no doubt* that this will happen"): Bone establishes that he is speaking to an audience that is accustomed to hearing about the inevitability of technical progress and the impossibility of legal maneuvering to change it, but his audience may not necessarily agree with these assumptions. Geeks occupy a spectrum from "polymath" to "transhumanist," a spectrum that includes their understandings of technological progress and its relation to human intervention. Bone's message clearly lands on the far transhumanist side.

A second point concerns censorship and the locus of power: according to Bone, power does not primarily reside with the government or the church, but comes instead from the private sector, in this case the coalition of corporations represented by the RIAA. The significance of this has to do with the fact that a "public" is expected to be its own sovereign entity, distinct from church, state, or corporation, and while censorship by the church or the state is a familiar form of aggression against publics, censorship by corporations (or consortia representing them), as it strikes Bone and others, is a novel development. Whether the blocking of file-sharing can legitimately be called censorship is also controversial, and many Silk-list respondents found the accusation of censorship untenable.

Proving Bone's contention, over the course of the subsequent years and court cases, the RIAA and the Motion Picture Association of America (MPAA) have been given considerably more police authority than even many federal agencies—especially with regard to policing networks themselves (an issue which, given its technical abstruseness, has rarely been mentioned in the mainstream mass media). Both organizations have not only sought to prosecute file-sharers but have been granted rights to obtain information from Internet Service Providers about customer activities and have consistently sought the right to secretly disable (hack into, disable, or destroy) private computers suspected of illegal activity. Even if these practices may not be defined as censorship per se, they are nonetheless fine examples of the issues that most exercise geeks: the use of legal means by a few (in this case, private corporations) to

suppress or transform technologies in wide use by the many. They also index the problems of monopoly, antitrust, and technical control that are not obvious and often find expression, for example, in allegories of reformation and the control of the music-sharing laity by papal authorities.

Third, Bone's message can itself be understood in terms of the reorientation of knowledge and power. Although what it means to call his message an "op-ed" piece may seem obvious, Bone's message was not published anywhere in any conventional sense. It doesn't appear to have been widely cited or linked to. However, for one day at least, it was a heated discussion topic on three mailing lists, including Silk-list. "Publication" in this instance is a different kind of event than getting an op-ed in the *New York Times*.

The material on Silk-list rests somewhere between private conversation (in a public place, perhaps) and published opinion. No editor made a decision to "publish" the message—Bone just clicked "send." However, as with any print publication, his piece was theoretically accessible by anyone, and what's more, a potentially huge number of copies may be archived in many different places (the computers of all the participants, the server that hosts the list, the Yahoo! Groups servers that archive it, Google's search databases, etc.). Bone's message exemplifies the recursive nature of the recursive public: it is a public statement about the openness of the Internet, and it is an *example* of the new forms of publicness it makes possible through its openness.

The constraints on who speaks in a public sphere (such as the power of printers and publishers, the requirements of licensing, or issues of cost and accessibility) are much looser in the Internet era than in any previous one. The Internet gives a previously unknown Jeff Bone the power to dash off a manifesto without so much as a second thought. On the other hand, the ease of distribution belies the difficulty of actually being heard: the multitudes of other Jeff Bones make it much harder to get an audience. In terms of publics, Bone's message can constitute a public in the same sense that a *New York Times* op-ed can, but its impact and meaning will be different. His message is openly and freely available for as long as there are geeks and laws and machines that maintain it, but the *New York Times* piece will have more authority, will be less accessible, and, most important, will not be available to just anyone. Geeks imagine a space where anyone can speak with similar reach and staying

power—even if that does not automatically imply authority—and they imagine that it should remain open at all costs. Bone is therefore interested precisely in a technical infrastructure that ensures his right to speak about that infrastructure and offer critique and guidance concerning it.

The ability to create and to maintain such a recursive public, however, raises the fourth and most substantial point that Bone's message makes clear. The leap to speaking about the "decentralized routing protocols" represents clearly the shared moral and technical order of geeks, derived in this case from the specific details of the Internet. Bone's post begins with a series of statements that are part of the common repertoire of technical stories and images among geeks. Bone begins by making reference to the "folklore" of the Internet, in which routing protocols are commonly believed to have been created to withstand a nuclear attack. In calling it folklore he suggests that this is not a precise description of the Internet, but an image that captures its design goals. Bone collapses it into a more recent bit of folklore: "The Internet treats censorship as damage and routes around it."[27] Both bits of folklore are widely circulated and cited; they encapsulate one of the core intellectual ideas about the architecture of the Internet, that is, its open and distributed interconnectivity. There is certainly a specific technical backdrop for this suggestion: the TCP/IP "internetting" protocols were designed to link up multiple networks without making them sacrifice their autonomy and control. However, Bone uses this technical argument more in the manner of a social imaginary than of a theory, that is, as a way of thinking about the technical (and moral) order of the Internet, of what the Internet is supposed to be like.

In the early 1990s this version of the technical order of the Internet was part of a vibrant libertarian dogma asserting that the Internet simply could not be governed by any land-based sovereign and that it was fundamentally a place of liberty and freedom. This was the central message of people such as John Perry Barlow, John Gilmore, Howard Rheingold, Esther Dyson, and a host of others who populated both the pre-1993 Internet (that is, before the World Wide Web became widely available) and the pages of magazines such as *Wired* and *Mondo 2000*—the same group of people, incidentally, whose ideas were visible and meaningful to Udhay Shankar and his friends in India even prior to Internet access there, not to mention to Sean and Adrian in Boston, and artists and activists in

Europe, all of whom often reacted more strongly against this libertarian aesthetic.

For Jeff Bone (and a great many geeks), the folkloric notion that "the net treats censorship as damage" is a very powerful one: it suggests that censorship is impossible because there is no central point of control. A related and oft-cited sentiment is that "trying to take something off of the Internet is like trying to take pee out of a pool." This is perceived by geeks as a virtue, not a drawback, of the Internet.

The argument is quite complex, however: on one side of a spectrum, there is the belief that the structure of the Internet ensures that censorship cannot happen, technically speaking, so long as the Internet's protocols and software remain open. Furthermore, that structure ensures that all attempts to regulate the Internet will also fail (e.g., the related sentiment that "the Internet treats Congress as damage and routes around it").

On the other side of the spectrum, however, this view of the unregulatable nature of the Internet has been roundly criticized, most prominently by Lawrence Lessig, who is otherwise often in sympathy with geek culture. Lessig suggests that just because the Internet has a particular structure does not mean that it must always be that way.[28] His argument has two prongs: first, that the Internet is structured the way it is because it is made of code that people write, and thus it could have been and will be otherwise, given that there are changes and innovations occurring all the time; second, that the particular structure of the Internet therefore governs or regulates behavior in particular ways: Code is Law. So while it may be true that no one can make the Internet "closed" by passing a law, it is also true that the Internet could become closed if the technology were to be altered for that purpose, a process that may well be nudged and guided by laws, regulations, and norms.

Lessig's critique is actually at the heart of Bone's concern, and the concern of recursive publics generally: the Internet is a *contest* and one that needs to be repeatedly and constantly replayed in order to maintain it as the legitimate infrastructure through which geeks associate with one another. Geeks argue in detail about what distinguishes technical factors from legal or social ones. Openness on the Internet is complexly intertwined with issues of availability, price, legal restriction, usability, elegance of design, censorship, trade secrecy, and so on.

However, even where openness is presented as a natural tendency for technology (in oft-made analogies with reproductive fitness and biodiversity, for example), it is only a partial claim in that it represents only one of the "layers" of a recursive public. For instance, when Bone suggests that the net is "invulnerable to legal attack" because "technology will evolve more quickly than businesses and social institutions can," he is not only referring to the fact that the Internet's novel technical configuration has few central points of control, which makes it difficult for a single institution to control it, but also talking about the distributed, loosely connected networks of people who have the right to write and rewrite software and deal regularly with the underlying protocols of the Internet—in other words, of geeks themselves.

Operating systems and social systems: the imagination of order shared by geeks is both moral and technical. It is not only about the technical structure of the Internet, however innovative that is, but also about the legal and social structure that has emerged with it, the kind of order that has made it possible for geeks to associate in a planetary public and to become aware of the value of the space they have made.

Many geeks, perhaps including Bone, discover the nature of this order by coming to understand how the Internet works—how it works technically, but also who created it and how. Some have come to this understanding through participation in Free Software (an exemplary "recursive public"), others through stories and technologies and projects and histories that illuminate the process of creating, growing, and evolving the Internet. The story of the process by which the Internet is standardized is perhaps the most well known: it is the story of the Internet Engineering Task Force and its Requests for Comments system.

Requests for Comments

For many geeks, the Internet Engineering Task Force (IETF) and its Requests for Comments (RFC) system exemplify key features of the moral and technical order they share, the "stories and practices" that make up a social imaginary, according to Charles Taylor. The IETF is a longstanding association of Internet engineers who try to help disseminate some of the core standards of the Internet through

the RFC process. Membership is open to individuals, and the association has very little real control over the structure or growth of the Internet—only over the key process of Internet standardization. Its standards rarely have the kind of political legitimacy that one associates with international treaties and the standards bodies of Geneva, but they are nonetheless de facto legitimate. The RFC process is an unusual standards process that allows modifications to existing technologies to be made before the standard is finalized. Together Internet standards and the RFC process form the background of the Napster debate and of Jeff Bone's claims about "internet routing protocols."

A famous bit of Internet-governance folklore expresses succinctly the combination of moral and technical order that geeks share (attributed to IETF member David Clark): "We reject kings, presidents, and voting. We believe in rough consensus and running code."[29] This quote emphasizes the necessity of arguing with and through technology, the first aspect of a recursive public; the only argument that convinces is working code. If it works, then it can be implemented; if it is implemented, it will "route around" the legal damage done by the RIAA. The notion of "running code" is central to an understanding of the relationship between argument-by-technology and argument-by-talk for geeks. Very commonly, the response by geeks to people who argued about Napster that summer—and the courts' decisions regarding it—was to dismiss their complaints as mere talk. Many suggested that if Napster were shut down, thousands more programs like it would spring up in its wake. As one mailing-list participant, Ashish "Hash" Gulhati, put it, "It is precisely these totally unenforceable and mindless judicial decisions that will start to look like self-satisfied wanking when there's code out there which will make the laws worth less than the paper they're written on. When it comes to fighting this shit in a way that counts, everything that isn't code is just talk."[30]

Such powerful rhetoric often collapses the process itself, for someone has to write the code. It can even be somewhat paradoxical: there is a need to talk forcefully about the need for less talk and more code, as demonstrated by Eugen Leitl when I objected that Silk-listers were "just talking": "Of course we should talk. Did my last post consist of some kickass Python code adding sore-missed functionality to Mojonation? Nope. Just more meta-level waffle about the importance of waffling less, coding more. I lack the

proper mental equipment upstairs for being a good coder, hence I attempt to corrupt young impressionable innocents into contributing to the cause. Unashamedly so. So sue me."[31]

Eugen's flippancy reveals a recognition that there is a political component to coding, even if, in the end, talk disappears and only code remains. Though Eugen and others might like to adopt a rhetoric that suggests "it will just happen," in practice none of them really act that way. Rather, the activities of coding, writing software, or improving and diversifying the software that exists are not inevitable or automatic but have specific characteristics. They require time and "the proper mental equipment." The inevitability they refer to consists not in some fantasy of machine intelligence, but in a social imaginary shared by many people in loosely connected networks who spend all their free time building, downloading, hacking, testing, installing, patching, coding, arguing, blogging, and proselytizing—in short, creating a recursive public enabled by the Internet.

Jeff Bone's op-ed piece, which is typically enthusiastic about the inevitability of new technologies, still takes time to reference one of thousands (perhaps tens of thousands) of projects as worthy of attention and support, a project called Fling, which is an attempt to rewrite the core protocols of the Internet.[32] The goal of the project is to write a software implementation of these protocols with the explicit goal of making them "anonymous, untraceable, and untappable." Fling is not a corporation, a start-up, or a university research project (though some such projects are); it is only a Web site. The core protocols of the Internet, contained in the RFCs, are little more than documents describing how computers should interact with each other. They are standards, but of an unusual kind.[33] Bone's leap from a discussion about Napster to one about the core protocols of the Internet is not unusual. It represents the second aspect of a recursive public: the importance of understanding the Internet as a set of "layers," each enabling the next and each requiring an openness that both prevents central control and leads to maximum creativity.

RFCs have developed from an informal system of memos into a formal standardization process over the life of the Internet, as the IETF and the Internet Society (ISOC) have become more bureaucratic entities. The process of writing and maintaining these documents is particular to the Internet, precisely because the Internet

is the kind of network experiment that facilitates the sharing of resources across administratively bounded networks. It is a process that has allowed all the experimenters to both share the network and to propose changes to it, in a common space. RFCs are primarily suggestions, not demands. They are "public domain" documents and thus available to everyone with access to the Internet. As David Clark's reference to "consensus and running code" demonstrates, the essential component of setting Internet standards is a good, working *implementation* of the protocols. Someone must write software that behaves in the ways specified by the RFC, which is, after all, only a document, not a piece of software. Different implementations of, for example, the TCP/IP protocol or the File Transfer Protocol (ftp) depend initially on individuals, groups, and/or corporations building them into an operating-system kernel or a piece of user software and subsequently on the existence of a large number of people using the same operating system or application.

In many cases, subsequent to an implementation that has been disseminated and adopted, the RFCs have been amended to reflect these working implementations and to ordain them as standards. So the current standards are actually bootstrapped, through a process of writing RFCs, followed by a process of creating implementations that adhere loosely to the rules in the RFC, then observing the progress of implementations, and then rewriting RFCs so that the process begins all over again. The fact that geeks can have a discussion via e-mail depends on the very existence of both an RFC to define the e-mail protocol and implementations of software to send the e-mails.

This standardization process essentially inverts the process of planning. Instead of planning a system, which is then standardized, refined, and finally built according to specification, the RFC process allows plans to be proposed, implemented, refined, reproposed, rebuilt, and so on until they are adopted by users and become the standard approved of by the IETF. The implication for most geeks is that this process is permanently and fundamentally open: changes to it can be proposed, implemented, and adopted without end, and the better a technology becomes, the more difficult it becomes to improve on it, and therefore the less reason there is to subvert it or reinvent it. Counterexamples, in which a standard emerges but no one adopts it, are also plentiful, and they suggest that the standardization process extends beyond the proposal-

implementation-proposal-standard circle to include the problem of actually convincing users to switch from one working technology to a better one. However, such failures of adoption are also seen as a kind of confirmation of the quality or ease of use of the *current* solution, and they are all the more likely to be resisted when some organization or political entity tries to force users to switch to the new standard—something the IETF has refrained from doing for the most part.

Conclusion: Recursive Public

Napster was a familiar and widely discussed instance of the "reorientation of power and knowledge" (or in this case, power and music) wrought by the Internet and the practices of geeks. Napster was not, however, a recursive public or a Free Software project, but a dot-com-inspired business plan in which proprietary software was given away for free in the hopes that revenue would flow from the stock market, from advertising, or from enhanced versions of the software. Therefore, geeks did not defend Napster as much as they experienced its legal restriction as a wake-up call: the Internet enables Napster and will enable many other things, but laws, corporations, lobbyists, money, and governments can destroy all of it.

I started this chapter by asking what draws geeks together: what constitutes the chain that binds geeks like Sean and Adrian to hipsters in Berlin and to entrepreneurs and programmers in Bangalore? What constitutes their affinity if it is not any of the conventional candidates like culture, nation, corporation, or language? A colloquial answer might be that it is simply the Internet that brings them together: cyberspace, virtual communities, online culture. But this doesn't answer the question of why? Because they can? Because Community Is Good? If mere association is the goal, why not AOL or a vast private network provided by Microsoft?

My answer, by contrast, is that geeks' affinity with one another is structured by shared moral and technical understandings of order. They are a public, an independent public that has the ability to build, maintain, and modify itself, that is not restricted to the activities of speaking, writing, arguing, or protesting. Recursive publics form through their experience with the Internet precisely because the Internet is the kind of thing they can inhabit and transform. Two

things make recursive publics distinctive: the ability to include the practice of creating this infrastructure as part of the activity of being public or contesting control; and the ability to "recurse" through the layers of that infrastructure, maintaining its publicness at each level without making it into an unchanging, static, unmodifiable thing.

The affinity constituted by a recursive public, through the medium of the Internet, creates geeks who understand clearly what association through the Internet means. This affinity structures their imagination of what the Internet is and enables: creation, distribution, modification of knowledge, music, science, software. The infrastructure—*this-infrastructure-here*, the Internet—must be understood as part of this imaginary (in addition to being a pulsating tangle of computers, wires, waves, and electrons).

The Internet is not the only medium for such association. A corporation, for example, is also based on a shared imaginary of the economy, of how markets, exchanges, and business cycles are supposed to work; it is the creation of a concrete set of relations and practices, one that is generally inflexible—even in this age of so-called flexible capitalism—because it requires a commitment of time, humans, and capital. Even in fast capitalism one needs to rent office space, buy toilet paper, install payroll software, and so on.

Software and networks can be equally concrete—connecting people, capital, and other resources over time and thus creating an infrastructure—but they are arguably more flexible, more changeable, and more reprogrammable—than a corporation, a sewage system, or a stock exchange. The Internet, in particular, especially in the stories of the IETF and the RFC process, represents a radicalization of this flexibility: not only can one create an application like Napster that takes clever advantage of the layers (protocols, routers, and routes) of the Internet, but one can actually rewrite the layers themselves, rendering possible a new class of Napsters. The difficulty of doing so increases with ever deeper layers, but the possibility is not (yet) arbitrarily restricted by any organization, person, law, or government. Affinity—membership in a recursive public—depends on adopting the moral and technical imaginations of this kind of order.

The urgency evidenced in the case of Napster (and repeated in numerous other instances, such as the debate over net neutrality) is linked to a moral idea of order in which there is a shared imagi-

nary of The Public, and not only a vast multiplicity of competing publics. It is an urgency linked directly to the fact that the Internet provides geeks with a platform, an environment, an infrastructure through which they not only associate, but create, and do so in a manner that is widely felt to be autonomous, autotelic, and independent of at least the most conventional forms of power: states and corporations—independent enough, in fact, that both states and corporations can make widespread use of this infrastructure (can become geeks themselves) without necessarily endangering its independence.

Notes

Introduction

Throughout this volume, some messages referenced are cited by their "Message-ID," which should allow anyone interested to access the original messages through Google Groups (http://groups.google.com).

1 A Note on Terminology: There is still debate about how to refer to Free Software, which is also known as Open Source Software. The scholarly community has adopted either FOSS or FLOSS (or F/LOSS): the former stands for the Anglo-American Free and Open Source Software; the latter stands for the continental Free, Libre and Open Source Software. *Two Bits* sticks to the simple term *Free Software* to refer to all of these things, except where it is specifically necessary to differentiate two or more names, or to specify people or events so named. The reason is primarily aesthetic and political, but *Free Software* is also the older term, as well as the one that includes issues of moral and social order. I explain in chapter 3 why there are two terms.

2 Michael M. J. Fischer, "Culture and Cultural Analysis as Experimental Systems."

3 So, for instance, when a professional society founded on charters and ideals for membership and qualification speaks as a public, it represents its members, as when the American Medical Association argues for or against changes to Medicare. However, if a new group—say, of nurses—seeks not only to participate in this discussion—which may be possible, even welcomed—but to *change the structure of representation* in order to give themselves status equal to doctors, this change is impossible, for it goes against the very aims and principles of the society. Indeed, the nurses will be urged to form their own society, not to join that of the doctors, a proposition which gives the lie to the existing structures of power. By contrast, a public is an entity that is less controlled and hence more agonistic, such that nurses might join, speak, and insist on changing the terms of debate, just as patients, scientists, or homeless people might. Their success, however, depends entirely on the force with which their actions transform the focus and terms of the public. Concepts of the public sphere have been roundly critiqued in the last twenty years for presuming that such "equality of access" is sufficient to achieve representation, when in fact other contextual factors (race, class, sex) inherently weight the representative power of different participants. But these are two different and overlapping problems: one cannot solve the problem of pernicious, invisible forms of inequality unless one first solves the problem of ensuring a certain kind of structural publicity. It is precisely the focus on maintaining publicity for a recursive public, over against massive and powerful corporate and governmental attempts to restrict it, that I locate as the central struggle of Free Software. Gender certainly influences who gets heard within Free Software, for example, but it is a mistake to focus on this inequality at the expense of the larger, more threatening form of political failure that Free Software addresses. And I think there are plenty of geeks—man, woman and animal—who share this sentiment.

4 Wikipedia is perhaps the most widely known and generally familiar example of what this book is about. Even though it is not identified as such, it is in fact a Free Software project and a "modulation" of Free Software as I describe it here. The non–technically inclined reader might keep Wikipedia in mind as an example with which to follow the argument of this book. I will return to it explicitly in part 3. However, for better or for worse, there will be no discussion of pornography.

5 Although the term *public* clearly suggests *private* as its opposite, Free Software is not anticommercial. A very large amount of money, both real and notional, is involved in the creation of Free Software. The term *re-*

cursive market could also be used, in order to emphasize the importance (especially during the 1990s) of the economic features of the practice. The point is not to test whether Free Software is a "public" or a "market," but to construct a concept adequate to the practices that constitute it.

6 See, for example, Warner, *Publics and Counterpublics*, 67–74.

7 Habermas, *The Structural Transformation of the Public Sphere*, esp. 27–43.

8 Critiques of the demand for availability and the putatively inherent superiority of transparency include Coombe and Herman, "Rhetorical Virtues" and "Your Second Life?"; Christen, "Gone Digital"; and Anderson and Bowery, "The Imaginary Politics of Access to Knowledge."

9 This description of Free Software could also be called an "assemblage." The most recent source for this is Rabinow, *Anthropos Today*. The language of thresholds and intensities is most clearly developed by Manuel DeLanda in *A Thousand Years of Non-linear History* and in *Intensive Science and Virtual Philosophy*. The term *problematization*, from Rabinow (which he channels from Foucault), is a synonym for the phrase "reorientation of knowledge and power" as I use it here.

10 See Kelty, "Culture's Open Sources."

11 The genealogy of the term *commons* has a number of sources. An obvious source is Garrett Hardin's famous 1968 article "The Tragedy of the Commons." James Boyle has done more than anyone to specify the term, especially during a 2001 conference on the public domain, which included the inspired guest-list juxtaposition of the appropriation-happy musical collective Negativland and the dame of "commons" studies, Elinor Ostrom, whose book *Governing the Commons* has served as a certain inspiration for thinking about commons versus public domains. Boyle, for his part, has ceaselessly pushed the "environmental" metaphor of speaking for the public domain as environmentalists of the 1960s and 1970s spoke for the environment (see Boyle, "The Second Enclosure Movement and the Construction of the Public Domain" and "A Politics of Intellectual Property"). The term *commons* is useful in this context precisely because it distinguishes the "public domain" as an imagined object of pure public transaction and coordination, as opposed to a "commons," which can consist of privately owned things/spaces that are managed in such a fashion that they effectively function like a "public domain" is imagined to (see Boyle, "The Public Domain"; Hess and Ostrom, *Understanding Knowledge as a Commons*).

12 Marcus and Fischer, *Anthropology as Cultural Critique*; Marcus and Clifford, *Writing Culture*; Fischer, *Emergent Forms of Life and the Anthropological Voice*; Marcus, *Ethnography through Thick and Thin*; Rabinow, *Essays on the Anthropology of Reason* and *Anthropos Today*.

13 The language of "figuring out" has its immediate source in the work of Kim Fortun, "Figuring Out Ethnography." Fortun's work refines two other sources, the work of Bruno Latour in *Science in Action* and that of Hans-Jorg Rheinberger in *Towards History of Epistemic Things*. Latour describes the difference between "science made" and "science in the making" and how the careful analysis of new objects can reveal how they come to be. Rheinberger extends this approach through analysis of the detailed practices involved in figuring out a new object or a new process—practices which participants cannot quite name or explain in precise terms until after the fact.

14 Raymond, *The Cathedral and the Bazaar*.

15 The literature on "virtual communities," "online communities," the culture of hackers and geeks, or the social study of information technology offers important background information, although it is not the subject of this book. A comprehensive review of work in anthropology and related disciplines is Wilson and Peterson, "The Anthropology of Online Communities." Other touchstones are Miller and Slater, *The Internet*; Carla Freeman, *High Tech and High Heels in the Global Economy*; Hine, *Virtual Ethnography*; Kling, *Computerization and Controversy*; Star, *The Cultures of Computing*; Castells, *The Rise of the Network Society*; Boczkowski, *Digitizing the News*. Most social-science work in information technology has dealt with questions of inequality and the so-called digital divide, an excellent overview being DiMaggio et al., "From Unequal Access to Differentiated Use." Beyond works in anthropology and science studies, a number of works from various other disciplines have recently taken up similar themes, especially Adrian MacKenzie, *Cutting Code*; Galloway, *Protocol*; Hui Kyong Chun, *Control and Freedom*; and Liu, *Laws of Cool*. By contrast, if social-science studies of information technology are set against a background of historical and ethnographic studies of "figuring out" problems of specific information technologies, software, or networks, then the literature is sparse. Examples of anthropology and science studies of figuring out include Barry, *Political Machines*; Hayden, *When Nature Goes Public*; and Fortun, *Advocating Bhopal*. Matt Ratto has also portrayed this activity in Free Software in his dissertation, "The Pressure of Openness."

16 In addition to Abbate and Salus, see Norberg and O'Neill, *Transforming Computer Technology*; Naughton, *A Brief History of the Future*; Hafner, *Where Wizards Stay Up Late*; Waldrop, *The Dream Machine*; Segaller, *Nerds 2.0.1*. For a classic autodocumentation of one aspect of the Internet, see Hauben and Hauben, *Netizens*.

17 Kelty, "Culture's Open Sources"; Coleman, "The Social Construction of Freedom"; Ratto, "The Pressure of Openness"; Joseph Feller et al., *Per-*

spectives on Free and Open Source Software; see also http://freesoftware.mit.edu/, organized by Karim Lakhani, which is a large collection of work on Free Software projects. Early work in this area derived both from the writings of practitioners such as Raymond and from business and management scholars who noticed in Free Software a remarkable, surprising set of seeming contradictions. The best of these works to date is Steven Weber, *The Success of Open Source.* Weber's conclusions are similar to those presented here, and he has a kind of cryptoethnographic familiarity (that he does not explicitly avow) with the actors and practices. Yochai Benkler's *Wealth of Networks* extends and generalizes some of Weber's argument.

18 Max Weber, "Objectivity in the Social Sciences and Social Policy," 68.

19 Despite what might sound like a "shoot first, ask questions later" approach, the design of this project was in fact conducted according to specific methodologies. The most salient is actor-network theory: Latour, *Science in Action*; Law, "Technology and Heterogeneous Engineering"; Callon, "Some Elements of a Sociology of Translation"; Latour, *Pandora's Hope*; Latour, *Re-assembling the Social*; Callon, *Laws of the Markets*; Law and Hassard, *Actor Network Theory and After*. Ironically, there have been no actor-network studies of networks, which is to say, of particular information and communication technologies such as the Internet. The confusion of the word *network* (as an analytical and methodological term) with that of *network* (as a particular configuration of wires, waves, software, and chips, or of people, roads, and buses, or of databases, names, and diseases) means that it is necessary to always distinguish *this-network-here* from *any-network-whatsoever*. My approach shares much with the ontological questions raised in works such as Law, *Aircraft Stories*; Mol, *The Body Multiple*; Cussins, "Ontological Choreography"; Charis Thompson, *Making Parents*; and Dumit, *Picturing Personhood*.

20 I understand a concern with scientific infrastructure to begin with Steve Shapin and Simon Schaffer in *Leviathan and the Air Pump*, but the genealogy is no doubt more complex. It includes Shapin, *The Social History of Truth*; Biagioli, *Galileo, Courtier*; Galison, *How Experiments End* and *Image and Logic*; Daston, *Biographies of Scientific Objects*; Johns, *The Nature of the Book*. A whole range of works explore the issue of scientific tools and infrastructure: Kohler, *Lords of the Fly*; Rheinberger, *Towards a History of Epistemic Things*; Landecker, *Culturing Life*; Keating and Cambrosio, *Biomedical Platforms*. Bruno Latour's "What Rules of Method for the New Socio-scientific Experiments" provides one example of where science studies might go with these questions. Important texts on the subject of technical infrastructures include Walsh and Bayma, "Computer Networks and Scientific Work"; Bowker and Star, *Sorting Things Out*; Edwards, *The*

Closed World; Misa, Brey, and Feenberg, *Modernity and Technology*; Star and Ruhleder, "Steps Towards an Ecology of Infrastructure."

21 Dreyfus, *On the Internet*; Dean, "Why the Net Is Not a Public Sphere."

22 In addition, see Lippmann, *The Phantom Public*; Calhoun, *Habermas and the Public Sphere*; Latour and Weibel, *Making Things Public*. The debate about social imaginaries begins alternately with Benedict Anderson's *Imagined Communities* or with Cornelius Castoriadis's *The Imaginary Institution of Society*; see also Chatterjee, "A Response to Taylor's 'Modes of Civil Society'"; Gaonkar, "Toward New Imaginaries"; Charles Taylor, "Modes of Civil Society" and *Sources of the Self*.

1. Geeks and Recursive Publics

1 For the canonical story, see Levy, *Hackers*. *Hack* referred to (and still does) a clever use of technology, usually unintended by the maker, to achieve some task in an elegant manner. The term has been successfully redefined by the mass media to refer to computer users who break into and commit criminal acts on corporate or government or personal computers connected to a network. Many self-identified hackers insist that the criminal element be referred to as *crackers* (see, in particular, the entries on "Hackers," "Geeks" and "Crackers" in The Jargon File, http://www.catb.org/~esr/jargon/, also published as Raymond, *The New Hackers' Dictionary*). On the subject of definitions and the cultural and ethical characteristics of hackers, see Coleman, "The Social Construction of Freedom," chap. 2.

2 One example of the usage of *geek* is in Star, *The Cultures of Computing*. Various denunciations (e.g., Barbrook and Cameron, "The California Ideology"; Borsook, *Technolibertarianism*) tend to focus on journalistic accounts of an ideology that has little to do with what hackers, geeks, and entrepreneurs actually make. A more relevant categorical distinction than that between hackers and geeks is that between geeks and technocrats; in the case of technocrats, the "anthropology of technocracy" is proposed as the study of the limits of technical rationality, in particular the forms through which "planning" creates "gaps in the form that serve as 'targets of intervention'" (Riles, "Real Time," 393). Riles's "technocrats" are certainly not the "geeks" I portray here (or at least, if they are, it is only in their frustrating day jobs). Geeks do have libertarian, specifically Hayekian or Feyerabendian leanings, but are more likely to see technical failures not as failures of planning, but as bugs, inefficiencies, or occasionally as the products of human hubris or stupidity that is born of a faith in planning.

3 See The Geek Code, http://www.geekcode.com/.

4 Geeks are also identified often by the playfulness and agility with which they manipulate these labels and characterizations. See Michael M. J. Fischer, "Worlding Cyberspace" for an example.

5 Taylor, *Modern Social Imaginaries*, 86.

6 On the subject of imagined communities and the role of information technologies in imagined networks, see Green, Harvey, and Knox, "Scales of Place and Networks"; and Flichy, *The Internet Imaginaire*.

7 Taylor, *Modern Social Imaginaries*, 32.

8 Ibid., 33–48. Taylor's history of the transition from feudal nobility to civil society to the rise of republican democracies (however incomplete) is comparable to Foucault's history of the birth of biopolitics, in *La naissance de la biopolitique*, as an attempt to historicize governance with respect to its theories and systems, as well as within the material forms it takes.

9 Ricoeur, *Lectures on Ideology and Utopia,* 2.

10 Geertz, "Ideology as a Cultural System"; Mannheim, *Ideology and Utopia*. Both, of course, also signal the origin of the scientific use of the term proximately with Karl Marx's "German Ideology" and more distantly in the Enlightenment writings of Destutt de Tracy.

11 Geertz, "Ideology as a Cultural System," 195.

12 Ibid., 208–13.

13 The depth and the extent of this issue is obviously huge. Ricoeur's *Lectures on Ideology and Utopia* is an excellent analysis to the problem of ideology prior to 1975. Terry Eagleton's books *The Ideology of the Aesthetic* and *Ideology: An Introduction* are Marxist explorations that include discussions of hegemony and resistance in the context of artistic and literary theory in the 1980s. Slavoj Žižek creates a Lacanian-inspired algebraic system of analysis that combines Marxism and psychoanalysis in novel ways (see Žižek, *Mapping Ideology*). There is even an attempt to replace the concept of ideology with a metaphor of "software" and "memes" (see Balkin, *Cultural Software*). The core of the issue of ideology as a practice (and the vicissitudes of materialism that trouble it) are also at the heart of works by Pierre Bourdieu and his followers (on the relationship of ideology and hegemony, see Laclau and Mouffe, *Hegemony and Socialist Strategy*). In anthropology, see Comaroff and Comaroff, *Ethnography and the Historical Imagination*.

14 Ricoeur, *Lectures on Ideology and Utopia*, 10.

15 Taylor, *Modern Social Imaginaries*, 23.

16 Ibid., 25.

17 Ibid., 26–27.

18 Ibid., 28.

19 The question of gender plagues the topic of computer culture. The gendering of hackers and geeks and the more general exclusion of women in computing have been widely observed by academics. I can do no more here than direct readers to the increasingly large and sophisticated literature on the topic. See especially Light, "When Computers Were Women"; Turkle, *The Second Self* and *Life on the Screen*. With respect to Free Software, see Nafus, Krieger, Leach, "Patches Don't Have Gender." More generally, see Kirkup et al., *The Gendered Cyborg*; Downey, *The Machine in Me*; Faulkner, "Dualisms, Hierarchies and Gender in Engineering"; Grint and Gill, *The Gender-Technology Relation*; Helmreich, *Silicon Second Nature*; Herring, "Gender and Democracy in Computer-Mediated Communication"; Kendall, "'Oh No! I'm a NERD!'"; Margolis and Fisher, *Unlocking the Clubhouse*; Green and Adam, *Virtual Gender*; P. Hopkins, *Sex/Machine*; Wajcman, *Feminism Confronts Technology* and "Reflections on Gender and Technology Studies"; and Fiona Wilson, "Can't Compute, Won't Compute." Also see the novels and stories of Ellen Ullman, including *Close to the Machine* and *The Bug: A Novel*.

20 Originally coined by Steward Brand, the phrase was widely cited after it appeared in Barlow's 1994 article "The Economy of Ideas."

21 On the genesis of "virtual communities" and the role of Steward Brand, see Turner, "Where the Counterculture Met the New Economy."

22 Warner, "Publics and Counterpublics," 51.

23 Ibid., 51–52. See also Warner, *Publics and Counterpublics*, 69.

24 The rest of this message can be found in the Silk-list archives at http://groups.yahoo.com/group/silk-list/message/2869 (accessed 18 August 2006). The reference to "Fling" is to a project now available at http://fling.sourceforge.net/ (accessed 18 August 2006). The full archives of Silk-list can be found at http://groups.yahoo.com/group/silk-list/ and the full archives of the FoRK list can be found at http://www.xent.com/mailman/listinfo/fork/.

25 Vinge, "The Coming Technological Singularity."

26 Moore's Law—named for Gordon Moore, former head of Intel—states that the speed and capacity of computer central processing units (CPUs) doubles every eighteen months, which it has done since roughly 1970. Metcalfe's Law—named for Robert Metcalfe, inventor of Ethernet—states that the utility of a network equals the square of the number of users, suggesting that the number of things one can do with a network increases exponentially as members are added linearly.

27 This quotation from the 1990s is attributed to Electronic Frontier Foundation's founder and "cyber-libertarian" John Gilmore. Whether there

is any truth to this widespread belief expressed in the statement is not clear. On the one hand, the protocol to which this folklore refers—the general system of "message switching" and, later, "packet switching" invented by Paul Baran at RAND Corporation—does seem to lend itself to robustness (on this history, see Abbate, *Inventing the Internet*). However, it is not clear that nuclear threats were the only reason such robustness was a design goal; simply to ensure communication in a distributed network was necessary in itself. Nonetheless, the story has great currency as a myth of the nature and structure of the Internet. Paul Edwards suggests that both stories are true ("Infrastructure and Modernity," 216–20, 225n13).

28 Lessig, *Code and Other Laws of Cyberspace*. See also Gillespie, "Engineering a Principle" on the related history of the "end to end" design principle.

29 This is constantly repeated on the Internet and attributed to David Clark, but no one really knows where or when he stated it. It appears in a 1997 interview of David Clark by Jonathan Zittrain, the transcript of which is available at http://cyber.law.harvard.edu/jzfallsem//trans/clark/ (accessed 18 August 2006).

30 Ashish "Hash" Gulhati, e-mail to Silk-list mailing list, 9 September 2000, http://groups.yahoo.com/group/silk-list/message/3125.

31 Eugen Leitl, e-mail to Silk-list mailing list, 9 September 2000, http://groups.yahoo.com/group/silk-list/message/3127. Python is a programming language. Mojonation was a very promising peer-to-peer application in 2000 that has since ceased to exist.

32 In particular, this project focuses on the Transmission Control Protocol (TCP), the User Datagram Protocol (UDP), and the Domain Name System (DNS). The first two have remained largely stable over the last thirty years, but the DNS system has been highly politicized (see Mueller, *Ruling the Root*).

33 On Internet standards, see Schmidt and Werle, *Coordinating Technology*; Abbate and Kahin, *Standards Policy for Information Infrastructure*.

2. Reformers, Polymaths, Transhumanists

1 Foucault, "What Is Enlightenment," 319.

2 Stephenson, *In the Beginning Was the Command Line*.

3 Message-ID: tht55.221960$701.2930569@news4.giganews.com.

4 The Apple-Microsoft conflict was given memorable expression by Umberto Eco in a widely read piece that compared the Apple user interface