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Worlding Cyberspace: Toward a Critical Ethnography in Space, Time, and Theory

The growing realization of the inherent dangers of technology as such—not of its sudden but of its slow perils, not of its malevolent abuses which, with some watchfulness, one can hope to control, but of its most benevolent and legitimate uses . . .

. . . our actions have opened up a whole new dimension of ethical relevance for which there is no precedent in the standards and canons of traditional ethics. —Hans Jonas

For philosophical or political reasons, this problem of communicating and receivability, in its new techno-economic givens is more serious than ever for everyone; one can live it only with malaise, contradiction, and compromise. —Jacques Derrida

Cyberspace is (check one): [if reading this on the Web, click on one of the links]: (1) a game of finance and corporate maneuver; (2) an undoing of the legal system of intellectual and economic property rights, patents and copyright, secrecy and military export laws, and community standards for moral codes, as well as an undoing of several other traditional intellectual arenas of distinctions such as the economics of (free) speech versus (commodifiable) texts, and materialities of (patentable) machine versus (copyrightable) text (software); (3) a hardware technology of jury-rigging together computers, satellites, copper and fiber-optic cables, and perhaps soon silicon to neural tissues, with uneven coverage into the Third World, and also in the First World, but with potentials for providing access around traditional deadened schools, local censorship, and bureaucratic stonewalling; (4) a conceptual space of connectivity, information, assorted desires for escaping or enhancing the body or material world, new paralogical language games for creating selves and socialities; (5) a research space of postliterate, graphic, self-organizing, and experimental models, simulations, and constructions; (6) a cultural-ideological, even ritual, space of (con)fusion, at least in the United States, between a "cowboy-hacker-

individualist-anarchist-libertarian" ethic and a series of market and political mechanisms for restructuring labor in new forms of manufacturing and services; (7) an object world with which to think about the changes of the late twentieth century that go under the name of the postmodern, poststructuralist, or second-order cybernetic; and an arena productive of humorous, fertile, and mind-shaping metaphors for dealing with (8) all of the above.

Ethnographies provide fieldwork tools of investigation, but ones that are themselves challenged by cyberspace not to become absorbed, to maintain insider-outsider critical and comparative perspectives, and to adapt writing strategies that can map voicings and tonalities, locate people and their social structures, and thereby articulate critical sites of constraints and openness. There is a pervasive feeling in many fields touched by cyberspace that things are beyond traditional control, that realities have outrun our usual conceptual categories. The very rhetorics of cyberspace make a claim for the new: both that there are new realities and that cyberspace provides tools for handling interactive complex realities beyond traditional disciplinary vocabularies or methods. Cyberspace is chronically "under construction," rapidly changing, expanding and mutating among technologies and populations. Ethnographies, to keep up, must themselves become more open textualities, with "ports" to many dimensions and connections, without succumbing to incoherent fragmentation. Ethnographies must attempt simultaneously to unveil the underlying "constricted potential of a combinatory grid that is both exhausting and indefatigable,"[1] and to publicly screen emergent social and cultural configurations.

Ethnographies of cyberspace need to deal in theory, time, place, languages (and cultures), institutions (legal, economic, psychological, science), and reconfiguring the knowledge-power nexuses involved in all these arenas. They are challenged to do so both substantively and in their own forms and force of writing. Even more than a multisited ethnography, cyberspace presents a topological challenge for a multidimensional ethnography that is able to bring into sharp juxtaposition the contradictory elements of cyberspace's political economy, cultural elaborations, liberatory and subjugating potentials, new information-based sciences, alternative engineering designs, and their social implications.

Ethnographies, in their traditional forms of *writing*, may increasingly seem now under pressure of a growing cyberspace pedagogical regime to operate under the *anxiety* of being endangered, the anxiety of being already conceptually and pedagogically *archaic* [click for links to psychodynamic and philosophical, techne or logos-en*gendered*, doppelgänger trackings of this *discourse*]. But, more realistically, while it is not the case that there is no more place for traditional writing, it is from the perspective of "twenty minutes into the future," as science fiction often likes to posit, that we can gain a sense of possibility, enrichment, as well as difficulty and danger, amidst which we might strive with our future-looking but present capabilities, making ourselves open to the ear and desire and positioning of the other, facilitating of social institutions that are flexible and reflexively modern, rather than brittlely hierarchical, dogmatic, and univocally normative.

In Theory, In Time, In Place, In Language—all these categories or dimensions for ethnographies of cyberspace foreground linguistic and conceptual double-voiced articulations of the potential/actual, the located/unfolding, the rooted/differentially dispersed. Temporalities as well as topologies fold themselves into interesting configurations. The ethnographic task of worlding cyberspace "In Theory" is to situate preliminary frames for thinking about the emergent computer-mediated worlds in which we are all inserted or enframed, if not always with equal access or capacity. These theories themselves need placement in historical horizons, the task of worlding cyberspace "In Time": while the 1970s were fueled by certain texts of theory in general, although they were intended as models of and models for, as proleptic of and pedagogy for, an emergent common sense, the 1990s more concretely finds practical institutions—law ("In Brief"), economics ("In Exchange"), psychology ("In Consciousness"), science ("In"-formation Sciences")—under pressure in their very conceptual formulations thanks to the technologies of computers and computer-mediated communication. The uneven distribution of these technologies and their attendant thought styles indexes both new, and intensifications of old, horizons of power and inequalities and constitutes a task of worlding cyberspace in geographic and social space. Many of these challenges are registered "In Language" and new forms of writing, electronic, multimedia, cross-generic, crypto-figural, paralogical, paradoxical, and otherwise. The literature of cyberspace, like that of ethnography, "re-establishes contact between the corpora and the ceremonies of several dialects" and so runs the risk of eliciting anger and charges of unreadability, frivolity, and transgression (Derrida 1992/1995: 116). As Derrida wryly notes, "No one gets angry at a mathematician or a physicist whom he or she doesn't understand . . . but rather with someone who tampers with your own language, with this 'relation,' precisely, which is yours" (115). It is a cultural politics that works its magic as powerfully in popular culture idioms (tech talk, science fiction, advertising) as in academic theory, and that is in play against

a concentration of media power which "tends to put technical modernity to work in the service of worn out things" (124).

In Theory

The computing capacity of even bacterial DNA was enormous compared to man-made electronics. All Virgil had to do was take advantage of what was already there—just give it a nudge, as it were.—Greg Bear, *Blood Music*

In theory—and unevenly in time and space—many of our communicative and perceptual structures are being changed by computers and simulation technologies from a world of direct experience to one more accurately knowable through indirect play with structural coordinates and physical worlds available to the human consciousness only through technological prostheses.[2] (Examples abound in medical technologies—such as imaging diagnostics or being able to perform more delicate surgery with virtual reality technology—in architecture and planning, in aeronautical and space engineering, in sciences such as molecular biology or nanotechnology, in financial planning models, as well as more vulgately through the entertainment and communications media.) In a sense this is merely a catching up by everyday experience and common sense to the movement of the sciences since the late nineteenth century where direct experience has long been understood to be either misleading or at best a partial and supplementary access to the complexities of reality. But the world mediated by computers and simulation has taken us a step further yet, one that requires at least two kinds of knowledge simultaneously, that of the indirect structural precision of the sciences, supplemented by that of the experiential, relational world of social relations and cultural mapping.[3]

In theory (to condense and summarize the arguments about the contemporary era as systemically different from the earlier modernities of the twentieth century), we now live in a poststructuralist world insofar as the world constructed in the 1940s by cybernetic control systems has continued to evolve to the point where decentralized systems (such as the Internet) are necessary lest there be systemic breakdown. The Internet is an important icon of "reflexive modernity,"[4] of the gradual move toward a more pluralistic world of decision making that can restructure the now increasingly ineffective and dysfunctional division of labor between weakening parliamentary politics and increasingly more powerful but nonpublic decision making by the market or by military-subsidized research and development.[5] The phantasmic, speculative, indeterminate threats of ecological decay and catastrophe are among the fields of pressure in public consciousness toward new institutions of reflexive modernization, which depend on contemporary sciences and their computerized information modeling, processing, and institutional coordination.[6] As Ulrich Beck argues, ecological consciousness in the 1990s has moved beyond nostalgias of attempting to "preserve" or "conserve" nature conceived as primordial and is premised on the dynamics of consumerism. Consumerism is a cause of ecological damage, but it also provides the market and political demand for rights to clean air, water, and products that are not toxic. Ecological or Green consciousness depends both on scientific mediation, since much of the pollution and toxicity of environmental damage is only visible and monitorable through measurement, rather than to ordinary perception, and on the experiential and differential knowledges that people in different positions in the production and consumption chain can provide. Even traditional bureaucratic institutions such as federal law enforcement agencies can now be put under pressure: computerized records of prosecutors' selection of cases and severity of punishments can be tracked and compared by investigative journalists, thereby exposing to the public tacit and behind-the-scenes patronage networks that have structured Justice Department allocations of resources, personnel, and interests (Burnham 1996; Transactional Records Access Clearinghouse [TRAC]: http//:trac.syr.edu).

"In theory" plays constitutive, proleptic roles as well as provides models from which realities deviate, ever generating need for new theory. The illusions or projections of recent French theorists remind us through their proleptic missteps of the differences between theory and world (for instance, Lyotard's 1979 "report on knowledge," *The Postmodern Condition*; see "In Time," hereafter) yet are themselves productive, constitutive, ethico-aesthetic, or symptomatic of new subjectivities made possible by new machinic assemblages (Guattari 1992/1995). Among these "effective dreams"[7] of theory are the ways in which technologies change temporal and power relationships (Virilio 1977, 1993/1995; Latour 1988); provide sensory prostheses, object relations for libidinal investment, evocative objects for self-definition and social engagement (Guattari 1992/1995; Ronell 1989; Stone 1995; Turkle 1995); operate through language games of paralogy, mutation, modification, rhizomatic generativity, play and dissemination (Lyotard 1979/1984; Serres 1980/1982; Deleuze and Guattari 1980/1987; Derrida 1972/1981, 1992/1995; Bukatman 1993; McHale 1992); and illuminate the tensions between intensification of old political economic mechanisms of restructuring and poten-

tially new economic logics and flexible capital accumulation at the expense of atomized professionals as well as manufacturing labor (Aronowitz 1994; Barlow 1994; Gilder 1989; Hayes 1989; Lanier 1994; Samuelson et al. 1995).

In Time

email: (i) electronic mail (ii) c. 1480: embossed or arranged in a network, from Fr. *emmaileure* (network) — *OED* — *The Hacker's Dictionary*

Just as "In Theory" two kinds of knowledge, two kinds of science — explanatory structures that are breaks with normal experience, that can only be arrived at through the prostheses of instruments, experiments, models, and simulations; and experiential, embodied, sensorial knowledge that acts as situated feedback — can no longer do without each other, so too two charter mythologies of temporality vie in our understanding of cyberspace: skeins of genealogical origin stories that shape hopes and fears about technological innovation; and cycles of political economy liberatory hopes repeatedly disciplined by market processes of capital accumulation facilitated or redirected by law and politics (legislation, regulation). One thinks in the latter case of the democratizing and decentralizing hopes for a "people's" minicomputer in the early 1980s (Brand 1989; Rheingold 1991; Wooley 1992) as undoing the oligopolistic industrial structure of mainframe suppliers, and the disappointment that was later to set in; and how that cycle is (in danger of) being repeated with the Internet. The danger fuels the politics of cypherpunks, cryptoanarchists, and others dedicated to keeping the Internet democratically or anarchistically open.

In time: technological origins and futures are shifting complicities. Insofar as origins in technological matters are ordinarily belated — they exist in concept, desire, imagination, and linguistic metaphor before they are installed — the gap between expectation or fantasy and implementation can resonate with, and be used to provide openings to, alternative worlds through multiple precursor genealogies;[8] utopian hopes foreclosed;[9] designers' inabilities to foresee users' appropriations (Feenberg 1995); alternative styles of using a technology (Turkle 1995);[10] desires, family romances, and spirit worlds that provide the obsessive urgency and dedication for the tedium of experimenting until invention is achieved (Ronell 1989); machinic assemblages that facilitate/enforce new subjectivities (Guattari 1992/1995), that speed up the flow of mutation (Virilio 1993/1995) and leverage displaced relations of power (Latour 1988; Koch 1995), that encourage a shift in thinking about technology as task-specific tools to technology as instruments of play and experimentation in social learning (Stone 1995; Turkle 1995).

Prefigurations of technology are often simultaneously wrong and prescient, particularly for our ambivalent and ambiguous computer technologies which, on the one hand, threaten to create totalizing cybernetic control in more powerful shadow worlds than that of RL ("real life") such as the data banks in which our juridical, fiduciary, medical, and other "doppelgänger" personae are created, monitored, and manipulated often beyond our knowledge and control (Branscombe 1994; Burnham 1983). Yet, on the other hand, these technologies could create decentralized worlds that play out Enlightenment or modernist fantasies/nightmares of out-of-control dangerously exciting worlds (à la *The Cryptoanarchists' Manifesto* predicting the emergence of numerous nefarious as well as beneficial black markets once strong cryptography becomes widespread [May 1994]); playful, sensuous, multiple worlds of continuously recontracted identities (Stone 1995), and recontracted freedoms and ethics of answerability (Derrida 1987/1989, 1992/1995; Ronell 1989); or through decentralization able to create more diffusely stable worlds than centralization could dream (Foucault 1975/1977, 1978, 1980).

In time: two dates or two decades conventionally serve as markers of these ambivalent transitions: 1979 or the early 1980s, and the early 1990s. These are not origins of either the computer or the Internet, the one that extends back to the early post–World War II period, the other to the late 1960s, the one an outgrowth of World War II command-and-control, trajectory-and-firing, feedback-calculation needs (Norbert Wiener's cybernetics), of general calculators and decryption (Alan Turing, John von Neumann), as well as of telephone information technology needs (Claude Shannon's information theory); the other an outgrowth of the need for a communication system that could withstand nuclear attack and not be knocked out by hitting a centralized switch. Rather, they are transitions in theory, in outlook, in historical horizon.

Nineteen seventy-nine was the date of Jean-François Lyotard's *The Postmodern Condition: A Report on Knowledge*, produced for the Quebec government's council on universities, a book that became a touchstone for electric (hysterical?) debates about theory (the "postmodern"). Praised for its enigmatic acknowledgment of the computer as a medium for social changes of the late twentieth century, the book depended, as Andrew Feenberg points out (1995), on a slightly misguided vision of the computer. This was the era just before the introduction in France of Minitel, and in the United

States of minicomputers (IBM's personal computer was introduced in 1981, Apple's Macintosh in 1984). The French Minitel was part of a state-directed modernization program to upgrade the French infrastructure and to carve out a niche in the global trade system. Six million terminals, networked to X.25 time-sharing hosts, were given away to households in a bid to acculturate the French to the new medium, to provide access to information as part of the state telecom utility, and to provide a protected market for terminals which could subsequently be the basis for a global export industry. But designed not to tax users with skills beyond their telephonic habits, the primitive terminals and keyboards were unable to expand into the international market, and Lyotard's vision of increasingly decentralized self-government through free access to data banks was more a vision of a technocratic information society than the many-to-many computer-mediated-communication society that was to emerge.

Still, Lyotard was prescient about many of the forms that such computer-mediated communication would take, including anonymous pseudonyms (institutionalized by Minitel services requiring pseudonyms) that called forth new language games, where identity is assumed-constructed rather than assumed-presupposed, where "cognitive regimes of phrases" can lead to incommensurable "differends" or multiple worlds based on different social contracts, where social and cultural forms are generated paralogically (through modification, mutation, and innovation) rather than through centrally planned rational, transparent design. When Minitel's Videotext system was first tested in 1981, a means for feedback to the designers was included, but the popularity of such messaging from users was not recognized as a precursor to mass demands for interactivity. In 1982 hackers turned Gretel, a host machine where users could send messages to system operators or post advertising, into a decentralized messaging system, and other services quickly followed, with names such as Desiropolis, SM, and Sextel. Paris walls were filled with graffiti about the new "pink" entertainment form; telephonic habits colonized the Minitel in the desire of users to communicate, not just access information; and by 1985 the system crashed because the volume of messages had exceeded capacity.

Feenberg points out that it was not only the French state and its intellectuals, such as Lyotard, Derrida, Deleuze, and Guattari, who were thinking about the implications of computers; science fiction writers such as Ursula K. Le Guin, Philip Dick, and Stanislaw Lem were also making a break in conventions and obsessions toward interactivity, the fragility of reality, and the multiplicity of selves. The first minicomputers in the 1980s, especially the hopes surrounding the introduction of Apple's Macintosh and a number of IBM-compatible models by other companies, were widely discussed as a powerful democratizing potential against monopoly mainframe industrial machines, hierarchical corporations, and oligopolistic markets. Sherry Turkle (1995) and Susan Leigh Star (1995), writing about computer cultures in the United States, talk about this period as one gradually shifting from computational styles of using computers, formalist pedagogies (the "right way" of programming was by linear, logical, rule-based thinking), reductionist epistemologies (one learns how things work by breaking them down into simpler parts), and anxieties about whether computers could think (the Turing test), toward an "aesthetic of simulation," evocative metaphors for programming and user interfaces (the desktop as dialogue partner), and a joyful sense of complexity or epistemologies of emergence from simultaneous interaction of many parts, and a looking to connectivity (rather than single user-machine relationships) and to computers for emotional and social feedback and effects. No one, Turkle says, in the 1990s confuses computers with sentient beings (the anxiety of the 1970s posed in the fear of replicant humanoids in the film *Blade Runner*, the fascination with what computers and automation could and could not do, with Turing tests, with fears of surveillance, Taylorism, and job loss), but people instead take pleasure in treating computers as quasi-sentient and exploring the enriching potentials of simulations, virtual reality prostheses, interactivity facilitating new social arrangements and psychological spaces. "Design" and "configuration" are slogans, foregrounding claims for the expansion of human relations and capacities.

The early 1990s are often spoken of by the computer science community as a second major turning point, with the reorganization of the Internet, changes in the global competitive structure of the semiconductor and information technology industries, introduction of new user-oriented tools, and the huge influx of general users to the Internet, previously inhabited by relatively small, technically knowledgeable communities of hackers, students, researchers, engineers, and programmers. Rather than "theory" in general being at issue, now one practical and institutional arena after another—law, economics, sciences, psychology—find their traditional terminologies, premises, and models under profound pressure.

In time: just to cite a few dates, in 1990 coordination of the Internet backbone shifted from the Defense Department's Advanced Research Projects Agency to the National Science Foundation as part of a continuing and broad-based shift from a government- and university-dominated research community to privatization and impending commercialization. 1992 marked a sea change in competitive dynamics requiring internationalization

and modularization, and it became clear that information technology industries could not survive in domestic markets alone or build self-contained machines. They had to become transnational, dedicated to "open systems architectures" (rather than self-contained machines), compete over flexible features, pursue alliances and cross-licensing among firms, and develop networking (connecting computers to one another) and value-added services (moving data and images across the networks) (Yoffie 1994). In 1993 the introduction of Mosaic, the World Wide Web, and (two years later) Netscape interfaces and indexing robots ("search engines," "spiders," "crawlers") made the Internet easy for a broad range of users. Commercial providers (America Online, CompuServe, Prodigy) began opening gateways to the Internet. Businesses began to advertise and sell via the Internet, and encryption and problems of privacy, authentication, and digital money became foci of attention.

How does one access ethnographically the tension between market cycles and the kinds of cultural mutation that Lyotard's text, among others, focused the energies of cultural imagination on? Two strategies are to focus on its geographies (its uneven construction, costs, usages in different places, resistances to it on the part of bureaucracies and employees) and on its body politics (the Third World women who manufacture the chips, toxicities of clean-room production, surveillance and invasiveness of its "availability" imposed on professionals and service providers, the global division of labor, the dispersive, cottage-industrialization of the virtual office).

In Place (or Sites under Construction)

> Cyberspace remains a frontier region, across which roam the few aboriginal technologists and cyberpunks who can tolerate the austerity of its savage computer interfaces, incompatible communications protocols, proprietary barricades, cultural and legal ambiguities, and general lack of useful maps or metaphors.—John Perry Barlow, "Coming into the Country"

> Is your routing protocol complex? You've raised the cost of entry. Do you have an acceptable use policy? You've limited your population. Have you invented an anonymous FTP mechanism and an RFC series? You've encouraged the spread of the network. . . . Infrastructure . . . reflects how we apply . . . fundamental human values. Privacy, for example, can be protected or destroyed by a network.—Carl Malamud, *Exploring the Internet*

Carl Malamud (1993) provides a preliminary pilot survey for a global geographic and ethnographic history, stylized as a ribald hacker's (and gourmet's) traveling account, with himself as one of the free-spirited aboriginal technologists on the new frontier. He begins in good ethnographic fashion with an emblematic scene, a celebratory, almost ritual space: a 1991 trade show that serves as a microcosmic workshop for assembling the global Internet. Some thirty-five miles of cable were hung from the ceiling of the San Jose Convention Center using five cherry pickers. These supported two different backbones (FDDI, Ethernet), fifty subnets, microwave links, and T1 lines, connecting to the NSFNET (and video-link laid by Sprint from Geneva via Atlanta and Kansas City), so that three hundred vendors could demonstrate interoperability of their wares, and engineers could pinpoint ambiguities in standards. Enough components to wire a twenty-story high-tech skyscraper such as are being built in Singapore and other leading-edge high-tech sites.

Imagine expanding this globally. Malamud provides a humorous twenty-country field guide to the heterogeneous sites around the world that in 1991 were gradually linking themselves into a global Internet. The account provides a sardonic counterpoint to the usual histories of the Internet that celebrate a seemly, smooth development from the U.S. Defense Department's ARPA project to a civilian NSF-supervised backbone to a privatized Internet and a spreading international network. Malamud traverses Europe from Geneva to Prague to Dublin, the Pacific from Hawaii to Tokyo to Singapore to Canberra, Bombay, Bangkok, Kuala Lumpur, and various other places with different problems, situations, and goals. His account gets beneath the glib hype of magical connectivity and indicates the heterogeneity of the actual hardware, wiring, design, and organization of the various segments of the Internet; provides a historical account of the efforts to create, the resistances to, and efforts to limit or control, connectivity; and in the end also provides a bridge to a recognition that universal connectivity may not quite be the metaphor for the future, as design must cope with a flood of users who might better be served by a congeries of subnetworks, a field of diversity.

In Geneva, for instance, headquarters of the International Telecommunications Union, Malamud finds a bureaucracy at odds with its electronic communications environment, providing in concrete microcosm the historical picture of decaying bureaucratic control and emergent electronic connectivity that theorists such as Marshall McLuhan, Michel Foucault, Jean-François Lyotard, and Jacques Derrida have also been describing, albeit in more philosophical, less concrete registers. In 1991 the ITU headquarters (despite rights to free telecommunications throughout the world) had a telephone system with an old Siemens PBX that did not allow a secretary to transfer calls; there was only one fax machine for nine hundred employ-

ees (deliberately, to control communications with the outside), and officials were ambivalent about putting ITU recommendations for standards the ITU wished adopted on the Internet because they made money on selling the recommendations in book form (although dissemination on the Internet was one or two orders of magnitude beyond what they would ever reach through book sales). Things were so bad that high-powered officials brought their own AT&T phones to work so that they could have a few stored numbers, and got themselves guest accounts at CERN, the European high-energy physics lab, a key node of the Internet.

By contrast, Prague had been dependent until 1989 on reverse engineering IBM mainframes and attempting to fit these together with Bulgarian front-end processors and local operating systems. At the end of the Cold War, Prague was able to put in (still expensive) 9,600 bps leased lines to Western Europe and, with the aid of several IBM-donated 3090 mainframes, was beginning to establish networking capabilities. "As fast as the [Eastern Bloc] countries could persuade the United States to process the paperwork for Cisco routers [as a legacy of the Cold War, all these countries were on the U.S. export restrictions list; it had taken the Poles, for instance, a year to get a Cisco router], countries were plopping in TCP/IP nodes, enhancing EARN connections, and using UUCP and EUnet to spread connectivity into new places" (Malamud 1993: 271).

Malamud contrasts sites around the world and visits key individuals who made the initial connections in various sites happen: Torben Nielsen in Hawaii, who linked four university buildings with rented power tools, digging ditches and using salvaged materials from military aircraft to create a local area network (LAN) for $1,500; Jan Murai in Japan, who tied networks together into JUNET and, when Nippon Telegraph and Telephone deregulated, used two modems and a university-provided phone line to establish links to Amsterdam, Washington, and Hawaii; Dennis Jennings in Dublin, who in 1979 networked two Dublin universities, in 1983 became president of the BITNET that was being introduced by IBM to Europe as EARN (European Academic Research Network), in 1985 became U.S. National Science Foundation Program director when NSF was only beginning to think about networking its four supercomputer centers and nudged them into bringing about the NSFNET backbone, and in 1991 helped create EBONE, the European backbone.

Malamud's account provides a preliminary matrix to which can be added other accounts of struggles and competitions to establish networks (see the 1996 "hacker tourist" account of laying a third-generation fiber-optic cable from England to Japan [Stephenson 1996]). In Iran, for instance, the Institute for Studies in Theoretical Physics and Mathematics in Tehran has had an Internet site since 1992; in 1994 it upgraded its 9.6 kilobyte connection with a 64 kilobyte satellite telephone line leased from the American Hughes Corporation (Jahanshah 1995). In 1994 the institute leased part of its network to a private company that provided access to individuals, some two hundred. The government telecommunications company began showing interest in the Internet and tried to run the private company out of business, even using tactics such as cutting off its phone lines. The private company went to court with the support of customers such as the Tehran Municipality. Qum, the theological center of Iran, as always, showed interest in the newest technological means for spreading its messages. Meanwhile the American NSF briefly ordered the connection between Tehran and the University of Vienna closed, on the grounds that Iran should not benefit from federally funded infrastructures, but on review this position was reversed. Such competitions are not unusual. (By 2002 there were some 1.75 million users of the Internet in Iran.)

In India parts of the bureaucracy are dedicated to the expansion of networks, but other parts (including segments of the banking system) are attempting to protect jobs and self-reliance of production and to restrict access to computerization and the Internet. Meanwhile businesses are establishing their own links, and the software industry and chip design are beginning to take off, both as offshore support for American and multinational companies but also in producing products on their own account. Such competitions are sites where the strains and differential needs within a society may be exposed to view, and are indices of sociocultural change.[11]

Compared to Finland, a country with more than ten thousand hosts (10 percent of the European hosts on the Internet), the United States seems a bit archaic: in Finland utilities and all sorts of services are normally ordered and paid through the computerized network, eliminating separate checking, paperwork, or standing in line. Experiments with municipal networking exist in many parts of Scandinavia, and the Sophia-Antipolis "Silicon Valley" of France (near Nice), which is a nine-town joint venture with the regional government and the Nice Chamber of Commerce, but rarely in the United States except for the much touted Blacksburg, Virginia, experiment.

In Language (Tech Talk, Hackish, Fiction)

It's in words that the magic is—Abracadabra, Open Sesame, and the rest—but the magic words in one story aren't magical in the next. The real magic is to understand which words work, and when, and for what; the trick is to learn the trick.—John Barth, *Chimera*; used

as epigraph to chap. 4 of Abelson and Sussman, *Structure and Interpretation of Computer Programs*

Either Elvis Presley is dead, or he isn't!—complaint attributed to Eric Hobsbawm

Isn't this an "interface" here, a meeting surface for two worlds . . . sure, but *which two?*—Thomas Pynchon, *Gravity's Rainbow*

Tech talk, hackish, infinite loops, future Bostons—the lively languages of the denizens of the several subcultures on the electronic frontier provide rich arenas for exploring emergent cognitive styles and new worlds of interaction. The languages that hackers and techies use and that leak into general discourse (how do they sound and reconfigure thought in Japanese, Portuguese, Hindi,[12] Malay, Russian?), the literary languages of science fiction (especially cyberpunk) and science-incorporating novels (e.g., Richard Powers's *Galatea* 2.2.), the advertising language used to sell new technologies in medical and science journals (see also Haraway 1997), and the figurations and metanarratives that lie behind the ways scientists and engineers explain what they are up to, and how they conceive their discoveries as contrasting with the recent pasts of their fields—all provide rich entries into new ethnographic worlds both of the present and of the near future. Nanotechnology, chemistry and materials sciences, molecular biology, genetics, evolutionary and theoretical biology, remote sensing and environmental monitoring, PET scans and medical imaging are among the many arenas that are mediated by the lively new languages of the information and computer technologies that form a skein of threads in this new fabric of understanding.

Imbricated in the use of these languages is also a pragmatics of engineering interaction premised on partial knowledge and constant need for translation, interfacing, sharing, and updating, as well as a willingness to deal with real-world complexities that cannot be completely controlled (hardware always goes wrong; software can never be completely debugged). This pragmatics cannot be separated from the hardware material worlds of the new information highway, the market pressures that are gradually sharing dominance with earlier state funding for shaping the evolution of cyberspace, and the legal structures that are lagging behind the technological changes but can powerfully affect their development.

The worlds being constructed and mediated by the new biological, material sciences, and information technologies, moreover, are not merely cognitive ones but also profoundly, if also playfully, sensual ones. The debates about virtual reality systems are many, but as yet quite underdeveloped, often split between those who can see only testosterone-driven entertainment examples (Kramarae 1995), and not, for instance, the medical surgical systems for allowing finer kinesthetic control than ordinary human haptic sensation or seeing into the body in ways not otherwise available. Feminist literary criticism of both science fiction proper and computer scientist fantasies such as Hans Moravec's *Mind Children* (1988) (downloading wetware brains into silicon form so as to escape the body) has focused attention on the embodiments of cyberspace prostheses (N. Hayles 1993, 1996; Stone 1995).

There is something special about the lively languages of tech talk, hackish, and the science fictions that engineers and scientists enjoy. For the ethnographer, even if the distinction eventually breaks down, one needs to pay attention to these as native languages, as pragmatics deployed situationally by computer scientists and other information scientists, before lumping them with general popular culture variants. Thus, for instance, Scott Bukatman (1993) is onto something when he suggests that science fiction writing often exploits a distinctive writerly and playfully paradoxical style that requires active inferential work by readers, and that it is on this formal level—Joycean semantic fusions, syntactical revisioning, presuppositional implications—that the genre provides some of the most sustained attempts to identify and narrate the ambiguities of contemporary culture.[13] But the traditions to which he links this style are the neologistic play of William Burroughs and the literary theories of Roland Barthes. One wonders if more important might not be a different set of traditions that await excavation: the lively, playful, polysemic, working languages of engineering and software techies, such as are cataloged in *The New Hacker's Dictionary* (Raymond 1993). These are, of course, not entirely separated traditions, as the epigraph to this section from one of the leading textbooks for computer science students indicates (and as Raymond protests, "Hackers often have a reading range that astonishes liberal arts people" [484]). Still, there is an ethnography waiting to be done on the nuances (and pragmatics) of, for instance, why William Gibson's *Neuromancer* is initially dismissed by techies when cited by humanists as a foundational cyberspace or cyberpunk text. Not that techies and hackers have not read it—Pengo, one of the (in)famous German hackers who broke into the Lawrence Livermore Laboratories computers, said his image of himself as a hacker was modeled on Case in *Neuromancer* (Hafner and Markof 1991: 15)—but its valuation or intertextual location is marked differently. It is not that techies and hackers have not read Gibson, but that in their view, liberal arts people have read little else, little of actual substance that pertains to, or is generative of, this emergent arena of communicative connectivity; and of course that Gibson famously describes himself as not being computer knowledgeable when he wrote the book.[14] Such rela-

tive marking is itself a field of pragmatics, constitutive of difference in the ways that different communities relate to, and interact through, computers, informational technologies, cyberspace, or the information highway.

Literary critics such as Brian McHale (1992) and cultural historians of science such as Paul Edwards (1996) are similarly also onto something when they try to chart the shifts in plot structures and metanarratives that science fiction literature and films have gone through in the last few decades, and in Edwards's case, the correlations of such shifts with thinking among planners and funders in the military-industrial-university complex are usefully at issue. McHale distinguishes cyberpunk from older science fiction through the way that microworlds, cyberspace, cybernetic or bioengineered prostheses, artificial intelligences, and mediated deaths are deployed. No longer are the orbiting space colonies or subterranean cities so often showcases of technology and egalitarian liberal governance; there are decaying slums, enclaves of privilege, ghettos of crime and commerce, multicultural juxtapositions and interspecies heterotopias. No longer are there humanoid robots; now there are more often AIs, bioengineered improvements, alter egos, and prostheses of all sorts, renegade cybernetic systems attempting to absorb humans, and hybrid human-machine interfaces that allow the biological metabolism to shut down (die) and reboot for varying periods. More skeptical is Paul Edwards's survey of science fiction films and novels over the post-World War II period, looking for alternatives to closed worlds of cybernetic command and control fantasy, some alternative structures that would lead to more open and green worlds.

And yet there is a striking difference in "structure of feeling" in how writers immersed in the new technologies and sciences pose these issues—one, I think, that is not explained by their being Panglossian enthusiasts. Kevin Kelly (1994) and Claus Emmeche (1994), for instance, find precisely these alternatives to the post-World War II closed-world modernisms in the language of "out of control," self-organizing, evolving learning systems and parallel processing. One needs to read these with critical care, attuned to the metanarrative utopias, teleological aspirations, or simple idealizing hopes that are structured into speculative models (Egger 1993), and look for the alternative accounts that can be given of the same technologies and scientific developments (Porush 1993). But we need to read for the connectivities and emergences as well that are growing through our everyday practices of using these technologies, and not dismiss them through an equally metanarrative, but cynically dismissive, application of past (Luddite, Marxist, or romantic) frames to new forms.

Might the language and creative writing of techies and hackers be a guide to the worlds that many of us are now entering with our laptops, desktops, and workstations, networked into a global information network? Consider the "handles" or "aliases" used by hackers—Phiber Optik, Knight Lightning, frogrot, Koda.Krome, Notjeff—both the worlds to which they allude and also the metaphorical play they put into motion, part of the larger universe of puns, contractions, acronyms, verbal forms, and other linguistic humor that makes up hacker reference and repartee, and the degree to which these reflect a technical concern with substitutability, abstraction, alternative coding, and signal-to-noise ways of regarding communication. These play on and extend the recombinant material forms that computer-mediated sciences invoke, and science fiction written by programmers reflect on: bots of various forms (robots, nanobots, mobots, fleabots), simulated intelligence forms (stims, microsofts, personality chips aka perks), biological computers and transgenetic animals, prostheses and cybernetic machine-biological cyborgs, objects made of new materials, new languages, and trans-species multicultural social formations, new illnesses of multiple chemical sensitive and virally transported transgenetic modalities. These are the worlds we are entering, and they are not accessible through the old languages of nature-versus-culture dichotomies. We turn first to hackish, then to creative writing by computer professionals.

Hackish

hack: (i) an appropriate application of ingenuity; (ii) creative practical joke.

banana problem: [from the story of the little girl who said, "I know how to spell banana, but I don't know when to stop"]. — *The Hacker's Dictionary*

To what degree does "hackish" not merely reflect a love of language play but provide a "particularly effective window into the surrounding culture" (Raymond 1993: 20)?[15]—into how its inventions grow out of the way in which computers are configured and software language is designed, showing if there is in fact a new style of technically grounded cultural logic, in which "flavorful," elegant puns bend phrases to include a second jargon word as a function of a kind of condensation that increases awareness of linguistic form, logic, multiple allusions or references, precision, and yet maintains transparency, efficiencies of communication, and relatively easy accessibility. As a friendly visiting anthropologist to hacking culture—and as a slow but determined learner-user of computer literacy, e-mail, and World Wide Web connections—I am constantly amazed by the openness of these

subcultures, and of the degree to which everyone is dependent on others for help in keeping knowledge current, growing, and adaptable to a state of constant and rapid change. I am also impressed by the degree to which speed of communication is mimicked by the density of punning allusions to multiple referents, and the pressure that the speed and volume of information places on my old-fashioned tendency to take notes, an increasingly out-of-phase slowness for pacing the "fire hose" flow of electronic connectivity (part of what was called, in this chapter's opening section, the anxiety of operating under a growing cyberspace pedagogical regime, and the need to develop new reading and processing tactics).

There are many ways in which a "technically grounded new cultural logic" might be sifted. For instance, "much to the dismay of American editors," hackers "tend to use quotes as balanced delimiters, placing punctuation outside the quotation marks: 'Jim is going', 'Bill runs', and 'Spock groks'." For programmers, putting the commas and periods inside the quotes violates the integrity of literal strings with characters that don't belong, and would, if it were a piece of code, issue false instructions: a tutorial that tells you to delete a line by typing "dd" is quite different from one that tells you to type "dd.". *Hart's Rules* and the *Oxford Dictionary for Writers and Editors* accept the hacker sensibility and call that convention "new" or "logical" quoting.

This is a more technological grounding of cultural logic than simple terminological coinages. However, insofar as coinages have extended hermeneutical relations and histories, they can begin to tell us a good deal about the cultures in which they are shaped. A few examples, like the spoken hackish "bang" referring to the grapheme!, aka "excl" (pronounced /eks'kl/) or "shriek," begin to resonate with Jacques Derrida's sub-version that writing is prior to speech, and provide a grounding for the interpretation of Derrida that Greg Ulmer (1994) advances: seeing grammatology being mediated through the new electronic media and cultural writing becoming increasingly an experimental "heuretics." But one wants to immerse oneself in this concrete world of sounds and silent electron traces before jumping into the Derridean sea, or into the Deleuzian complementary intuition (in the interpretation put forth by the Critical Art Ensemble [1994]) that the new electronic media allow a new literal "logic of sense" (where the sensorium is not separated from the intellect as an other; indeed, a fascination for many people of digitized multimedia virtual reality is the ability to place oneself in altered states). Another Derridean trace: There is also an accepted convention for 'writing under erasure'; the text, 'Be nice to this fool ^H^H^H^H^H^H gentleman, he's in from corporate HQ.' would be read as 'Be nice to this fool, I mean this gentleman . . . ,' the diagraph ^H being a print representation for a backspace. Quelle différence!

Form-versus-content jokes seem to follow easily: "This sentence no verb"; "too repetetetive"; "bad speling"; "incorrectspa cing"; "excuse me I'm cixelsyd [dyslexic] today." As does patterned play with verbing ("I'll clipboard it over"; "I'll mouse it up"), pluralizing with inflection particles from imported languages or archaic strata (Yiddish *frobbotzim* as a plural of *frobnitz*, little things you can tweak, manipulate, adjust; VAXen using the Anglo-Saxon plural *-en*), and anthropomorphizing. (This last apparently gives great difficulties to some philosophers and certain anthropologists whose theories of metaphor refuse to acknowledge the uses of humor. As Raymond patiently admonishes: "This isn't done in a naive way; hackers don't personalize their stuff in the sense of feeling empathy with it, nor do they mystically believe that the things they work on every day are 'alive' " [13].) You may hear "The protocol handler got confused," and explanations like "And its poor little brain couldn't understand X, and it died" (13). Which leads to the quite important observation, not unlike the old cliché about the many words Eskimos are supposed to have for snow, that "hackers have even more words for equipment failures than Yiddish has for obnoxious people" (14). Important, because it points to the material grounding of the cultural logics, but also because it points to the continual adjustments, patching, flexibility, rerouting, reconfiguring, sharing, negotiating, translating, interacting, communicating, clarifying, that working with this technology requires and that is accepted as reality by its resident hackers, viz.:

> *creationism* (the false belief that large innovative software designs can be completely specified in advance and then painlessly magicked out of the void by the normal efforts of a team of normally talented programmers. In fact, experience has shown repeatedly that good designs arise only from evolutionary interaction between one [or at most a small handful of] exceptionally able designer(s) and an active user population . . .)
>
> *heisenbug* (a bug that disappears or alters its behavior when one attempts to probe or isolate it: not even particularly fanciful since use of a debugger can alter a program's operating environment)
>
> *mandelbug* ([From the Mandelbrot set], a bug whose underlying causes are so complex and obscure as to make its behavior appear chaotic or even non-deterministic; the term implies the speaker thinks it is a Bohr bug rather than a heisenbug)
>
> *Bohr bug* ([From quantum physics], a repeatable bug that manifests

reliably under possibly unknown but well-defined conditions; antonym of heisenbug)

schroedinbug ([MIT: from Schroedinger's cat thought experiment], a design or implementation bug in a program that doesn't manifest until someone reading source or using the program in an unusual way notices that it never should have worked, at which point the program promptly stops working for everybody until fixed. Though (like bit rot) this sounds improbable, it happens . . .[16]

If an engineering pragmatics of sharing, patching, and kluges (from German "clever," i.e., a patch) is basic to the technological mode, contradictory principles are nonetheless also basic to the landscape, including various ways of limiting freedom of action, ranging from "bondage and discipline languages" (e.g., BASIC, PASCAL, early versions of the Athena Project at MIT) to marketplace proprietary rules and competitive blocking of opponents' freedom of action. This provides the grounds for the elaboration of the hacker ethic in favor of open systems, but also the grounds for the intense debate over the evolving direction of law and ethics on the electronic frontier (see "In Brief").[17] Again a few simple terms can help index the nature of the terrain. BASIC (Beginner's All-Purpose Symbolic Instruction Code), originally designed for Dartmouth's experimental time-sharing system in the early 1960s, like Pascal, another instructional "toy" designed in the late 1960s, according to Raymond, although allowing some simple programming, not only becomes difficult to use for longer and more complicated tasks but is counterproductive because it instills habits that impede learning more powerful languages (54). A more general version of this type of relatively benign dilemma is "candygrammar" using mostly "syntactic sugar," that is, the effort to design English-like languages (COBOL, Apple's Hypertalk, many "4GL" database languages) to help unskilled people program. Hacker aesthetics hold that since it is not really the syntax that makes programming hard, candygrammar languages are often just as difficult to program as more elegant, terser ones and end up simply creating more pain for experienced hackers who have to help out inexperienced users.

More serious are real situations of "fear and loathing": "[from Hunter Thompson] . . . a state inspired by the prospect of dealing with certain real-world systems and standards that are totally brain-damaged but ubiquitous—Intel 8086s, or COBOL, or EBCDIC, or any IBM machine except the Rios (a.k.a. the RS/6000)." EBCDIC, for instance, is an "alleged character set" that exists in a number of incompatible versions and lacks several ASCII punctuation characters important in modern computer languages. Hackers

suspect that IBM made people use this as a customer control tactic, a form of "connector conspiracy" (designing products that do not fit with competitors' products), since the ASCII standard was already well established at the time. Moreover, as Raymond notes, although "today, IBM claims to be an open-systems company, IBM's own description of the EBCDIC variants and how to convert between them is still internally classified top-secret, burn-before reading" (159). IBM is the target of much hacker hostile humor, the company acronym itself being said to stand for "Inferior But Marketable," and many other such witticisms.[18] (The barbed humor parallels similar, more recent witticisms against Microsoft, for similar reasons, as Microsoft dominates the operating system and Internet markets.)

"What galls hackers about most IBM machines above the PC," explains Raymond, "isn't so much that they are underpowered and overpriced . . . but that the designs are incredibly archaic, crusty and elephantine . . . and you can't fix them—source code is locked up tight, and programming tools are expensive, hard to find, and bletcherous to use once you've found them" (235). FUD and FUD wars are a result. FUD (fear, uncertainty, and doubt that IBM sales personnel instill in the mind of customers thinking about buying from competitors) was coined by Gene Amdahl after leaving IBM to found his own company. FUD wars thus are the posturing of vendors ostensibly committed to standardization but actually attempting to fragment the market to protect their share of the market. (See also the 1979 Charles Andres comic allegory about "brainwashed androids of IPM [Impossible to Program Machines] to conquer and destroy the peaceful denizens of HEC [Human Engineered Computers]," containing, aside from many references to the prototypical computer game Adventure, also the immortal line "Eat flaming death, minicomputer mongrels!" [uttered, of course, by an IPM stormtrooper].) Tactics in this economic war of position are varied (and a large subject for business school case studies [Yoffie 1994]) ranging from minor and ineffective forms such as "crippleware" (software that has some important functionality deliberately removed to entice you to pay for a working version; compare "guiltware" for shareware pleas to send money if you are using their product, also "nagware") to the attempts to utilize increasingly archaic and ill-adaptive intellectual property law protections and lawsuits.

The hacker ethic, by contrast, located naturally enough in universities like MIT, insists that information sharing is a "powerful positive good, and that it is an ethical duty of hackers to share their expertise by writing free software and facilitate access to information and to computing resources wherever possible," including the more controversial "belief that system-cracking for fun and exploration is ethically OK as long as the cracker com-

mits no theft, vandalism, or breach of confidentiality." This puts hackers often, and in principled active ways, at odds with industry, the archaic legal structure, and government attempts at regulation, national-security-justified controls (the export control act), and computer crime surveillance (FBI and Secret Service).

Underneath the pragmatics of computer subcultures and their differences, underneath the competitions for control of various forms (market share, security, privacy, freedom), is a material substratum of historically changing hardware and institutional legacies and possibilities. The hacker subculture, for instance, whose jargon is collectively compiled in *The New Hacker's Dictionary* (and its 1983 predecessor), has a history traceable to the early 1960s PDP-1 machines at the AI Labs at Stanford (where the Jargon File was started in 1975) and MIT (where a duplicate copy of the Jargon File was maintained from 1976), Carnegie Mellon, Worcester Polytechnic, and similar sites. The first *Hacker's Dictionary* (Steele 1983) was thought at the time to be a monument to a subculture dealt a death blow by funding cuts, the introduction of personal computers (fear of atomizing the social relations fostered by time-sharing machines), and the seduction of the best and brightest into industry. There is a machine-specific set of implications surrounding the 1983 cancellation of Digital's Jupiter Project (meaning the death of PDP-10 centered cultures that nourished the Jargon File), the shift from "home-brew" hardware engineering to vendor-supported hardware, the shift of MIT to dedicated LISP machines, and the shift at the AI Lab from the beloved ITS to TWENEX.[19] It is significant, for instance, that GNU ([acronym: "GNU's Not UNIX!"], a UNIX-emulating set of developments, including the popular GNU EMACS and GNU C compiler) is part of Richard Stallman's and the Free Software Foundation's efforts to agitate for the position that information is community property and all software source should be shared. In this context, the history of networking developments from Multics to UNIX takes on more than a technical significance, opening onto ethical, political, and economic issues as well.[20]

While hacker culture grew up around certain kinds of machines and artificial intelligence labs, it is only one of several distinctive and overlapping subcultures, including techspeak and SF fandom, in which many hackers participate. There is a danger among humanists to make SF fandom stand in for these other cultures rather than recognizing them as interactive subcultures. My interest here is attempting to move ethnographers toward a mapping of the overlap with various techspeak and science subcultures, rather than continuing to replant in the much-used garden of popular culture/science fiction versions of the scientific and technological imaginary. I

am interested both in the ways those (real-world) scientific and technological imaginaries grow and in the social worlds they inhabit, grow from, and shape.

Raymond claims that the network constitutes a geographically dispersed think tank, pointing to the fact that during the 1988 cold fusion controversy, many papers were disseminated on the Net before making their way into print. There has in fact been a good deal of experimentation with various forms of communication on the Net, and considerable dubiousness about the degree to which serious discussion can be pursued and protection from troublemakers of all sorts can be prevented, problems of netiquette and of governance. Initially, many BBS (electronic bulletin board systems) appear to be poor forums for serious discussions (see Stone's 1995 account of the history of CommuniTree; Lotfalian 1996) despite their democratic promise of open access in contrast to hierarchical and/or heavily screened, gate-guarded arenas such as the classroom, journals, television, and radio. They initially appear to be poor forums because they are heavily spur-of-the-moment opinion driven, rather than carefully analytic or documented; also because their space seems to be markedly male voiced, often increasingly so (with time, female voices fall silent). Things need not be this way. The World Wide Web, with interface programs like Mosaic and Netscape with (hypertext) links to databases of all sorts, can transform the opinion-driven nature of initial BBS; discussion groups can be self-disciplined arenas (various forms of governance mechanisms have been experimented with); and genuine interest-driven discussion lists—like the breast cancer or other disease-focused support groups—can contain an inherent process of warning and skepticism toward poorly supported assertions or advice and can provide an important counter to the self-protecting authority systems of institutional medicine. Gender and other identity play in the place of user IDs can change the communicational dynamics (for good or ill). One old gentleman, it is said, who plays bridge on-line, signs on as a woman because he has found he is invited to join games much more quickly than if he is a man.

Our class discussion list at MIT in 1994 with PGP-encrypted signatures and pseudonyms for interaction showed a quite interesting gender distribution: eighteen of the twenty-six registered names were gender neutral: bitdiddle, nexus, axis, quickster, swizzle.shtick, cactus, the hacker, gyphon, Kipple, shalako, jello44, koda.krome, lizard, notjeff, bagel, frobgrot, elephant, the Keeper).[21] In time some of the posters felt signature pressure, so The Hacker began to sign Alyssa or Alyssa P. Hacker; bitdiddle soon gendered himself as ben bitdiddle. There were then perhaps a half-dozen male names (ben bitdiddle, sean, Prof Charles, joebloggs, Ishmael Gabanzai,

notjeff, gilligan) and two or three female ones (Morrighan; 3 Jane or Lady 3 Jane Tessier-Ashpool, a character from William Gibson's *Neuromancer*). Only four were vaguely ethnic (Morrighan, shalako, Ishmael Garbanzai, Prof. Charles). Some draw on specific hacker jargon (joebloggs is a reference to the imaginary family, Fred and Mary Bloggs and their children, used as a standard example in knowledge representation to show the difference between extensional and intensional objects [Raymond 1993: 72]; frob is a productive particle [frobnitz, frobinicate, frobnosticate, etc.] referring to a small thing that can be tweaked or frobnicated, from a command on some MUDs to change a player's experience level, and to make wizards or request wizard privileges [193]), or stylistic linguistic play (koda.krome; notjeff>notwork as network not working or acting flaky). A few drew on the SF/Dungeons and Dragons mythos or cybergame references (one used his well-known out-of-class handle, Warlock),[22] such as were popular among the Legion of Doom and Masters of Deception hackers busted by Operation Sundevil (Sterling 1992): Knight Lightning, Phiber Optik, Acid Phreak.

Writing Infinite Loops and Future Bostons

If *The Hacker's Dictionary* and ethnographic investigations of linguistic usages open windows into not just the life worlds but philosophical attitudes and engineering-design pragmatics of several hacker, programmer, and computer scientist subcultures, the larger linguistic units of storytelling by such subculture members reflecting on their worlds may help sketch some of the broader and deeper dimensions of these worlds and perspectives. Indeed, storytelling is itself a central object of speculation, analysis, and design-curiosity for several of these subcultures (see, for instance, the weekly meetings of the Narrative Group at MIT's Media Lab [ni@media.mit.edu]). Three story collections provide first frames: *Infinite Loop: Stories about the Future by the People Creating It* (Constantine, ed., 1993), an anthology of twenty-seven short stories (eight by women) by programmers, systems analysts, and software engineers, not inappropriately published (as was Malamud's book) by a company that also produces software trade shows; *Future Boston* (D. Smith 1994); and *In the Cube* (D. Smith 1993), a science fiction collective project (with each writer contributing a different piece of a single story-world) by a more varied set of ten contributors (two women), including one from *Infinite Loop* and five other programmers and technical writers, a physicist, a multimedia artist, a financial consultant, and a writer.

The ethnographic fascination of these stories lies in the interplay between the texts and RL (real lives), especially in *Infinite Loop*. In contrast to stereotypes about nerds who have no emotional lives, or whose emotional lives are fueled largely by adolescent testosterone—not that such a subculture does not exist,[23] but there are many other more interesting groups,[24] including the turn by some who have suffered neurological diseases in their families to intensive research in cognitive science, linguistics, and artificial intelligence modeling (see Powers 1995)—these stories are about psychological and relational issues, about animating paradoxes and breakthroughs of apparent impossibilities that computer or cyborg futures provide as proleptic vehicles of current design thinking.

Pati Nagle's story "Pygmaleon 3.0," for instance, interplays fascinatingly with MIT Media Lab team leaders' descriptions of their projects. At the tenth anniversary celebration of the Media Lab (10/10/95), Pat Maes talked about the butler metaphor common in thinking about the design of software agents. Other Media Lab researchers described projects in perceptual computing (the programming of computers to recognize faces, emotions, gestures, and subtle changes of expression); smart rooms and the communication among smart objects so that, for instance, a vacuum cleaner knows not to turn itself on when someone is home, or could be told by a couch that it was too heavy to be pushed around. Even the fact that *Infinite Loop* is published by a company that produces trade shows was mirrored in Marvin Minsky's self-consciously and ironically identifying the manufacturers of the various robotic devices he talked about, identifying each manufacturer with a pause and a laugh line, "made by Hewlett-Packard . . . a sponsor of the Media Lab."

In Nagle's story, a single woman programmer is trying to negotiate the expectations of having to sleep with a boss who disgusts her in order to get ahead. Her condominium is fully managed by an operating system named Oz, who not only adjusts the lights and heat, brings her drinks, and talks to her, and whose programming can be overridden by her voice commands, but also monitors her emotional states and adjusts her environment according to her stress levels. One of the advertising catalogs displayed on her holographic television screen includes an extraordinarily responsive, self-learning male lover whom she decides to rent, "just to test out" how his operating system works. He is much more sophisticated than she expects, and he and Oz propose various ways of dealing with her boss. This is one of the few stories that incorporate the computer command structures into the story text.

Other stories involve psychological conundrums of holograms and implants that change personality or sensation (the commoditization of brands of personality, the mapping onto human players various animal sensory capabilities); of bioengineering (a woman has her dog, Riley, reengineered

as a man and slowly trains him to do what she wants; this process is intertwined with a budding relationship with a real man who leaves when the reengineered Riley is delivered, providing a neatly ambiguous mediation by a woman on "what women want"); and the (im)possibilities of computer mediation of illicit, impersonal sex without guilt. There are stories about rivalry between programmers and the feeling of omnipotence that computing can give; the dilemmas of parenting in a municipality that is free of computer viruses because it has outlawed personal computers but where they still exist illicitly; a parody of the San Francisco heavy metal, mechanical gladiatorial artist Mark Pauline (see Dery 1996) and what his work says about bloodshed among humans. There are stories about the fierce competition of the computer age, both about speeded-up work time (a hilarious version of the physics fantasy of being in two, or more, places at once, and the devastation and havoc this can wreak on family, body, and ability to survive economically); as well as about a laid-off lead programmer at Boeing who, now a homeless woman, finds a stolen biological computer. (After a few false starts, she guesses the correct command to turn it on, "Boot!" Imagining its uses, she thinks of selling it for fabulous sums, starting her own company, and gaining new autonomy; but she decides what she really needs is emotional security, and takes it along to the homeless center for Sunday turkey dinner.) There is a spoof of gadgets designed for the military-industrial complex (the true uses of which are as consumer tools for "personal discovery"), which simultaneously parodies the script style of thinking about life that programming can foster.

A lovely story about cyborgs used to reengineer the human species and our environment as the latter becomes increasingly a threat to the former has a world populated with nanobots that allow humans to process chlorophyll, nanotooters to regenerate aging bodies, nanoassemblers for building, nanocomputers for designing. The hero works on a holographic design model of a bird to fix the ozone by breathing in oxygen and nitrogen and breathing out ozone and nitrogen. But the story is also a deft account of husband-wife interaction, in which she proposes a solution but he does not hear her, at the same time remembering an old design that triggers his insight: the solutions are formally the same, if technologically differently located, and so he gives her no credit.

Lois Gresh, the author of the story about the human effects of time compression, also has a wonderful story about a self-reproducing biological computer with a capacity-straining program called Nietzsche ("compiles so slowly you'll think you've shorted"), which she finally births into a separate biological computer. Nietzsche now needs more tasks to keep from "terminal boredom" and thus births a third computer, a Hasidic rabbi intelligence that begins debating with Nietzsche. Parodying programming and philosophy, and hinting at the diseases of cancer and malignant tumors (and attendant ethical issues) to which such biologies might be subject, the dilemmas of what seems at first a merely amusing and textured story are shadowed more darkly in the life tragedies of the human designers: Marge, who lost her only child, and Arnie, who lost his wife to cancer. They worry about the transfer of their creations to the medical establishment and speculate about their possible future roles as consultants watching over these AIs, more animal than machinelike. Woven throughout run the ethical dilemmas of life, in whatever form, "out of control."

If *Infinite Loop* is ethnographically fascinating for the interplay between story and contemporary RL, as in the "Pygmaleon 3.0" and Media Lab project resonances, the *Future Boston* stories provide potential for ethnographically located grounding in a real place and for implicating history and changing social dynamics (see also *Zodiac*, Neal Stephenson's 1988 ecological SF reality parody set in Boston). The armature of *Future Boston* has a standard SF or cyberpunk cast (new technologies embedded in a decaying environment and a stratified authoritarian governance caught between warring factions), and the plot is noir thriller. (A female detective who misses her father killed in the Great Flood is used to repress an uprising. The client, a hardboiled professional female City Operator or Supervisor, is, in turn, desperate to find her kidnapped adopted daughter, whose fingers are being sent to her one by one by a revenge-seeking infiltrator of a school for the children of the Boston elite merchant families.) Boston is projected into a more multicultural society (the detective is Irish, the police chief is Italian, but elite merchant families have names like Nyo, Martinez, Mudandes, and Gutfreund) and is expanded also through multispeciation (especially with the linguistically distinctive Phner, and the recombinant, bioengineering Targive).

The epic frame is a futuristic parody of Boston history: a busy interplanetary spaceport, after secession from the United States (in a Pyrrhic replay of the American Revolution), after the arrival of the Loophole, through which various alien species have arrived, after a municipal mutiny (Civil War) and repressive use of a Great Flood to drown the mutineers. The sea has reclaimed much of the landfill, and Bostonians now live in a huge, 180-story cube, an enclosed and stratified environment with video-simulation windows. Unenclosed suburban towns exist across the water: Charlestown, Dorchester, and Cambridge, where MIT and Harvard still maintain marginal existences. The spaceport in the harbor is the access to the obligatory physics parody: the Loophole or "multiply-connected space-time topologi-

cal anomalous region which a spaceship can traverse to travel from one place to another without crossing the intervening distance" (D. Smith 1994: 155).

But the Loophole is less access to a *Star Trek* fantasy of outward expansive space colonization and more an inward, implosive, historical reminder of being colonized and of the tragic Fall of the Phner, a parody of the biblical myths of origin, including a Tower of Babel reminder that language differences can carry alternative worldviews. The linguistic play continues to be characteristic and a meditation on grammatical-philosophical potentials.

The Phner have a language without verbs: instead they "use concepts that concatenate existence and time, words like destruction-imminent-but-necessary or existed-once-now-ended-and-memory-still-influences-events" (40). From an English language point of view, "they have trouble with verb tenses, time sequences and causality—before and after are almost the same word in Phner" (12). But they have acute memories, imitate others to perfection as communication devices, and so can act as the "sents of Boston" (17): "To the Phner, every spot of blood, every crumb of dirt, every wound and scar and broken bone tells a story" (19). This syntactical, memory, and sleuthing structure provides as well a kind of karmic-cosmic attitude toward life and death: deaths are never forgotten, yet they are placed in larger contexts that judge them as "artful" or not. "Phner can accelerate their time-sense for brief periods, react more quickly, move faster, think more clearly . . . a survival reflex that conjures up terrifying and sad memories of the Endless Fall" (after losing a war with the Sh'ik), but which "at the same time it can be . . . a terrific buzz."

The Phners' acute memories (a process of esfn') make them superb craftsmen of the reconstructed historic parts of town, and also a threat to art markets that depend on uniqueness, since Phner easily re-create objects as they were when first esfn'd. To the Phner, the notion of copies destroying value makes little sense because "no two objects are identical because they have unique histories" (a re-created object retains for them traces of its mode and time of re-creation). They consequently also have extremely skilled physicians, and from human points of view ghoulish interests in dissecting the dead to learn what they can. Phner are social animals who live in tightly packed "warrens" and have communal rituals that exercise the moral as well as psychological senses. Whatever one makes of this fantasy, it stands in for, acts as a token of, cultural differences premised on real epistemological and linguistic-structural differences, something rare in most science fiction (Ursula Le Guin being a notable other exception).

The Targive are a similar token, this time of recombinant biological potentials, which even if not worked out with any particular technical didacticism available through contemporary molecular biology, nonetheless marks out that conceptual terrain. They are a race of nomads who build citadels, basilica, cathedrals out of local forms of biological life, and who also produce various "mods" or modifications of local biological forms. Every Targive gift (punning no doubt both on the German "gift," which means poison, and on the oxymoron of tar, which sticks rather than being giveable, or which tars the gift receiver with unwanted side effects) "conceals a scorpion so only the desperate accept their offer" (41). For cleaning up Boston's effluents, they biodesigned a "clivus" that eats, digests, and transforms, helping bacteria dismantle the complicated man-made molecules of pollutants into ammonia, water, nitrogen, and carbon dioxide (91). The Targive can perform modifications on human brains as well, but at a serious cost, for they exact in tissue of their choosing a price for their gifts.

The world of this future Boston is filled with chairs made of Targive-modified jellyfish; bioelectronic blackbirds that act as eyes for the City Operator; holographic exercise environments in which one can fight off lizards or Zulu and Nubian warriors; "biodesign on a grand scale, micronics so small and powerful that a lint-sized chip could not only beat you at chess but insult you in Swahili all the while, truly independent servobots, artificial brain aids, field-based technology; the list went on endlessly. With them came vermin, bugs, bizarre foodstuffs, and a host of alien con artists, lunatics, political fanatics, demagogues, courtesans, smugglers, and rapscalawags. And the dread disease cities, which in the late 2030s killed a fifth of the City's population before the Targives designed a treatment and a vaccine" (156). Indeed, "It's part of City lore that . . . City Operators have Targive implants to help them interface better with the bots, eyes, spatiens, and Phneri, and with the half-biological City organism itself" (24). There are even jesters: the popcorn aliens who parody the world of buying and selling:

> "Sell to you and sell for me! Cells of two and cells of three! Cells for yet a hundred indecisions, and for a hundred visions and revisions, before the toasting of a fake or spree. This has been dyed grue, the rarest color in the galaxy. . . . appears green until you buy it, then . . . it turns blue. . . . that's why grue is unique!" . . .
>
> "I've got to go I'm hunting for someone."
>
> "Why didn't you say so?" . . .
>
> "I did say so. You weren't paying attention."
>
> "You weren't charging attention! I didn't know I could buy it from you." . . . The popcorn grabbed the picture and immediately turned it

upside down. "Yes, yes," he replied. "Absolutely distinctive hairline. I can certainly sell you to him."

"But you haven't got him."

"Oh but this is a futures contract."

In Brief (the Law)

Everything you know about intellectual property is wrong. . . . Intellectual property law cannot be patched, retrofitted, or expanded to contain digitalized expression anymore than real estate law might be revised to cover the allocation of broadcasting spectrum.—John Perry Barlow, "The Economy of Ideas"

It is difficult for intellectual property laws to keep pace with technology. When technological advances cause ambiguity in the law, courts rely on the law's purposes to resolve that ambiguity. However, when technology gets too far ahead of the law, and it becomes difficult and awkward to apply the old principles, it is time for reevaluation and change.—Lehman Working Group Preliminary Draft

Software is a machine whose medium of construction is text.—Randy Davis

Futures contracts, in the lively languages of the law, changing briefs for changing times: It is striking how often lawyers write about challenges of law and cyberspace in the tropes of radical breaks with the past, that precedents are multiple and ambiguous, that a choice of metaphor on the part of legislators or judges can make an extraordinary difference. Paula Samuelson et al. (1995) writing about copyright and patent law, Michael Froomkin (1995) writing about cryptography, privacy, First and Fourth Amendment rights, Judge Richard Sterns, in the 1994 case of MIT undergraduate David LaMacchia, writing a decision about wire fraud, copyright infringement, and system operator liability—all express concern that the law is inadequate to developments in the new medium.[25]

Courtroom and legislative committee provide adversarial grounds between plaintiff and defendant, but also between economic interests and societal ones, state and individual rights. Networked connectivity, accumulating data banks, encryption, and the economics of a shape-shifting technological medium have over the past fifteen years reframed the conceptual universes by which lawyers, judges, and law enforcement operate. In the struggle for comprehension and adjudication, legal language has been given a workout. Lively languages operate here as much as in literary or imaginative spheres; metaphor here is both a serious workhorse (on the basis of which precedent and analogical reason operate with quite profoundly different outcomes depending on the metaphor chosen) and a computer functionality that the law has fumbled in accommodating (e.g., conceptual metaphors as the modality in which software programs give behavioral coherence and wherein resides much of their value as user interfaces).

That the law operates by matching new situations and new technologies to older precedents through metaphors and analogical logic is not a new observation, but Michael Froomkin's 1995 essay "The Metaphor Is the Key" demonstrates how the choice of metaphor in the debates over cryptography can make a major difference.[26] If encryption is regarded as being like a car (vehicle for messages), then government demands for random inspection can be analogized to random checks on cars: escrowed keys might be like license plates or like photographs on a license; no warrant would be necessary (by the time a warrant is obtained, car or message is long gone), and one can check for whether messages are encrypted according to approved encryption systems, without necessarily looking at the message content. "If the car metaphor prevails," warns Froomkin, "there will be far fewer constitutional rights in cyberspace than if any other metaphor comes to dominate."

If, on the other hand, one regards the cyphers of encryption as a language, then the government argument that it must have the ability to decrypt would be analogous to imposing limits on the use of other languages than English and would be unconstitutional under the First, Fifth, and Fourteenth Amendments. Rejection of the language metaphor, warns Froomkin, can lead to undesirable consequences. The metaphor of a house "may provide protection depending on whether a court could compel production of [an encryption] key not committed to paper. If the court is unwilling to do this on Fifth Amendment grounds, strong cryptography would provide nearly unbreakable protection of private papers stored on a home computer."

These metaphors do not operate in a historical vacuum, and Froomkin suggests shifting concern away from Big Brother to Big Drugs in the rhetoric of the FBI's campaign to impose mechanisms that would allow the government to access encrypted messages.[27] In fact, while much of the press coverage of computer crime has been about hackers breaking into systems,[28] white-collar crime and misuse of data banks are much more serious sources of computer crime both in financial terms and invasion of privacy terms.[29] Encryption technologies can be used both to protect privacy and to make such crimes much easier, and thus the struggle is vigorously contested between those who fear anarchistic black markets in everything from body parts, kidnapping and assassination contracts, money laundering, extortion ("the four horsemen" of drugs, terror, money laundering, and pedophiles), as well as the breakdown of taxation and general law enforcement abilities of

the state, and those who fear the imposition of police state controls including outlawing of privacy-enhancing encryption, imposition of national identity cards (to be used at point-of-sale terminals to collect taxes and monitor health and other statuses),[30] as well as the general growth of surveillance by employers, marketing, and other information entrepreneurs.[31]

"Regardless of how the Court decides to strike the balance," says Froomkin, "it will involve a process requiring decisions not compelled by any precedent. . . . to predict where the law . . . may be going and to suggest feasible alternatives, one needs to understand the concerns that are likely to influence [future decisions]" (845).

Similar kinds of metaphorical choices are debated in the still unsettled question of system operator liability: is s/he like a publisher, an editor, a bookstore, or a common carrier? If an editor, then more liability is likely to accrue; if a bookstore or common carrier, then s/he cannot be held responsible for the content of the books/messages.[32] System operators at the moment are caught between potential suits for libel by victims of defamatory statements on their systems, and suits for abridgment of free speech. Economic pressures mediate some of this: Prodigy monitors at least children's chat rooms for fear that parents will cancel subscriptions if they find their children being subjected to materials and solicitations they find offensive. Legislative and technical mediations are also now being proposed.[33]

The debates over intellectual property law—copyright, patent, trade secrets—are central to the economic incentive structure of the computer industry. A series of contradictory outcomes of major appellate and Supreme Court decisions (*Whelan v. Jaslow* [1986]; *Lotus v. Mosaic and Paperback* [1987–1990]; *Apple v. Microsoft and H-P* [1988–1992]; *Computer Associates v. Altai* [1992]; *Borland v. Lotus* [1997]) have sparked vigorous debate about whether copyright and patent laws are adequate to the new medium, and whether a sui generis law should be written as was done for computer chips in 1984. At issue is the confusion over whether software can be analogized to texts and literary productions (copyright), or to machines (patents), or—least likely given the relative ease of reverse engineering—to trade secrets. At issue as well is a temporally unfolding change in the nature of the software market, which is paralleled by changes in positions taken by the industry.

The first software patent was issued in 1968, but in the 1960s software was normally bundled with hardware, given away as something that made mainframes usable. A 1966 presidential commission chaired by J. W. Birkenstock, the head of IBM (which controlled 70 percent of the computer market), did not want software to be patentable: algorithms are laws of nature, and thus not patentable. In *Gottshalk v. Benson* (1972) IBM, Burroughs, and Honeywell filed friends of the court briefs in which again they argued that the mathematical character of algorithms, even if they facilitate machine implementation, make them ineligible for patent protection. But by the 1980s a mass market began to emerge for software, and industry began to demand protection for a commodity that was expensive to develop but easy to copy. A 1978 presidential commission urged Congress to add software to the 1976 Copyright Protection Act because there was no patent protection, and this was done in a 1980 amendment to the act. But copyright is an uncomfortable fit for software: copyright is intended to promote diversity of literary production; software to be most useful requires standardization. Copyright is intended to prevent copying; every computer operating system integrally contains copying programs. Although there have been extensions of copyright protections from the original application to printing, reprinting, and vending of printed materials (to public performance rights for drama, music, and public display, analyzed by the 1976 law into five kinds of rights: reproduction, derivation, distribution, public performance, and public display), copyright seems to stretch the meanings of copying to various reductio ad absurdums. These have become the source of the contradictory appellate court decisions in the series of "look and feel" court cases of the late 1980s, and the impetus for new policy initiatives explored in the July 1994 Preliminary Draft Report (or Green Paper) of the National Information Infrastructure initiative (NII) working group chaired by Bruce Lehman, the commissioner of patents and trademarks and assistant secretary of commerce.[34]

In 1981 the case of *Diamond v. Diehr* reopened the patent system to software, adding to the confusion. Taking the position that patents can be issued for industrial processes controlled by computer programs (rubber curing, in this case), IBM immediately began filing patents on software, and after an influential article by Donald Chisum (1986) supporting the use of patents for software, the Patent and Trademarks Office began in 1989 to accept more and more applications. IBM files some two hundred a year, and there are as many as a thousand a year being filed, many in anticipation of their use for cross-licensing with other companies. Indeed, software is often written up as both a patent application and a copyright, since it is increasingly difficult to distinguish between implementations done through hardware or software: they can be done either way. Like copyright, the patent system also fits software poorly. Intended to encourage the making public of processes and methods of production in exchange for a seventeen-year protection, the time period for protection is the first problem, since the time cycles of software (and hardware) in the computer industry are much shorter. The search

for "prior art" to demonstrate that one's patent is nonobvious and original is difficult and confusing, both because of the lack of technical expertise in the PTO and because of the complexity of programs and the difficulty of deciding which elements might constitute prior art. These problems open the door to endless litigation, since software development depends on incremental modification. Litigation becomes a means for raising entry barriers to small companies and embroiling big ones, but it works, arguably, in the favor of large companies with considerable legal resources.[35]

If both copyright and patent definitions are hard to apply to software, perhaps a sui generis law is required. This was the solution found in the 1984 Semiconductor Chip Protection Act, in which patentlike protection is given for two years automatically, and for eight years if the chip is registered. At the same time, the act acknowledges incremental design development, the right to reproduce and reverse engineer chip designs to test and analyze how they work. The industry wants competitors to make compatible chips, and the production process relies on second sourcing. But the semiconductor industry, unlike the software industry, has only a dozen or so large manufacturers, the barriers to entry are high, and it is very expensive to set up a production facility. Still, the argument can be made (Samuelson et al. 1995) that the current laws generate an unstable oscillation between overprotection and underprotection, because none of the categories of intellectual property apply neatly to software. At the time of *Whelan v. Jaslow* (1986), it seemed that there was underprotection and the need to encourage investment, so an expansive interpretation of copyright was pursued. At the time of *Computer Associates v. Altai* (1992), it was not just a different circuit court and a different reasoning process but a different time, when the market felt cramped by overprotection, and so a narrower definition of copyright was pursued.

It would be better, argue Samuelson et al. (1995), if one thought out ways to protect the actual value of computer software, rather than forcing poor analogies. The most important property of programs lies in their useful behavior, including the conceptual metaphors that give behavior coherence. Behavior can be "cloned" without appropriating the text of the software: that is, different codes can produce the same behavior. If what is of value in the market is the behavior, it misses the point to try to copyright the codes, which in fact are made up of incremental elements modified, but rarely directly copied, from various prior art sources.

The 1994 Green Paper is an interesting document against which to test out this line of argument. Although the paper claims that copyright law needs only "minor clarification amendment," what is revealing is its item-by-item puzzlement over what traditional legal concepts might mean in the new digital environment. It can be read rather the way a wickedly delighted psychoanalyst might look for hesitations, ambivalences, and contradictions in the Official Story and thereby find another quite contradictory one being told. (The Green Paper was succeeded by a 1995 White Paper, which according to many analysts tries to erase the telltale ambiguities in the Green Paper by omitting unfavorable legal precedents, and tilts the resolution in favor of already existing communications industries in an unsustainable attempt to extend the meaning of copyright to even such "copies" as the electronic repetitions in the machine memory in order to be able to display or send a document.)[36]

Photocopying, once an analogous new technology, the Green Paper begins, also once "caused apprehension among copyright owners," but thanks to the time, cost, and degradation of quality involved in copying, as well as court decisions denying application of "fair use" to Kinkos and other off-campus copy shops' production of anthologies for professors, print copyright rules still work reasonably well. The same holds for audiotape recording, even digital ones (as worked out under the Audio Home Recording Act of 1992). But digital integration of all forms of text, image, and sound information, done with speed, ease, and no loss of quality, makes it sometimes difficult to even tell what is distribution, what is reproduction, what is publication. Traditional copyright law depends on a definition of publication that requires a material object to change hands in contrast to a display or performance. How stable is the notion that browsing in another computer constitutes "fixing" of a new copy because for it to be displayed, it must be in RAM or the buffer? In *Playboy Enterprises v. Frena*, the court decided that unauthorized downloading of digitized images scanned from Playboy photographs constituted economic damage to Playboy Enterprises. However, the Green Paper notes that it remains unclear whether in fact Frena "distributed" the photographs, or subscribers "reproduced" them; furthermore, if subscribers are then liable for copyright infringement, it is unclear if Frena is liable as contributory. In the Playboy case, and a similar case concerning video games *(Sega Enterprises Ltd. v. MAPHIA)*, judgments were made, but the principles at issue are unclear when applied more generally to the liability of bulletin board sysops (system operators) if the latter are able to claim no knowledge of what is put on their electronic bulletin boards. A prominent 1994 court case dealing with these issues, that of an MIT undergraduate, David LaMacchia, was dismissed as unprosecutable under either copyright law (he did not himself either engage in uploading or downloading, nor did he profit, nor was he held liable as "contributory" to copyright infringement for telling people where to place and get pirated software)[37] or

the wire fraud statutes often used by prosecutors when they need a vaguer general-purpose statute. The judge in the case noted that prosecution should not be used as a vehicle for writing laws where current legislation does not fit the new cyberworld, that if Congress wished LaMacchia-style activity to be made criminal, it needed to write legislation to that effect.

Moreover, the Green Paper continues, the new digital environment also creates problems for the "first sale doctrine" (that when one buys a book, one may resell it), for archival and library exemptions (which allow free use and limited reproduction rights), for rights of free transmission on receiving apparatuses like radios in a bar or beauty shop (which "will change as home equipment merges with other equipment"), and for licensing provisions allowing cable and satellite operators to retransmit copyrighted materials ("will need to be reviewed" as creative, communications, and computer entities continue to merge). More subtly yet, since copyright infringement does not depend on intent, and since it also need not be a literal copying, the ability to easily manipulate works in digital format leads to a whole raft of issues regarding infringement, reproduction, and derivative work. Among these issues, the Green Paper lists manipulating photographs (in which the input may be infringement, but the result may not be) and the resale or distribution of items from gray markets (legally produced for distribution abroad but not authorized for the U.S. market). "If an infringing literary work, for instance, was physically shipped into the United States in the form of a paper copy, a CD-ROM disk or even stored on a memory chip, then it could be an infringing importation if the above discussed conditions exist, but it would appear that Section 602, as currently written, could not be used to block the electronic transmission of such material" (238).

A more obvious and basic issue is that domestic law will be made increasingly ineffective unless at the same time an international or "global" information infrastructure and legal framework are constructed. This, the Commerce Department Green Paper notes, is not merely an issue of intellectual property rights ("When the globe is blanketed with digital information dissemination systems, a user in one country will be able to manipulate information resources in another country in ways that may violate that country's copyright laws"), but also a potential problem for commerce: doing "electronic business" over information superhighways will be difficult unless rules for protection (of rights, but also privacy, and security) and harmonization of legal structures are provided. The initial issue is the claim of the Software Business Association that its members lose billions of dollars each year in pirated software.

Harmonizing copyright systems means among other things coming to terms with at least two different moral understandings of the purpose of copyright: for Anglo-American law, the purpose is to protect authors' economic rights so that they will make their ideas publicly available in order to promote the progress of science and the arts; for European law, "moral rights" of authorship are not transferable and have to do with natural rights or rights of personhood. The American authors of the Green Paper, citing a Japanese study for legitimacy, say these moral rights may have to yield in the new digital world.

The Green Paper has relatively little to say about patent law, which is under siege by the digital revolution at least as much as if not more than copyright law. Indeed, it has little to say about the entire confusion of patent and copyright categories created in a series of important court decisions over the past fifteen years about the copyrightability and patentability of software (as well as the blurring or interchangeability between hardware and software), a confusion so severe that many (e.g., Barlow, Newell, Samuelson) suggest that a whole new intellectual framework may have to emerge. The Green Paper proposal timidly hints at this by proposing that "transmission" be elevated into an elaborated conceptual apparatus to deal with many of the issues listed here. It ends with an important reminder of two social issues fundamental to the conflicts among the major interest groups (academia, industry, programmers as a profession, and the state)—the basic purpose of the copyright law and the problem of access:[38]

> The Copyright Act exists for the benefit of the public. To fulfil its constitutional purpose, the law should strive to make the information contained in protected works of authorship freely available to the public. "Freely available," of course, does not necessarily mean "available free." The Working Group does not believe that authors should be required to donate access time to their works on-line, but some reasonable approach must be adopted to ensure that the economically disadvantaged in this country are not further disadvantaged or disenfranchised by the information revolution.

The Green Paper, in short, provides a preliminary site of contestation in the information revolution as well as a sense of the destabilizing effect on basic conceptual categories that this revolution is generating. It does so by looking not at language uses that celebrate, exacerbate, or elaborate on these instabilities (as for instance in a "pomo" playful theoretical exposé), but on the contrary at a conservative document unable to hide the contradictions;

the paper argues both that only minor clarifications and amendments are needed and that when technology gets too far ahead of the law, . . . it becomes difficult and awkward to apply the old principles."

This situation should not be taken as an argument in favor of a presumption that new technologies necessarily make old laws obsolete, as Laurence Tribe (1991) notes in regard to First and Fourth Amendment rights, but rather that one pay close attention to the values that the law—constitutional or statutory—is meant to foster. While the stress here has been on the instabilities of legal categories, language, and reasoning, the argument has been underpinned by a questioning of the economic dynamics, democratic access, and private liberties that are under pressure. Just as the legal system periodically needs to be reminded that the Fourth Amendment protects the privacy of people, not places, so too, in thinking about the economic restructuring that cyberspace is facilitating, one needs to consider the values of the human beings involved, the values placed in the exchange system.[39]

In Exchange

Nineteen ninety-two . . . signaled a sea change in competitive dynamics. . . . The importance of this transition reaches far beyond the participants in the [information technology] industry. . . . None of these industries are able to operate successfully within autarkic national boundaries.—David Yoffie, *Strategic Management in Information Technology*

Chips make me think of the eyesight of women in Singapore and Korea, going blind during the process of crafting the fiddly little wire; of "clean rooms" . . . in Silicon Valley and the Netherlands . . . perhaps it is time to have a less boring idea of the body right now—a body politic . . . the combination of telecommuting with the global factory has proved terrible for women . . . isolated in the "electronic cottage," . . . an easy way for a corporation to do legal "union busting" and bypass any particular state's labour regulations . . . Tayloristic intervention . . . monitoring of key strokes in data entry . . . timing breaks to go to the toilet.—Susan Leigh Star, *The Cultures of Computing*

Information . . . Like other such deep phenomena as light or matter, it is a natural host to paradox . . . helpful to understand light as being both a particle and a wave, an understanding of information may emerge in the abstract congruence of its several different properties. . . .

Information is an activity . . . is experienced, not possessed . . . has to move . . . is conveyed by propagation, not distribution . . . grow[s] in the usual fractal lattice like frost spreading on a window. . . .

Information is a life form . . . as in an oral tradition, digital information has no final cut. . . .

Information is a relationship. . . . Receiving information is often as creative an act as generating it.—John Perry Barlow, "The Economy of Ideas"

Just as in the law (intellectual property law, export controls, privacy, freedom of information) there is a claim that the new electronic media are undoing old assumptions, definitions, and regulatory mechanisms, so too there is a claim that the information economy operates by laws different from those of classical or marginal utility economics. It is in the details of the paradoxes of this new economy that the double ethnographic challenges reside: the challenges to produce credible ethnographic accounts of the concrete and detailed temporal changes in the political economy of cyberspace; the challenges to provide critical mirrorings in which the utopian and dystopian sides of the political economy can be screened in their partialities and contingencies. In public discourse at least, it is as if one side of the paradoxical structure cannot be seen while the other is being discussed.

On the one side, in the extreme, John Perry Barlow, Carver Mead, George Gilder, and others argue that the constraints of labor and capital are being removed thanks to a technology that increasingly operates on the level of the microcosm, the particle world of electrons and biological molecular processes, as miniaturization has moved down from circuit boards to the integrated circuit and faster and faster chips made out of sand (silicon), and as parallel processing allows computations to work as "out of control" self-organizing systems. On the other side, these processes have also been described as allowing for an intensification of the labor and capital processes described by nineteenth-century political economists (exchange of formally free labor through a mystified process of alienation and extraction of surplus value). Cycles of innovation and consolidation have plagued the computer industries (Hayes 1989; Yoffie 1994; Teitelman 1994). David Yoffie and his colleagues at the Harvard Business School put together a casebook on the informational technologies in 1994, arguing that almost all firms have a stake in the evolution of these technologies both as customers for the technologies themselves and arguably more importantly as a model for management in the twenty-first century. None of the IT industries can operate in autarkic national boundaries; all must be transnational. No market is big enough (not the United States or Europe) to support the costs of developing a digital switch or semiconductors; those that tried to remain national went bankrupt. Only in the 1990s did the promise of merging technologies

actually happen, and this caused the disintegration of vertically integrated businesses. Computers and telecommunications began to merge; the difference between personal computers, workstations, minicomputers, and mainframes began to collapse. "Blurred firm boundaries" led to new corporate forms of shifting alliances. First movers had enormous advantages in capturing market share and setting standards, and this required willingness to cannibalize one's own business (offering new products that reduce sales on older ones). Others might argue (Aglietta 1976/1979) that these are but consolidations of a globalizing market, acting like earlier and more national or regional mechanisms, as in the postwar housing and automobile consumer markets, supported by socialization of credit and loan facilities.

A second such paradox is the separation in cyberspace between production and use. Office use of software and terminals (where the physical downside seems to be "only" carpal tunnel syndrome, eye strain, sometimes sick building problems, and a sterility of environment that makes the screen seem like life) is so far removed from the manufacturing of the chips in "clean rooms" (which generate hidden toxicities) that it is far too easy for many to forget the production processes when talking about cyberspace. A third paradox has to do with the inability of economic measures to show productivity gains through computerization (Teitelman 1994; Uchitelle 1996). A fourth paradox, often tacitly understood and regretted, is the still important role that military contracts seem to play in the computer worlds of corporate survival. The secrecy of the military contracts, and the ways in which the work is parceled out so that programmers need not know the end uses to which they are contributing, are not dissimilar from the studied displacements of attention away from the hazards of manufacturing chips.

Hayes's 1989 exposé of these hazards suggests an ethnographic method of "following the work processes": evacuations of facilities for toxic leaks, medical disabilities, the intentional disabling of occupational hazard indicators, and the lack of medical research on accumulating multiple chemical sensitivity syndromes. The semiconductor industry uses toxic gases (arsine, phosphine, diborane, and chlorine) to give electrical properties to microchips. Hydrofluoric and hydrochloric acids are used to harden and etch chips, to electroplate, and to retard oxidation of solder attaching chips to boards. Trichloroethane, methylene chloride, chloroform, and carbon tetrachloride are used as solvents (64–69). Inhaling hydrogen chloride from silicon tetrachloride leaks can form hydrochloric acid inside the body (65). By 1980, occupational illness rates for semiconductor workers were more than three times those of general manufacturing workers. In response, the Semiconductor Industry Association changed the way it recorded injuries and illnesses so as to show a two-thirds drop in occupational illness rates (65), and the Reagan administration cut funding for the Project on Health and Safety in Electronics, PHASE, a program that collected and publicized information for electronics workers on chemicals used in manufacturing(66). In 1986, faced with preliminary results of a survey of its workers in Hudson, Massachusetts, showing a twice normal miscarriage rate—39 percent among workers in wafer etching, 29 percent in wafer photolithography—Digital Equipment Corporation reacted by banning interviews with workers and announcing programs of pregnancy testing and transfers for women of child-bearing age. AT&T also mandated job transfers out of clean-room work for pregnant women (67). In 1988 a California Department of Health study found that pregnant women who drank tap water in Silicon Valley had twice as many miscarriages and had babies with four times as many birth defects as those who drank filtered water or no tap water; IBM and Fairchild settled a class action suit quietly out of court (24). The astronaut-like suits worn in clean rooms are designed not to protect workers from chemical toxicities but to protect the wafers from the particles human bodies throw off (67); similarly, laminar airflows and filters are designed to protect the chips by extracting particulates, not to protect the workers by extracting fumes. Describing the false sense of protection that suits, filters, and airflow can impart, Hayes comments, "The ambience is misleading in a distinctly modern (i.e., ambiguous) way."

Apart from acute dangers from spills and leaks, chemical toxicities can build up in the fatty tissues of the body and can induce "chemical hypersensitivity," meaning increasing sensitivity to chemicals in the everyday environment. This "chemically induced T-cell inadequacy" debilitates the immune system not unlike the virally induced AIDS. And yet the chemicals, techniques, and brand names of clean-room equipment are all protected as "trade secrets" and "proprietary information," and daily logs with evacuations, fume detector tapes, and injured worker dismissals are also kept secret and rarely reported in the press. Threshold limit values (TLVs) are set by professional organizations for monitoring systems, but there is no independent checking; in fact, according to a National Research Council/National Academy of Sciences study, there are no TLVs at all for 79 percent of 48,523 workplace chemicals (76). Immigrant women are often favored workers in Silicon Valley for clean-room work, and as these manufacturing jobs are outsourced abroad, it is often women who are new industrial labor entrants who perform the work there.

It is thus not only the so-called clean room that is misleading but the entire economy of the computer industry, which goes through a classic sort

of labor reorganization while claiming to be part of a new economy that operates according to laws that are no longer constrained by scarcities of labor. And yet the ideology of descent into the microcosm, and the laws of a quantum economics, remains a vital spur to the imagination and to chip design, to the embedding of cyberspace into a changing world of scientific exploration and technological innovation, a world of quantum, optical, and DNA computers that can overcome current physical limits to computational speed, and that operate on new computing principles far removed from the sequential logics of mechanical Turing machines. At each turn, in each dimension of cyberspace—in time, in language, in place, in brief, and in exchange—there appears to be productive paradox. As Richard Powers puts it in *Galatea 2.0*, his novel exploring the intersection between the worlds of computer scientists and their own incapacities and psyches:

> "It went like this, but wasn't."
>
> . . . That's good. Lead with a paradox. Hook her. It's the traditional Persian fable opener.

Resituating Ethnography

> The problem was that you didn't always know what you were seeing until later, maybe years later, that a lot of it never made it in at all, it just stayed stored there in your eyes.—Michael Herr, *Dispatches*

> Ethics has been confined largely to the domains of doing, which include performative acts of a linguistic nature. . . . What might interest us here is the fact that responsibility no longer pivots on a notion of interiority.—Avital Ronell, "Video/Television/Rodney King: Twelve Steps beyond the Pleasure Principle"

> Man is no longer man enclosed, but man in debt.—Gilles Deleuze, "Postscript on the Societies of Control"

Like a Möbius strip, we return to the beginning, to Hans Jonas's suggestion that not only are the law, the economy, language, place, and time challenged by our contemporary technological era, but there is even a claim on the new in ethics, in how we deal with one another, and that this implicates, relocates, and complicates ethnographic writing.

The ethnographic starting point in this essay is the pervasive expressions by practitioners in many fields that things are outrunning their conceptual categories, and that in the 1990s, unlike earlier more generalized debates about the "postmodern," this has become a concrete practical matter for

the diverse institutions of society (law, economics, engineering). Among the institutional facets most developed in this essay have been the law ("In Brief") through dense casework sequences affecting economic, academic, and civil rights interests, and involving material effects of choices about metaphors, where practitioners feel under challenge of the new in ways that, they say, stretch their traditional employments of analogy and precedent. Economics ("In Exchange") too has practitioners, from business school case writers to technology writers, who claim that traditional categories are outrun. Here the discussion opens further into historical horizons of business cycles, industrial reorganizations, labor processes and transvaluations of ideas, labor and materials into producer and consumer goods. It also engages the ongoing dialectic between those processes and what at least since Marx have been called processes of fetishization, specterization, or virtualization of the economy, and to which there has been an interesting return of analysis in the 1990s (Leitch 1996), as well as some ethnographic work on the social effects (Stacey 1990; Star 1995; G. Mathews 2003). Parallel fields of discussion might be opened into psychology ("In Conscience"), both human-machine interfaces (e.g., Papert 1996; Turkle 1995; or Stone 1995) and artificial life, brain and cognitive psychology, or neuroscience; into popular culture, entertainment, and advertising ("In Play") as theaters of exploration and preparation, as well as voicings of things that cannot be said in less court-jester environments; and into sciences ("In-formation") such as molecular biology, where it has been argued that the imagery of the genome as an information science is both misleading and productive.[40] Most concrete is the section on building the infrastructure of connectivity around the world ("In Place"), captured also in the title of one of cyberspace's cheerleading journals, *Wired*. The laying of a third generation of fiber-optic cable from England to Japan is driven by competition between giant transnational business alliances that undo national PTT monopolies and regulatory controls (Stephenson 1996). The "sea change" arguments of "In Exchange" are thereby further strengthened.

The form of this essay attempts to capture on paper—a static medium—in a kind of freeze-frame, some of the dimensions and institutional facets of what a hypertextual ethnography with cross-linkages could accomplish. Ethnographies can be and already are (a few) being written in hypertext, multimedia, and CD-ROM formats that overcome the linearity of traditional writing and that might put interconnections into play more easily than simple text (e.g., Goldman-Segall 1990, 1995; Callison 2002). Some research and collaboration can be, and already is being, conducted through e-mail and on the Web. But at issue in the influence of these modalities—as with

cinematic or filmic forms earlier in the twentieth century—is not merely the literal adoption of new technical possibilities but a new pedagogical regime, in the same way that much fiction writing in the twentieth century is acknowledged to draw on cinematic techniques (Cohen 1979). Language itself is foregrounded in much thinking about this new pedagogical regime, ranging from the puns, metaphors, and syntactic play that access and hold in juxtaposition differential epistemological standpoints, to narratives and institutionalized discourses that act as switches and circuits of thought, behavior, action, organization, and cultural forms. Space, time, and differential access are being rearranged, and not only in the so-called First World.[41]

Cyberspace is part of the reality in which all of us live, and much of it works behind the scenes. Jaron Lanier debunks the hype that "virtual reality" prostheses could be mistaken as more real than the physical world: "The virtual world only exists because of the magic of the way your nervous system makes things real when you interact with them. And the moment you start to space out or become lazy, the reality goes away and it just turns into a bunch of junk on your head" (1996: 43–44). So too there is much hype about cyberspace. But cyberspace continues to work behind the scenes when we space out, compiling our credit ratings, positioning our financial futures, restructuring our work lives and stratification systems, building new decentralized bureaucratic surveillance and security systems, providing scientific and pragmatic knowledges beyond ordinary perception, keeping us distracted and suspended in complex temporal loops of partial knowledges, interactions, and circulating debts that merge and interact beyond individual responsibilities and control. We cannot afford to abandon responsibility, and we must therefore build new social forms of reflexive modernization that can make such systemic complexity and interactivity accountable. Hence the turn in much contemporary philosophy to questions of ethics—ethics no longer seen as the realm primarily of individual doings—as the quotations from Jonas, Derrida, Herr, Ronell, and Deleuze signal.

Ethnographies are challenged to no longer dwell merely in romantic tropes of discovery but to ground, make visible and audible,[42] contending worlds of difference, to provide translation circuitry that recognizes its own relations to other circulating representations (M. Fischer 1993).

9

Calling the Future(s): Delay Call Forwarding

Fifty years ago, Winston Churchill gave the keynote address at MIT's 1949 Mid-century Convocation on the Social Implications of Scientific Progress and the place of the humanities and social sciences in the education of engineers and scientists (Burchard 1950). The calls then for something like a science, technology, and society perspective as central to the conduct of professional lives as well as for the basic education of citizens in a technological society have continued to repeat in the succeeding decades. Easy generalities (and even disagreements) about humanistic or civilizational values (about which much was said at that three-day convocation on the occasion of the inauguration of a new president of MIT) sit uncomfortably with empirical investigations into the operations of the sciences and engineering, their social worlds, the worlds they transform, and the worlds within which they unfold (about which almost nothing was said). Fifty years later, at the beginning of a new century and a new millennium, even if many of the pieties remain the same, the conditions of the university, the composition of the student bodies and faculties, and the nature of knowledge bases and their constituencies have shifted dramatically; and a field of science, technology, and society has begun to emerge which makes available for citizens and professionals just such empirical investigations as basic everyday knowledge.

Science, technology, and society (STS) might become a canary discipline (as in the canaries miners take into the mines to sniff out deadly gases, thereby showing where the mines need to be vented or reworked) for the twenty-first century: a bringing together of the sciences and technologies around which modernities have been built, together with the social sciences, arts, and humanities, which constitute the analytic understanding and cultural commentaries about the societies of (post)modernity. Between 1996 and 1998 three calls were placed at MIT's STS program for such a canary discipline which would be integrative, critical, technically competent, and culturally resonant.[1] The calls placed were (1) to begin a conversation about, or testing-contesting, the disciplinary tools of ethnography and history, visual

tion films, see the essays in Berry 1991 and Gladney 1994. As Gladney points out, Tian Zhuangzhuang uses Tibetan footage and rituals to exoticize and sharpen alterity in order to critique urban Chinese society, rather than ethnographically attempting to generate understanding of, or provide points of identification with, Tibetan problems. But as others have argued, the minimalist dialogue, plot, and interpretive direction in Fifth Generation films did provide spaces of ambiguity and openness to alternative ideological stances that were previously not available in the overly didactic films of earlier filmmakers. Fifth Generation films were thus an important part of the cultural movements of the 1980s.

9 Born in 1948, Holland's mother was a Catholic journalist who joined the Polish underground and fought in the Warsaw uprising; her father was a prominent assimilated Jewish journalist whose parents died in the Warsaw ghetto and who escaped to fight in the Red Army. A committed communist, he saw Stalin as a historical necessity and argued after the war that anti-Semitism was finished. In 1961 he fell from a window to his death as either a suicide or a murder in the early days of an anti-Semitic purge. The parents divorced when Agnieszka was eleven, and her mother married another prominent Jewish journalist, Stanisław Brodzki. Her own films include the 1991 *Europa, Europa* (about the true story of Solomon Perl, sent by his parents to the east to avoid the Nazis approaching from the west); the 1985 *Angry Harvest* (about the love-hate relationship between a Polish Catholic farmer and a Jewish woman whom he hides from the Nazis); *To Kill a Priest* (about the 1984 case of the Polish priest Jerzy Popieluszko); *Provincial Actors, The Fever, A Woman Alone* (about individuals trying to escape oppression); and her 1966 Prague film school thesis, *The Sin of God* (about a prostitute, tired of being abused by men, who asks God for a tender man; God gives her an angel, but she crushes him making love to him, and rebukes God). She studied in Prague because she had been refused admission to the Lodz film school; but she was able to return to Poland and work with Wajda during the 1970s. In 1981 she denounced the martial law and went into exile to Paris.

10 No Ukrainians lived in town. Ukrainians of this region paid for the mass killings of Poles further east in Ukraine at Wolyn, and for the operations of Ukrainian guerrillas who burned villages during the war. General Swierczewski commanded one of the two Polish armies organized in the Soviet Union to deal with the Ukrainians. (A veteran of the Spanish civil war, he is the General Goltz of Ernest Hemingway's *For Whom the Bell Tolls*.) Assassinated, he was elevated after World War II into a national hero after whom streets and schools were named. Leszek Koczanowicz notes that it was more useful to the Russians to elevate a Pole martyred by Ukrainians than by Germans. After the war, Action Vistula removed Ukrainians and the Lemkowie (Ruthenian) ethnic group to the west (Legnica, Wroclaw). The general in charge was then arrested. From 1956 to 1958 a few were allowed to return, and in the 1990s a political debate emerged about whether reparations should be considered. The Polish senate condemned the action, but many Poles want Ukraine to condemn the massacre of Poles at Wolyn before anything further is done.

11 These are cataloged by the Hebrew University in Jerusalem, and Stanislaw keeps in touch with former Jewish residents of Rymanov and their children.

12 Not only does the film underplay the resistance by both Poles and Jews, but no motivation is established for Schindler, whereas Keneally, on the basis of interviews with survivors, repeatedly says that Oskar Schindler saw himself as a future witness. "You have to remember," says one survivor, "Oskar had a German side, but a Czech side too. He was the good soldier Schweik. He loved to foul up the system" (Keneally 1982: 233).

13 Wajda also made a movie version of Wyspianski's play.

8. Worlding Cyberspace

1 I adapt here for the infrastructure of cyberspace a phrase Derrida uses to describe the way in which "the closure of metaphysics" in philosophical discourses is used to unveil the limitations and inescapability of moves in philosophy (Derrida 1995: 80).

2 By spring 1995 the first successful experiment with a biological computer was no longer science fiction.

3 The notion of two necessary and complementary kinds of science has been broached in various ways by Lévi-Strauss (1962/1966), Lacan (1973/1977), Ulrich Beck (1986/1992), advocates of "social learning" participatory policy making (Rip, Misa, and Schott 1995), and others. As the Greg Bear epigraph and the first successful experiments with a biological computing illustrate, science fiction and popular culture can operate, as Lévi-Strauss describes "savage thought" more generally, as a proleptic or anticipation effect, "like a shadow moving ahead of its owner," partly through a systematizing of what is immediately presented to the senses, and partly through a bricolage style of working out logical possibilities (1962/1966: chap. 1).

4 On reflexive modernity, see Beck 1986/1992; Giddens 1991; Lash and Urry 1994. On empirical cases that support Beck's description of the dynamics of risk society, see Reich 1991; Brown and Mikkelsen 1990; on the agonism required to force honest disclosure, see Wiener 1999.

5 Thus, for example, while reform of the U.S. health care system foundered again in the political arena during the first two years of the Clinton administration, the market pushed ahead quite rapidly, totally reworking the nature of the health care system. Similarly, while the government seeds research in arenas such as the development of the Internet and the Human Genome project, the amount of money the private sector has to spend in these areas has dwarfed that of public monies.

6 See Ulrich Beck 1986/1992 for an elaboration of these formulations as well as those of shadowboxing and shell games by multinational corporations. At issue in these terms is not that the threats might not be real, but that one often does not know ahead of time, and that corporate strategies of investment and protecting against liability often involve publicizing alternative threats which make their product seem less of a risk (as in the publicizing of the ozone hole by the nuclear industry), or that new knowledge or accidents are liable to upset today's notions of prudent action, so that, in contrast to the negotiated contract relations after conflict between unions or communities and corporations in the nineteenth century and in contrast to the actuarial statistics on which rules of insurance accountability were made for traditional industrial risk, such stable frameworks seem less available in today's world of risk production, making corporate investment strategies

more volatile as well. See Beck's lovely passage comparing the specularity of risk today with the gods and demons of antiquity (73).

7 Or dreams that have effectiveness in the world, from Freenberg's reading of Ursula K. Le Guin's 1971 novel *The Lathe of Heaven* about a man whose dreams come true. The man tries to sleep as little as possible so as not to change the world too much, and goes to an unscrupulous psychiatrist who tries to turn these "effective dreams" into a tool for changing the world, but his posthypnotic suggestions, diffracted by the man's unconscious, never work the way the psychiatrist intends. The trick, says Feenberg, is to learn how to use effective dreaming in harmony with the complexity of the world, not to impose modern technology on the world (Feenberg 1995: 141–42).

8 On origin stories, see Serres 1991; for a technological example, see Ronell 1989. Alternative genealogies for contemporary computer and Internet cultures include cybernetic control systems, information theory, networking technologies (railroads, telegraph, water and sewage systems), and virtual reality sensory machinic assemblages (film, telephone, phonograph). On the pre–World War II development of cybernetics *avant la lettre*, see Mindell 1996; for a postwar history, see Edwards 1994. On the history of ARPA and the beginnings of the Internet, see Norberg and O'Neill 1996. On the history of networks as the political precursor for the struggles over the Internet, see Russell, McKnight, and Solomon 1995.

9 One thinks of Walter Benjamin's notion of "dialectical images" in which the technological object serves to remind subsequent generations of the difference between early liberatory hopes for the technology and the normalized subsequent uses. See Buck-Morss 1991; Mehlman 1993.

10 Consider the linear and hierarchical rule-governed modes of programming and modeling enforced in the 1970s, as opposed to the more intuitive and play-based styles of using the computer in the 1980s—and the fascination with user-friendly Macintosh-style metaphors for graphic interfaces, metaphors of self-organizing complexity, and small, multiple ("parallel processing") robots rather than large centralized computers.

11 For accounts of the struggles and competitions to establish networks in China, see Triolo and Lovelock 1996; on North Africa, see Danowitz, Nassef, and Goodman 1995. Egypt had 214 Internet hosts by 1995, and the state has supported not only university and government use but also the development of local PC assembly and software industries by creating demand in the state sector. The Ministry of Defense bought the first PCs locally assembled by the state-owned Banha Electronics Corporation. In Algeria, by contrast, a drive to computerize state firms in the 1980s and other uses of information technologies has slowed because of the current political unrest.

12 This is but a hint: Computers are called Acharya, Veda, Soochak . . . There are some Germanisms in *The New Hacker's Dictionary*: DAU (*Dummster Anzunehmender User*, "stupidest imaginable user") derived from engineering slang's GAU (*grosster anzunehmender Unfall*, "worst foreseeable disaster," as in nuclear plant core meltdown); but also borrowings such as "kluge," a patch, from the word for "clever"; and *gedanken thesis*, a pejorative and ironic contrast to physicists' usage of "gedanken experiment," lack of intuition about what is programmable, about what constitutes a clear specification of an algorithm. Russian via Yiddish makes some appearances in *The New Hacker's Dictionary*, and there are *kremvax* and *kgbvax*, fictitious USENET sites at the Kremlin announced on 1 April 1984, predating by six years the first genuine site in Moscow. Eventually Vadim Antonov had a real site named kremvax, which became an electronic center of anticommunist resistance during the failed coup of August 1991 (Raymond 1993: 252).

13 "The red sun is high, the blue low," Bukatman says, is a typical sentence that keeps the reader guessing until the final word signals a location diegetically far from earth, generically in an SF text. "The door dilated," or "Daddy married, a man this time," similarly keep one's assumptions flexible about the life worlds one is entering. New metaphors and terminologies are coined to capture emergent or possible combinatories, as in his title taken from Burroughs, "terminal identities," a double articulation of both the interface with the global electronic circulation of data and an end point or concrete machine that grounds the flight of electrons.

14 See the entry under "cyberpunk" in Raymond 1993: "Gibson's near-total ignorance of computers and the present-day hacker culture enabled him to speculate about the role of computers and hackers in the future in ways hackers have since found both irritatingly naive and tremendously stimulating" (129). See also Gibson's interview with Larry McCaffery (1986), in which he talks about influences (Thomas Pynchon, Robert Stone, Dashiell Hammett, William Burroughs), says that the language of *Neuromancer* that seems futuristic is actually from 1969 Toronto drug and biker slang, and admits, "Listen to me trying to explain this, it immediately becomes apparent that I have no grasp of how computers really work."

15 Unless otherwise noted, all jargon and definitions in this section are taken from Raymond 1993.

16 See also pyston, bogon, and inventing nonce particle names (cluon, futon, etc.). Pystons were elementary particles carrying the sinister force, with the probability of lossage being proportional to the number of pystons falling on a process; since pystons are generated by observers, demos tend to fail when many people watch. Now largely succeeded by bogon, whose antiparticle is a clutron or cluon, a unit of cluefulness. Futon is the elementary particle of randomness.

17 "Law and Ethics on the Electronic Frontier" is also the name of a course (6.095/STS095) at MIT—taught by Hal Abelson, Joanne Costello, Danny Weitzner, and myself—using, in addition to real-time class, an on-line signature-encrypted discussion, and a Web home page with readings and with links to various archives and information sources. In fall 1998 the MIT class joined forces with the Harvard Law School and Professors Larry Lessig and Jonathan Zittrain. Thirty law students and thirty engineers constituted the class. In spring 2002, a student paper challenging airport security screening scored some national publicity (Chakrabarti and Strauss). In fall 2002, Barbara Fox of Microsoft and Joe Pato of Hewlett-Packard helped teach the class, focusing attention on copyright, intellectual property, and security. See the course and exemplary student papers at http://swissnet.ai.mit.edu/6095/.

18 There is, however, a hacker underground and even institutional islands of hackerdom within IBM, acknowledged in Raymond 1993. Charles Andres allegedly even received a

letter of appreciation from the head of IBM's Thomas J. Watson Research Laboratories (Raymond 1993: 121).

19 ITS (Incompatible Time-Sharing System), influential operating system for PDP-6s and PDP-10s at MIT that generated much AI-hacker jargon; actual work shifted to newer machines after 1982, and the last ITS machine shut down at MIT in 1990, but the Royal Institute of Technology in Sweden maintains one in its computer museum (Raymond 1993: 243).

20 Multics was a late-1960s time-sharing operating system developed by MIT, GE, and Bell Labs, treating all devices uniformly as special files. After that consortium broke up, Ken Thompson and Dennis Ritchie in 1969 invented UNIX, "a weak pun on Multics," as an interactive time-sharing system that has become the most widely used multiuser general-purpose operating system in the world. Raymond comments that many see UNIX as the most important victory of hackerdom over industry opposition (1993: 427).

21 Year two of the class had the following: bitter, Boy, chopper, crab, durham, Dragon, hmm, Fox Muldor, Idless, interzone, kosmo, Kraken, krakpot, loki, Lyle, mercury, Motts, Nicki, Pik, Prophet, repeatloaf, satire@myplace.disorg, Seen, Smithers, spock, spot, student, Thoreau, vapor, will.

22 Wizards and warlocks being those empowered in various cybergames and MUDs to create and enforce rules. Or more generally, a wizard is "(1) a person who knows how a complex piece of software or hardware works . . . esp. someone who can find and fix bugs quickly in an emergency" and "(2) a person who is permitted to do things forbidden to ordinary people; one who has wheel privileges on a system" (Raymond 1993: 453).

23 For example, the FBI profile of hackers and crackers is one of young, introverted males who do not have outside interests. Enough publicity about computer crime has been disseminated that many young hackers who intend to go on to college quit cracking activities before their eighteenth birthday, when they would become liable to prosecution as adults, although they may continue as "mentors" to their juniors (Carol Covert, MIT, 3 October 1994). A more troubling subculture is that of virus writers (Korey Sandler, *PC Computing Magazine*, September 1994). These range from mischievous hackers to industrial saboteurs and disgruntled employees out for revenge, to Third World malcontents filled with resentment about a technology to which they can gain only partial access. Dark Avenger, for instance, was a Bulgaria-based (Bulgaria was the Soviet Union's Silicon Valley, but individuals did not have their own computers) individual who told a journalist that the United States might be able to deny him entry to the country but could not deny entry to his viruses.

24 Compare "A Portrait of J. Random Hacker" in Raymond 1993, which describes not only an older, university-educated age set but also the shift from the nerd stereotypes of the early 1970s to the "more whole earth than whole polyester" and more "mildly health-food faddish" than the junk food stereotype. See also the portrait of working for companies like Microsoft in Douglas Coupland's story "Microserfs" (1993) and subsequent novel (1995).

25 Decision dismissing the David LaMacchia case. LaMacchia had created a BBS in which people were encouraged to post and download pirated software, but since he himself did not profit from these activities, he could not be prosecuted under the Copyright Act; and the Wire Fraud Act under which prosecutors tried him was, according to Judge Stern, too far afield to apply, since there was no fraud (deceit, misleading statements). Expressing widespread discontent with prosecutorial efforts to make public policy by stretching the law, Judge Stern said that if Congress wanted to criminalize activities such as LaMacchia's, it needed to write legislation to that effect. Rumor at MIT has it that there had been similar bulletin boards before which had come to system operator notice and had simply been shut down; this one was not noticed in time and through a series of procedural missteps was turned over to authorities outside the university, rather than simply being shut down as well.

26 The 1994–1995 debates over the Clipper Chip, initially a mandate that the telecommunications hardware sold in the United States accommodate a chip that would allow law enforcement officials, under court order supervision, the ability to wiretap the flow of digital information. The FBI argued for this in its fight against the "four horsemen" of drugs, terrorists, money launderers, and pedophiles. Opponents feared Big Brother more than Big Drugs.

27 Admiral Bobby Inman, former director of the National Security Administration and a professor of public affairs at the University of Texas, points out that among voters, crime trumps privacy issues (talk to Law and Ethics on Electronic Frontier class, MIT, fall 1994).

28 In 1988 Robert Morris Jr., a computer science student at Cornell and son of the chief computer scientist at the National Security Agency, was the first to be charged under the new 1986 Computer Fraud and Abuse Act (18 USC 1030) for having released an Internet worm, causing computers around the country to crash. The now famous Internet worm was the first of a series of highly publicized viruses that forced awareness on users that one ought not to leave systems unprotected. A parallel case in the same year, centered in Germany but breaching the computers of NASA, the Lawrence Livermore Berkeley Laboratory, several corporations, CERN, and with a Cold War angle, reinforced the public awareness. The German Chaos Club founded in the mid-1980s had publicized its own hacking feats as a way of warning the public that it should not naively put trust in the new technologies. Eventually caught by Clifford Stoll on the Lawrence Livermore Berkeley computer system, Chaos Club members were traced and prosecuted for selling information gained through computer hacking to East German agents under Russian KGB supervision. Since the information sold proved to be trivial, and the reason for selling less interest in helping the Russians than merely in getting money to continue hacking, the primary outcome was to increase awareness of the inadequacy of the German legal system to deal with cases of this sort. Meanwhile hacking and phreaking into the telephone system were becoming a sufficient nuisance that the FBI and Secret Service launched "Operation Sundevil" in 1988, arrested some teenagers in sting operations, and then in 1990 made an infamous and legally bungling raid on Steve Jackson Games in Austin, Texas, seizing the computers and disks of the company, allegedly in search of a document stolen from Bell South. In 1993 a suit by SJG against the Secret Service found the latter guilty of violating the provisions of the 1986 Electronic Communications Privacy Act. Still, the publicity of Operation Sundevil put a fright into many teens, who shut down their electronic bulletin boards, and more importantly helped the hacker underground around the electronic magazine

Phrack mature into a security-conscious, more legally savvy, and political subculture. In turn, the ignominy for the FBI and Secret Service of the procedural debacle of Operation Sundevil, and the 1991 simultaneous failure of telephone switches on both the East and West Coasts, resulted in the formation of a Computer Crime Squad within the FBI that recruited computer-knowledgeable agents. Meanwhile the use of the Internet had expanded so rapidly that while problems of vulnerability of the system itself remain, focus shifted to rules of use, encryption and privacy protection, commercial security, system operator liability, control of pornography, stalking, and other issues of shaping a public and civil arena.

29 Senators Leahy and Kyle, for instance, in proposing a modification to the Computer Fraud and Abuse Act, cite not only concerns about Dutch hackers who broke into the computers used in the Gulf War and NASA computers but also the abuse of privileges on government computers, snooping tax returns, selling confidential criminal histories from the National Crime Information Center, and breaching federal courthouse computers holding confidential records.

30 For the most elaborate account of the potential implications of cryptoanarchy, see May 1994. See also M. Miller 1994.

31 Concern about employer surveillance has been long-standing, both in monitoring work operations, in reading employee e-mail, and in compiling and selling database information. There are now companies that are expanding the capabilities of all these activities, including forensics companies that retrieve e-mail that companies or employees thought destroyed to be used in court cases. Lotus Marketplace was a program, withdrawn after public outcry, which would have given small businesses consumer profiles on millions of households. The U.S. Postal Service finances a significant part of its operations by selling change-of-address lists to direct marketers. And most recently, entrepreneurial sites on the Web are experimenting with ways of collecting transactional information from people who visit their sites and click on advertising promotions.

32 *Cubby v. CompuServe* (1991) held the system operator not liable for content on the system because CompuServe does not regularly monitor content and serves more like a common carrier (like the telephone system). In 1995 Prodigy was sued by a stockbrokerage, Stratton-Oakmont, in a $200 million libel suit, because Prodigy does do a certain amount of routine screening.

33 A series of bills were proposed in the House and Senate during 1995 to regulate content, criminalize "indecent" material, but also to prohibit content regulations. The World Wide Web Consortium has instead proposed a demand-side technical mechanism: a rating format for content to which users can attach filters developed on their own or by advocacy groups, or by groups like the Good Housekeeping Seal of Approval.

34 The NII is sometimes compared in scale and ambition to the 1960s space program, as well as in its own metaphoric name to the federal interstate highway infrastructure for encouraging the postwar economy. Lewis Branscomb and Brian Kahin (1964) suggest that it is very different in organizational form and dynamics. It is not managed by a single agency but rather is a "distributed program, minimally managed by interagency task forces," and it is propelled by rapid changes in commercial information technologies, in turn heavily influenced by the entertainment and information services businesses. The question of whether or not there should be mechanisms to ensure universal service makes the comparison with the telephone system pertinent as well and foregrounds the role that intellectual property and regulatory law can play in shaping the economic direction of this new medium.

35 See the fascinating debate between Paul Heckel (1992) and Simpson Garfinkle, Richard Stallman, and Mitchell Kapor (1991).

36 The committee composition for the White Paper was heavily stacked with industries needed in any future lobbying effort for the proposal, and representatives of the public were marginalized. The Green Paper at least went through the motions of a more open set of hearings both physically around the country as well as soliciting feedback on-line.

37 See note 25.

38 For a critique of the stance of the report and its recommendations precisely in terms of these power balances, see Samuelson 1994.

39 Tribe writes about the way in which the court has abridged, expanded, and again abridged the constraints on wiretaps in *Olmstead v. U.S.* (1928), *Katz v. U.S.* (1964), and *Smith v. Maryland* (1976).

40 Compare the critiques of the Human Genome Project to those of Reagan's "Star Wars" Strategic Defense Initiative, both seen as technically improbable goals, yet mechanisms for generating new computational technologies and having powerful social effects. The promise of gene therapies and other medical interventions, even if further in the future than most realize or admit, is already having effects on employment practices, family planning, education, insurance, and in reworking notions of self, health, and disease. It has been argued that the influx of information theory concepts into biology in the 1950s and 1960s fostered a hegemonic role for molecular biology, occluding fields (at least temporarily) such as embryology and developmental biology, and that in the 1960s it even temporarily occluded the vital contributions of biochemistry (see Kay 1999; Keller 1995; Lewontin 1994; Nelkin and Tancredi 1989).

41 In India, for instance, the pioneering generation of S. Ramani (of the National Center for Software Technologies, a Ph.D. training ground, and ERNET), J. G. Krishnaya (early advocate of personal computers and the Macintosh instead of investment in mainframes at the computer center of the Indian Institute of Management and the Space Research Center, which shared the first mainframes in Ahmedabad in the 1970s and 1980s, and then founder of the Systems Research Institute, Pune, the first research and software developer for government, educational, and public sector development projects); Faqir C. Kohli (of Tata Consultancy Services, the largest and oldest employer and trainer of programmers and software engineers); and Narayan Murthy (of InfoSys, the first Indian software company listed on the Nasdaq stock exchange) are being replaced by a younger generation. The operating and economic environment has gone through at least three or four major reorganizations, beginning with liberalization in the early 1990s; body shopping, service contracting, and call center servicing for multinational and U.S. corporations in the mid-1990s; the rise and collapse of a dot.com bubble in the late 1990s; and, in the early twenty-first century, the gradual expansion into the export market of a few transnational

Indian firms such as Wipro and InfoSys, as well as the pilot experimentation domestic
with entrepreneurial village computer kiosks to reduce the hold of middlemen on
prices and on access to government forms and documents (see Kumar 2001; Kumar
Jhunjhunwala 2002; Rajora 2002). These are still new technologies in India, and in
ways the changing spatial and temporal connectivity and the differential access
seen in heigtened dramatic form. In the mid-1990s there was considerable resistan
computerization in banks and government agencies, in part for fear of labor redund
and in part for fear of managers that their knowledge and control would be quickly
obsolete. During the dot.com boom, young twenty-year-olds in Bangalore were ea
salaries much higher than executives in old-line companies, allowing them to buy ho
cars, and appliances, thus upsetting the seniority and status hierarchies. Companies
as InfoSys built their own cable and satellite connectivity, not daring to rely on the
and inefficient access through ERNET and the other state systems. India, it is often said,
a middle class the size of the U.S. population (some 300 million) that can afford comp
and Internet access. But today, urban ISTD telephone entrepreneurs also have comp
terminals for rent, making Internet access far more available than only through per
computers, corporate access, cybercafes, or upscale hotels. If villages can be conne
with high school students helping their elders make use of agricultural prices, gover
forms, agricultural extension help, and perhaps even primary medical consultatio
potential exists for rearranging agrarian life worlds.

42 "Worlding" draws on all three in quasi-Derridean *différance*: the auditory homop
with whirl, hinting at electron(ic) speed; the textual difference between ideational
and the grounding of the ethnographic world.

9. Calling the Future(s)

I take this chapter's subtitle, "Delay Call Forwarding," from Avital Ronell and mean
dicate with it the temporality of desire, constraint, blockage, and belatedness with
pedagogical goals are often installed (Ronell 1989: 1).

1 The initial formulations were worked out at a faculty retreat convened in sprin
for a modular core course, a three-tiered set of foundation and advanced co
courses, supplemented by workshops, a communal colloquium partly keyed to th
course platform, and a cross-linking set of requirements in both anthropology an
tory. See http://web.mit/sts/documents, and M. Fischer 1996. After 1998, in addi
courses cotaught in the Schools of Engineering (David Mindell), Science (David K
and the joint MIT-Harvard Health Science and Technology Program (at the Ha
Medical School) (Michael Fischer), the program sponsored cross-school initiati
technology and the self (under Sherry Turkle), the Center for Diversity (under
Hammonds), and agricultural and environmental history (under Deborah Fitzger
Harriet Ritvo). Several members of the faculty were also closely involved in the ne
gram in Comparative Media Studies (led by Henry Jenkins and William Urrichio
Dumit, Michael Fischer, and Susan Slyomivcs.

2 "The University in Ruins": Fifty years after the 1949 MIT convocation, the funct

the university, and of technical training of engineers and technoscientists, again is under question. A lecturer in a course in the joint MIT and Harvard Medical School HST Program (a program training both M.D.'s and Ph.D.'s) put it this way: Many scientists in the biological sciences say they hope their research will benefit humankind; that is equivalent to saying they hope someone will make money from their research. Otherwise it cannot get into the marketplace and has no way to benefit humankind. This is not an isolated example of dramatic changes in the academy over the past decades and is most obvious in the biology/biotechnology nexus. But it surfaces in other ways as well, as in the call for a new "postmodern engineer" by Joel Moses, former dean of engineering and provost of MIT, and the efforts to design a new five-year undergraduate engineering degree that will not just provide technical skills but provide the contextual, communication, and political understandings that career engineers need (and in midcareer often tell the alumni office they did not get in their training). Some of this sounds repetitive over the past five decades, the call for the humanist engineer, the well-rounded engineer, the engineer who will not just work for the executive trained at Harvard, Yale, or Princeton but will himself or herself be a leader (as engineers were in the 1920s and 1930s). While the phraseology of such calls sounds repetitive, many analysts claim that deeper changes lie underneath.

In the widely discussed book *The University in Ruins*, the late Bill Readings, for instance, argues that the university is being set adrift from its past modernist mooring in cultural projects of maintaining the nation-state, in favor now of becoming transnational bureaucratic corporations regulated under administrative metrics of "excellence" and productivity. This is felt most starkly in money-strapped state universities, less so in capital-rich private universities; but Readings points to a pervasive shift in cultural sensibility, not just a market-driven or management-glib pragmatics. The word "ruins" is from Walter Benjamin and baroque aesthetics, referring to the layered remembrance of past aspirations that are still encoded within contemporary objects and institutions that have taken on quite different functionalities. Ruins may provide means for redemption of such past aspirations and need not be simply nostalgic signs, or evidence of decay. Readings wants to suggest that there are important new functions for universities to perform in today's world that go beyond the efficient transmission of information, that can be measured in student-consumer satisfaction surveys, or in scores on exams, or in numbers of faculty publications or patents held.

Most importantly, Readings argues, the university now provides a space for learning to live with socially supported diversity. The nineteenth-century idea of the university formulated by Fichte and Humboldt had to do with the cultivation of the citizen and the creation of a culture for the nation-state. Hence the focal importance of national literatures in the university. Even scientists thought of their pedagogies as inculcating a "culture of science" built on the analogy of the cultures being taught by historians and literature professors. The university was a space apart from society, an ideal public sphere where argumentation could be pure, in search of truth, uncomplicated by the pressures in the real public sphere of power and resources. Even if it wasn't quite so, this operated as the regulatory ideal. But today, Readings argues, the regulatory ideas are changing, increasingly attuning themselves to notions of competition, efficiency, and transfer of information and