Modest_Witness@ Second_Millennium

.FemaleMan©_Meets_OncoMouse™

FEMINISM AND TECHNOSCIENCE

Donna J. Haraway

With paintings by Lynn M. Randolph

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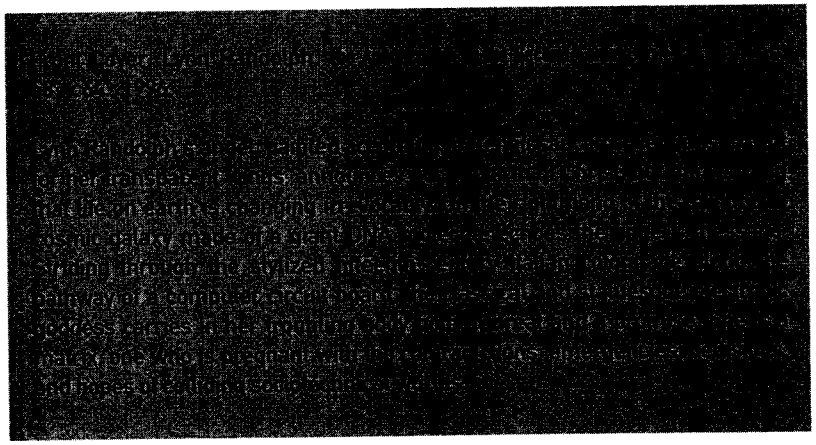

For Rusten, Field Notes, and HogWorks

Acknowledgments

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First, the paintings by Lynn M. Randolph in this book are part of an ongoing traffic between us in images, ideas, and hopes. Her art has been an extraordinary intellectual and physical gift.

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Thanks to Bill Germano for being the best editor and publisher I can imagine.

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Modest_Witness@Second_Millennium (Chapter 1)
[revised from "Modest Witness: Feminist Diffractions in Science Studies," in Peter Galison and David Stump, eds., *The Disunity of Sciences: Boundaries, Contexts, and Power* (Stanford University Press, forthcoming)]

FemaleMan©MeetsOncoMouse™. Mice into Wormholes: A Technoscience Fugue in Two Parts (Chapter 2)
[revised from essay in Gary Downey, Sharon Traweek, and Joseph Dumit, eds., *Cyborgs and Citadels: Interventions in the Anthropology of Technohumanism* (School of American Research; Seattle: University of Washington Press, forthcoming)]

Fetus: The Virtual Speculum in the New World Order (Chapter 5)
[revised from *Feminist Review*, special issue edited by Ann Phoenix and Avtar Brah, forthcoming; and essay in Adele Clarke and Virginia Olesen, eds., *Revisioning Women, Health and Healing: Feminist, Cultural and Technoscience Studies Perspectives*, forthcoming]

Race: Universal Donors in a Vampire Culture. It's All in the Family: Biological Kinship Categories in the Twentieth-Century United States (Chapter 6)
[revised from William Cronon, ed., *Uncommon Ground* (New York: Norton, 1995), pp. 321–66, 531–36]

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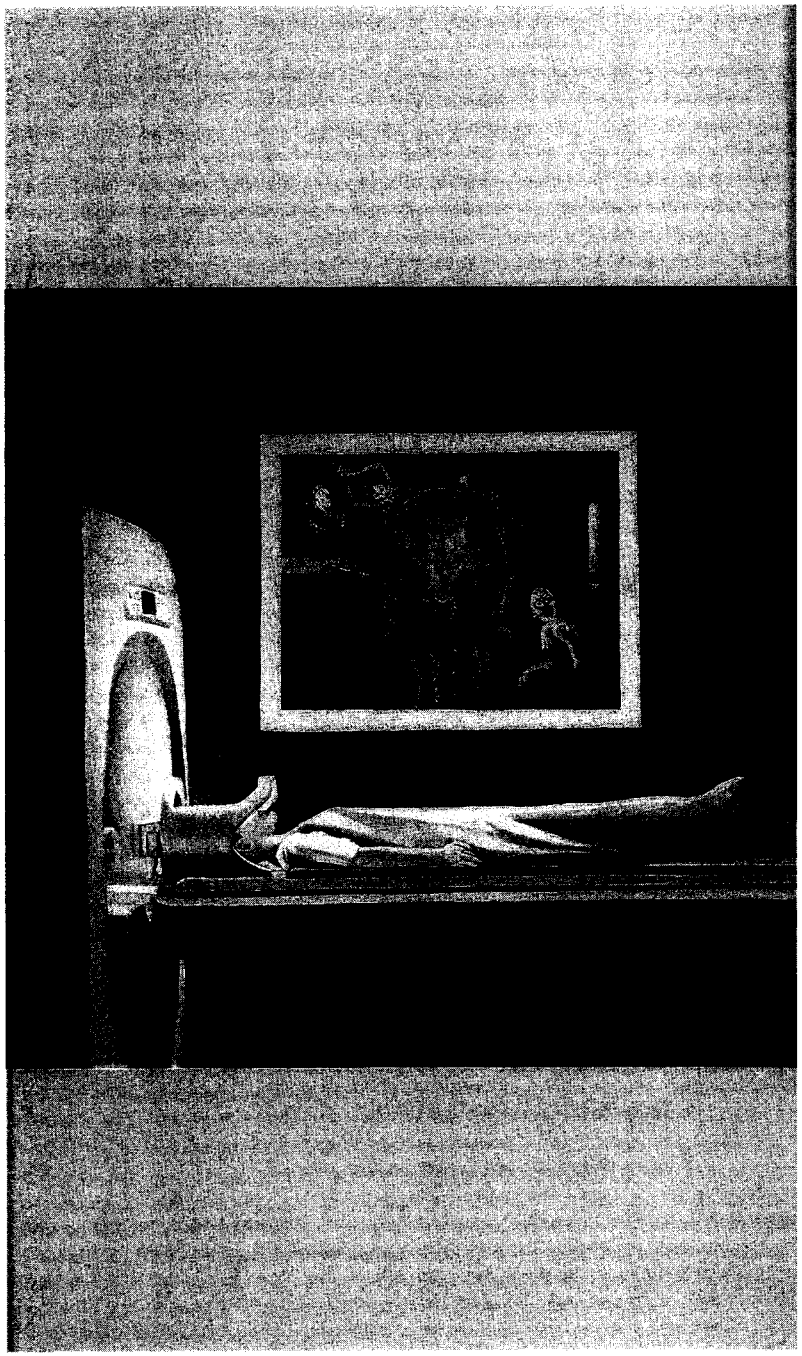
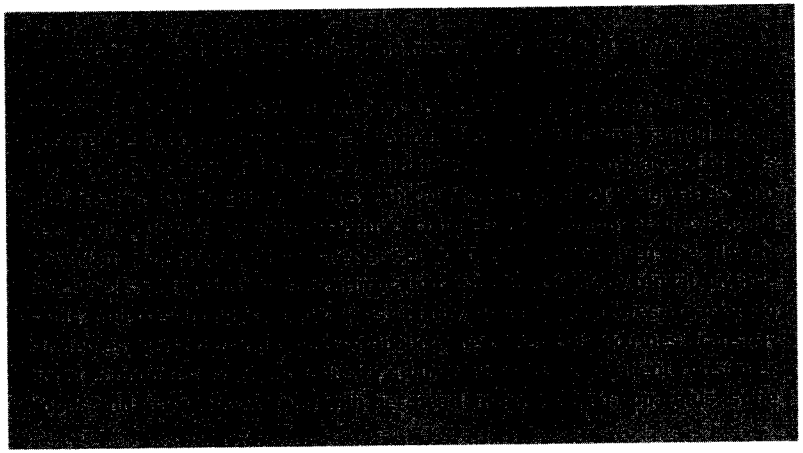
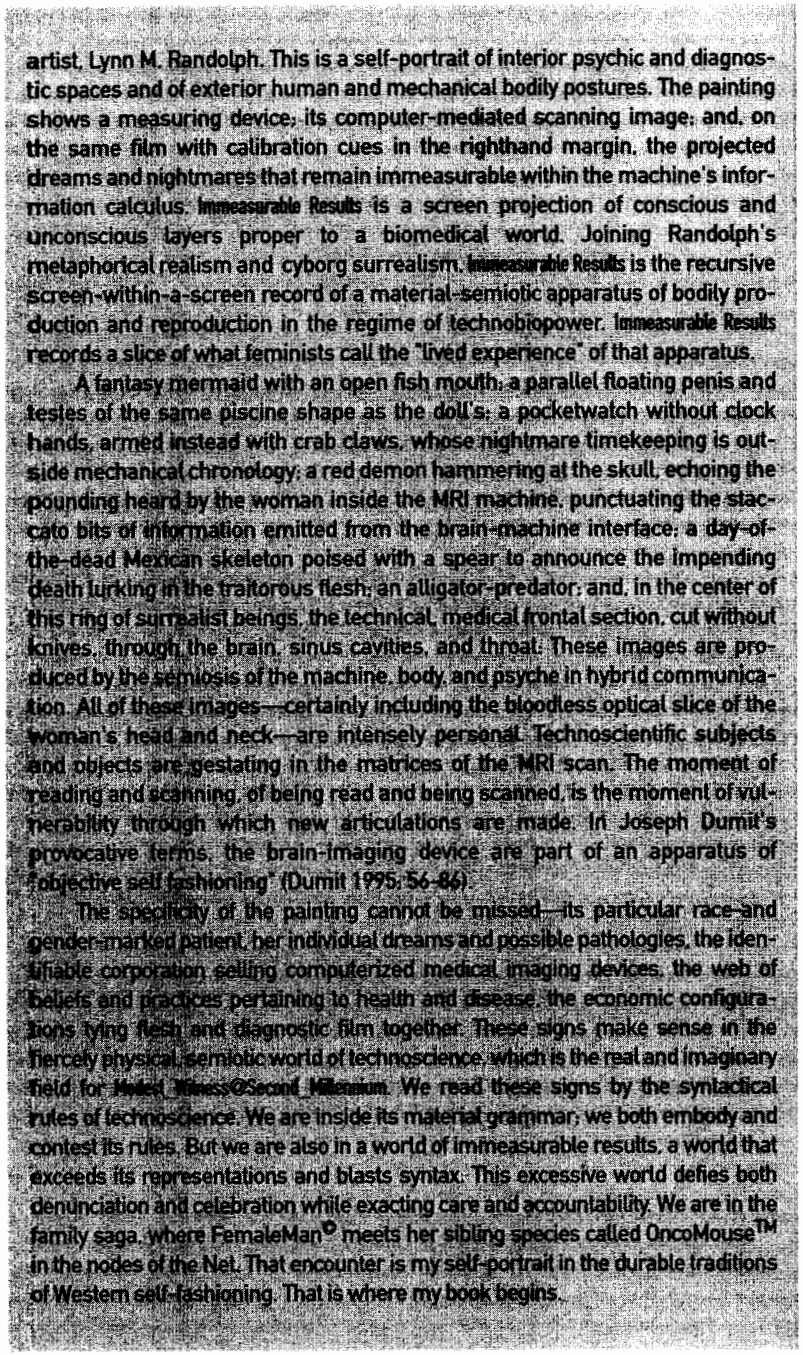


ONE

SYNTACTICS

THE GRAMMAR OF FEMINISM AND TECHNOSCIENCE





artist, Lynn M. Randolph. This is a self-portrait of interior psychic and diagnostic spaces and of exterior human and mechanical bodily postures. The painting shows a measuring device, its computer-mediated scanning image, and, on the same film with calibration cues in the righthand margin, the projected dreams and nightmares that remain immeasurable within the machine's information calculus. **Immeasurable Results** is a screen projection of conscious and unconscious layers proper to a biomedical world. Joining Randolph's metaphorical realism and cyborg surrealism, **Immeasurable Results** is the recursive screen-within-a-screen record of a material-semiotic apparatus of bodily production and reproduction in the regime of technobiopower. **Immeasurable Results** records a slice of what feminists call the "lived experience" of that apparatus.

A fantasy mermaid with an open fish mouth, a parallel floating penis and testes of the same piscine shape as the doll's, a pocketwatch without clock hands, armed instead with crab claws, whose nightmare timekeeping is outside mechanical chronology; a red demon hammering at the skull, echoing the pounding heard by the woman inside the MRI machine, punctuating the staccato bits of information emitted from the brain-machine interface; a day-of-the-dead Mexican skeleton poised with a spear to announce the impending death lurking in the traitorous flesh; an alligator-predator; and, in the center of this ring of surrealist beings, the technical, medical frontal section, cut without knives, through the brain, sinus cavities, and throat. These images are produced by the semiosis of the machine, body, and psyche in hybrid communication. All of these images—certainly including the bloodless optical slice of the woman's head and neck—are intensely personal. Technoscientific subjects and objects are gestating in the matrices of the MRI scan. The moment of reading and scanning, of being read and being scanned, is the moment of vulnerability through which new articulations are made. In Joseph Dumit's provocative terms, the brain-imaging device are part of an apparatus of "objective self fashioning" (Dumit 1995: 56–84).

The specificity of the painting cannot be missed—its particular race-and gender-marked patient, her individual dreams and possible pathologies, the identifiable corporation selling computerized medical imaging devices, the web of beliefs and practices pertaining to health and disease, the economic configurations tying flesh and diagnostic film together. These signs make sense in the fiercely physical, semiotic world of technoscience, which is the real and imaginary field for Naked Witness@Second_Millennium. We read these signs by the syntactical rules of technoscience. We are inside its material grammar; we both embody and contest its rules. But we are also in a world of immeasurable results, a world that exceeds its representations and blasts syntax. This excessive world defies both denunciation and celebration while exacting care and accountability. We are in the family saga, where FemaleMan© meets her sibling species called OncoMouse™ in the nodes of the Net. That encounter is my self-portrait in the durable traditions of Western self-fashioning. That is where my book begins.

SYNTACTICS

The Grammar of Feminism and Technoscience

> "The ability to access information is power," Nili said with her slight accent in her husky voice. . . . "The ability to read and write belonged to the Church except for heretics and Jews. We are people of the book. We have always considered getting knowledge part of being human."
>
> —Marge Piercy, *He, She and It*

Literacies

Nili bat Marah Golinken is the technologically enhanced, genetically engineered, matrilineal Jewish warrior woman in the postnuclear holocaust world of Marge Piercy's *He, She and It*. The novel explores the many kinds of boundaries at stake when a seventeenth-century golem in Prague's ghetto and a twenty-first-century cyborg in a Jewish freetown in North America are blasphemously brought into being to defend their endangered communities. Introducing herself at the home of the old woman, Malkah, who helped her colleague Avram to program the cyborg, Nili says of herself:

> "I can tolerate levels of bombardment that would kill you. We live in the hills — inside them, that is. We are a joint community of the descendants of Israeli and Palestinian women who survived. We each keep our religion, observe each other's holidays and fast days. We have no men. We clone and engineer genes. After birth we undergo additional alteration. We have created ourselves to endure, to survive, to hold our land. Soon we will begin rebuilding Yerushalaim. . . . We live in extreme isolation. We have a highly developed technology for our needs, but we don't tie into the Net. I'm a spy and a scout. . . . I am sent like the dove or maybe the raven

> from Noah's ark to find out if the world is ready for us, and also if there's anything out here we might want." (Piercy 991:205–06)

Nili comes into the story in partnership with her lover, Riva, daughter of Malkah and an anarchist data pirate who has turned into a serious revolutionary against the transnational corporate order that webs the globe. Nili and Riva are committed to the principle that information must not be a commodity. In the vulnerabilities and potencies of their altered bodies, these technologically savvy women understand the bond of literacy and wealth that structures the chances of life and death in their world. Nili, Riva, Malkah, and the cyborg live without innocence in the regime of technobiopower, where literacy is about the joining of informatics, biologics, and economics—about the kinship of the chip, gene, seed, bomb, lineage, ecosystem, and database.

Nili remembers that in the European past, the Catholic Church controlled literacy, except for the potent exceptions of heretics, infidels, and Jews, who can claim the status of peoples of the book with an originary authority that strikes at the heart of the Church's monopoly.[1] Tunneling under the wreckage of a violent history with the other Israeli and Palestinian survivors, Nili belongs to these oppositional traditions of reading and writing, with their generative accounts of what can count as human, as knowledge, as history, as insider and outsider. Dove, raven, and reconstructed assassin, Nili fights for rebuilding Yerushalaim outside the appropriations of Christian salvation history—and outside the patriarchal assumptions of all of the official peoples of the book, in both their religious and technoscientific incarnations. Her interrupted origin stories provide a platform for surfing the sacred-secular technoscientific web that infuses *Modest_Witness@Second_Millennium*: "We have always considered getting knowledge part of being human."

My book takes shape through cascading accounts of humans, nonhumans, technoscience, nation, feminism, democracy, property, race, history, and kinship. Beginning in the mythic times called the Scientific Revolution, my titular modest witness indulges in narratives about the imaginary configurations called the New World Order, Inc., and the Second Christian Millennium. I learned early that the imaginary and the real figure each other in concrete fact, and so I take the actual and the figural seriously as constitutive of lived material-semiotic worlds. Taught to read and write inside the stories of Christian salvation history and technoscientific progress, I am neither heretic, infidel, nor Jew, but I am a marked woman informed by those literacies as well as by those given to me by birth and education. Shaped as an insider and an outsider to the hegemonic powers and discourses of my European and North American legacies, I remember that anti-Semitism and misogyny intensified in the Renaissance and

Scientific Revolution of early modern Europe, that racism and colonialism flourished in the traveling habits of the cosmopolitan Enlightenment, and that the intensified misery of billions of men and women seems organically rooted in the freedoms of transnational capitalism and technoscience. But I also remember the dreams and achievements of contingent freedoms, situated knowledges, and relief of suffering that are inextricable from this contaminated triple historical heritage. I remain a child of the Scientific Revolution, the Enlightenment, and technoscience. My modest witness cannot ever be simply oppositional. Rather, s/he is suspicious, implicated, knowing, ignorant, worried, and hopeful. Inside the net of stories, agencies, and instruments that constitute technoscience, s/he is committed to learning how to avoid both the narratives and the realities of the Net that threaten her world at the end of the Second Christian Millennium. S/he is seeking to learn and practice the mixed literacies and differential consciousness that are more faithful to the way the world, including the world of technoscience, actually works.[2]

And so this book is sited as a node that leads to the Internet, which is synecdochic for the wealth of connections that constitute a specific, finite, material-semiotic universe called technoscience.

Modest_Witness@Second_Millennium.FemaleMan© *_Meets_OncoMouse*™ is an e-mail address. Let us see how its nodes and operators map out the tropes and topics of this book.

Keystrokes

My title contains three syntactical marks: @, ©, ™. Each little modifier signs us into history in particular ways. The @, ©, and ™ are minimalist origin narratives in themselves. Part of a writing technology (King 1991; Derrida 1976; Latour and Woolgar 1979), the marks also map an argument; they indicate its proper grammar. Like the special signing apparatus for operations in symbolic logic, the marks in my title are operators within a particular sociotechnical discourse. This discourse takes shape from the material, social, and literary technologies that bind us together as entities within the region of historical hyperspace called technoscience.

Hyper means "over" or "beyond," in the sense of "overshooting" or "extravagance." Thus, technoscience indicates a time-space modality that is extravagant, that overshoots passages through naked or unmarked history. Technoscience extravagantly exceeds the distinction between science and technology as well as those between nature and society, subjects and objects, and the natural and the artifactual that structured the imaginary time called modernity. I use technoscience to signify a mutation in historical narrative, similar to the

mutations that mark the difference between the sense of time in European medieval chronicles and the secular, cumulative salvation histories of modernity. Like all the other chimerical, condensed word forms that are cobbled together without-benefit-of-hyphen in the hyperspace of the New World Order, Inc., the word technoscience communicates the promiscuously fused and transgenic quality of its domains by a kind of visual onomatopoeia. Once upon a time, in another, closely related, ethnospecific narrative field called Western philosophy, such entities were thought to be subjects and objects, and they were reputed to be the finest and most stable actors and actants in the Greatest Story Ever Told—the one about modernity and man. In the imploded time-space anomalies of late-twentieth-century transnational capitalism and technoscience, subjects and objects, as well as the natural and the artificial, are transported through science-fictional wormholes to emerge as something quite other. Even drenched with all the hype about revolution and technoscience that pervades contemporary discussion, the ferocity of the transformations lived in daily life throughout the world are undeniable.

The "@" and "." are the title's chief signifiers of the Net. An ordinary e-mail address specifies where the addressee is in a highly capitalized, transnationally sustained, machine language-mediated communications network that gives byte to the euphemisms of the "global village." Dependent upon a densely distributed array of local and regional nodes, e-mail is one of a powerful set of recent technologies that materially produce what is so blithely called "global culture." E-mail is one of the passage points—both distributed and obligatory—through which identities ebb and flow in the Net of technoscience. Despite all the hype, technoscience is not the Greatest Story Ever Told, but it is playing powerfully to large, widely distributed audiences.

Partly because the Internet was originally developed for defense research and communication, including communication among academic scientists, and then extended to more civilian users primarily in universities, the system is only now becoming densely commodified (Krol 1992:11–30). The Net still has many of the practices and ethics of a public commons, but one that is being rapidly enclosed. The civilian freedoms of the Net are indebted to a tax-supported commons tied initially to Cold War priorities and then to goals of national economic competitiveness and requiring a broad technoscientific research and communication apparatus. The Internet was midwifed in the 1970s as a U.S. Defense Department network called ARPAnet, which was an experimental network designed to support military research.[3] The noncentralized structure of the communication

system was related to the need for it to survive nuclear destruction of component parts.

As other U.S. (and Scandinavian) organizations built their own networks, they used the ARPAnet's communications protocols. Connecting all these systems was, therefore, an attractive goal. In the late 1980s the National Science Foundation (NSF) established five supercomputer centers that made the capabilities of the world's fastest computers available for general scholarly research. Using ARPAnet technology, the tax-supported NSF created a web of regional networks connected with each other through a supercomputer center. "The NSF promoted universal educational access by funding campus connection only if the campus had a plan to spread access around. So everyone attending a four-year college could become an Internet user" (1992:13). The NSFnet came to form the backbone of the Internet, and the impact throughout the social fabric has been tremendous. Then, following policy set by the president and congress in 1992, the NSF fully privatized its system in 1995. The large users remain unworried and expect the continuing growth of volume and advances in technology to lower their costs in the long run. In addition the new net system will support high-speed, wide-bandwidth uses such as videoconferencing and other visual processing applications that the old NSFnet could not handle. Overall, immediate costs to users are expected to go up 10 percent to 100 percent, depending on distance from an access point. The losers are likely to be small colleges, institutions in more remote areas, and public libraries (Lawler 1995). Those parts of the public commons that cannot contribute to capital accumulation for private corporations, such as MCI, Bellcore, and Sprint, which reap the benefits of decades of tax-supported infrastructure, will naturally wither away in the free market. The rebirth of the nation seems to demand it.[4]

Furthermore, the Internet has been international for many years, but originally only U.S. allies and overseas military bases were connected. By the mid-1990s most countries in the world had attempted to connect as part of their national educational, commercial, and technology goals. More than 20 million users in over 60 countries were tied into the Internet by 1995. Inequality of access and the dominance of the Internet's, and so the United States', communications protocol standards—thereby isolating nets using other standards—have become serious international issues. As Marilyn Strathern put the matter in another context, "A world made to Euro-American specifications will already be connected up in determined ways" (1992:17).

Not even mentioning the World Wide Web, Mosaic, NetScape, and a host of other tools sustaining the information order at the end of the millennium, I am giving a very partial and abbreviated account of the Internet, much less of com-

puter-mediated communications systems in general. But even this micro-soft version shows that the relations in the Internet—among military needs, academic research, commercial development, democracy, access to knowledge, standardization, globalization, and wealth—embody many of the themes of technoscience in the last quarter of the twentieth century. Unlike the situation for Nili's community, which chose not to be part of the Net, there is no better place for my modest witness to lurk to be a spy and scout—and, to be sure, a user. Located in material-semiotic fact in the nodes of one of the world's most powerful technoscientific research institutions, the University of California, my modest witness is necessarily reminded of her terms of access as s/he logs on to collect her e-mail on a machine beside a Doonesbury cartoon. Trudeau draws a

Figure 1.1 Doonesbury. © 1995 Garry Trudeau. Reprinted with permission of Universal Press Syndicate. All rights reserved.

street person going to collect his e-mail at the public library, where addresses had been handed out free to the homeless. Looking for potential employers' responses to his job résumé, he posts an address that puts the hype about the universal democracy built into the technoscientific information system into perspective: lunatic@street_level.

Trudeau helps unlock the confusion of the "irrational" New World Order feared both by New Age people and by right-wing armed militias in the United States—who are convinced, in chilling anti-Semitic patterns, that the bankers and gray men are taking over the world—with the "rational" New World Order of the post-Cold War, transnational free-market system imagined by presidents, congresses, planners, and parliaments and advanced by the political-economic strategies of flexible accumulation and by free-trade instruments such as the North American Free Trade Agreement (NAFTA) and General Agreement on Tariffs and Trade (GATT). Informed by lunatic@street_level, as well as by Anna Tsing (1993b), the subtle ethnographer and theorist of the complex, shifting, and nonsystemic geometries of margins and centers in the contemporary

world, I try to write on the razor edge between *paranoia* that the New World Order effected by the bonding of transnational capital and technoscience actually defines the world and the *denial* that large, distributed, articulated practices of domination are in fact luxuriating in just that bonding. Our task is learning to navigate both the imagined Net and the actual net with the bracing literacies of Nili's "heretics, infidels, and Jews" and their many sisters and brothers who have learned the skills of differential consciousness. Reading and writing on the razor edge between paranoia and denial, I venture to consider the syntax of intellectual property in my title's Internet address.

The © and ™ in my title mark the syntax of natural / social / technical relationships congealed into property. Built into the Constitution and early legislative acts of the United States, these marks, as much as the "@" in my address, are about the origins and fates of nations as well as of personal and corporate individuals. Each dealing with the implosion of bodies, texts, and property, the Internet and the Market conjointly supply the principal metaphors and instruments for contesting communication, commerce, freedom, and foundations in the New World Order, Inc.

Like the stigmata of gender and race, which signify asymmetrical, regularly reproduced processes that give some human beings rights in other human beings that they do not have in themselves (Rubin 1975), the copyright, patent, and trademark are specific, asymmetrical, congealed processes—which must be constantly revivified in law and commerce as well as in science—that give some agencies and actors statuses in sociotechnical production not allowed to other agencies and actors. By sociotechnical production I mean the knowledge-power processes that inscribe and materialize the world in some forms rather than others. Only some of the necessary "writers" have the semiotic status of "authors" for any "text." That little point has animated transnational industries of literary and philosophical deconstruction. Similarly, only some actors and actants that are necessarily allied in a patented innovation have the status of owner and inventor, authorized to brand a contingent but eminently real entity with their trademark.

I am intensely interested in the power of such "syntactical" marks as the © and ™. I am extremely curious about what kinds of bodies, what forms of frozen as well as motile sociotechnical alliances, also called social relationships, these little ornaments can adorn, at whose cost, and to whose benefit. In particular, I am interested in the kinds of artifactual chimeras, like the FemaleMan and OncoMouse in my title, that bear such distinctive brands so naturally. I am absorbed by the supplement, excess, and commentary implied in these little marks; I ask what kinds of entities can be marked up in these ways.[5] I am riveted

by "brand names" as "genders"; that is, as generic marks that are directional signals on maps of power and knowledge. I am curious about how members of technoscientific cultures are, literally, invested in their proprietary kin, both psychically and commercially.

Property is the kind of relationality that poses as the-thing-in-itself, the commodity, the thing outside relationship, the thing that can be exhaustively measured, mapped, owned, appropriated, disposed. Something of an unreconstructed and dogged Marxist, I remain very interested in how social relationships get congealed into and taken for decontextualized things. But unlike Marx, and allied with a few prominent and deliberately crazy scholars in science studies, with armies of very powerful and paradigmatically sane scientists and engineers, and with a motley band of off-the-wall ecofeminists and science-fiction enthusiasts, I insist that social relationships include nonhumans as well as humans as *socially* (or, what is the same thing for this odd congeries, sociotechnically) active partners. All that is unhuman is not un-kind, outside kinship, outside the orders of signification, excluded from trading in signs and wonders.

Figures

Signs and wonders brings us to the next contaminated practice suffusing my book and built into the title *Modest_Witness@Second_Millennium.FemaleMan*©*_Meets_OncoMouse*™: that is, figuration. In my book, entities such as the modest witness of the Scientific Revolution, the FemaleMan© of commodified transnational feminism, and OncoMouse™ of the biotechnical war on cancer are all figures in secular technoscientific salvation stories full of promise. The promises are cheek-by-jowl with ultimate threats as well. Apocalypse, in the sense of the final destruction of man's home world, and comedy, in the sense both of the humorous and of the ultimate harmonious resolution of all conflict through progress, are bedfellows in the soap opera of technoscience. Figuration

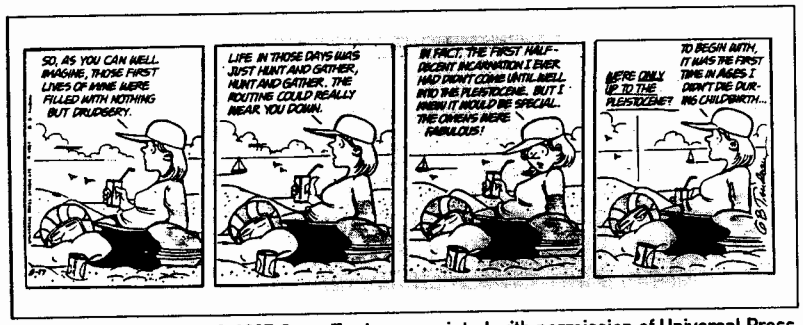


Figure 1.2 Doonesbury. © 1987 Garry Trudeau. reprinted with permission of Universal Press Syndicate. All rights reserved.

in technoscientific texts and artifacts is often simultaneously apocalyptic and comedic. As we will examine in detail later, figuration in technoscience seems to operate according to the corporate slogan for the patented transgenic rodent, OncoMouse™, "available only from DuPont, where better things for better living come to life."

Teleconferencing with lunatic@street_level, I explore technoscientific figuration with the help of another Doonesbury cartoon. Here, my modest witness is a New Age woman recounting her past lives. In her various incarnations, she recapitulates hominid evolutionary history as that developmental account is narrated within paleoanthropology. The typical fusing of New Age belief and orthodox scientific model is part of what makes the cartoon funny. Garry Trudeau's cartoon character, named Boopsie, figures—that is, embodies—"the "universal" story of "woman." Part of the joke is the whimsical reversal of the humanist narrative to give the story of woman instead of man. In this cartoon, "Man," that is, Boopsie's bored partner, is the one who listens (sort of). Biology is the vehicle of universality; we are in the domain of technobiopower, with its subject formations, beliefs, and practices. The early ages of drudgery—"Hunt and gather, hunt and gather, the routine could really wear you down"—give way in the saga of hominid progress to the Pleistocene: "The omens were fabulous." The punchline captures perfectly the identifications and hopes built into technoscientific accounts of progress; without losing their physical reality, the sufferings of the earlier period are transcended in the sociotechnical advances of universal history. "To begin with, it was the first time in ages I didn't die in childbirth." Technology, including the technology of the body itself, is the real subject of universal history. Trudeau knows that the story of technical progress is at the heart of Enlightenment humanism. He also has just the right twist on how the humor works when the subject of technical progress is woman and her body instead of man and his tools. Like the cartoonist Gary Larson, Trudeau comprehends how his audiences inhabit and are inhabited by the stories and explanations of technoscience. Trudeau understands the identities forged, the subject positions opened up, and the substitutions and surrogacies sketched in practices of figuration. He understands how Woman the Gatherer is a figure for the late-twentieth-century, white, middle-class woman on the beach with her football-helmet-clad companion, the descendent of Man the Hunter.

Figuration is a complex practice with deep roots in the semiotics of Western Christian realism. I am especially interested in a specific sense of time built into Christian figuration. I think this kind of time is characteristic of the promises and threats of technoscience in the United States, with its ebullient,

secular, disavowed, Christian national stories and practices. Despite the extraordinary multicultural, multiethnic, multireligious populations in the United States, with quite various traditions of signifying time and community, U.S. scientific culture is replete with figures and stories that can only be called Christian. Figural realism infuses Christian discourse in all of that religious tradition's contested and polyvocal variety, and this kind of figuration shapes much of the technoscientific sense of history and progress. That is why I locate my modest witness in the less than universal—to put it mildly—time zone of the end of the Second (Christian) Millennium. In the United States, at least, technoscience is a millenniarian discourse about beginnings and ends, first and last things, suffering and progress, figure and fulfillment. And the OncoMouse™ on the back cover of *Modest_Witness@Second_Millennium* doesn't have a crown of thorns on her head for no reason.

As Erich Auerbach explained in his great study of mimetic practice in Western literature, "Figural interpretation establishes a connection between two events or persons in such a way that the first signifies not only itself but also the second, while the second involves or fulfills the first.... They are both contained in the flowing stream which is historical life" (1953:64). The heart of figural realism is the Christian practice of reading the story of Christ into Jewish scripture. Although in Christian figuration both figure and fulfillment are materially real, history is fully contained in the eternal plan of Divine Providence, which alone can supply the key to historical meaning. Containing and fulfilling the whole, (Christian) salvation history *is* history. Auerbach insists that this kind of temporality is utterly alien to the conceptions of classical antiquity, both Jewish and Greek.

Auerbach examines Dante's development of figural realism in *The Divine Comedy*. Dante's innovation was to draw the end of man with such extraordinary vividness and variety "that the listener is all too occupied by the figure in the fulfillment.... The fullness of life which Dante incorporates into that interpretation is so rich and so strong that its manifestations force their way into the listener's soul independently of any interpretation. The image of man eclipses the image of God" (1953:176). The sense of history as a totality remains in this humanist order, and the overwhelming power of the images that promise fulfillment (or damnation) on earth infuses secular histories of progress and apocalypse. Secular salvation history depends on the power of images and the temporality of ultimate threats and promises to contain the heteroglossia and flux of events. This is the sense of time and of representation that I think informs technoscience in the United States. The discourses of genetics and information sciences are especially replete with instances of barely secularized Christian figural realism at work.

The legacy of figural realism is what puts my title's modest witness in the sacred secular time zones of the end of the Second Millennium and the New World Order. Second Millennium is the time machine that has to be reprogrammed by Nili's heretics, infidels, and Jews, who, it is crucial to remember, "have always considered getting knowledge part of being human." Challenging the material-semiotic practices of technoscience is in the interests of a deeper, broader, and more open scientific literacy, which this book will call situated knowledges.

Figuration has many meanings besides, or intersecting with, those proper to the legacy of Christian realism.[6] Aristotelian "figures of discourse" are about the spatial arrangements in rhetoric. A figure is geometrical and rhetorical; topics and tropes are both spatial concepts. The "figure" is the French term for the face, a meaning kept in English in the notion of the lineaments of a story. "To figure" means to count or calculate and also to be in a story, to have a role. A figure is also a drawing. Figures pertain to graphic representation and visual forms in general, a matter of no small importance in visually saturated technoscientific culture. Figures do not have to be representational and mimetic, but they do have to be tropic; that is, they cannot be literal and self-identical. Figures must involve at least some kind of displacement that can trouble identifications and certainties.

Figurations are performative images that can be inhabited. Verbal or visual, figurations can be condensed maps of contestable worlds. All language, including mathematics, is figurative, that is, made of tropes, constituted by bumps that make us swerve from literal-mindedness. I emphasize figuration to make explicit and inescapable the tropic quality of all material-semiotic processes, especially in technoscience. For example, think of a small set of objects into which lives and worlds are built—chip, gene, seed, fetus, database, bomb, race, brain, ecosystem. This mantralike list is made up of imploded atoms or dense nodes that explode into entire worlds of practice. The chip, seed, or gene is simultaneously literal and figurative. we inhabit and are inhabited by such figures that map universes of knowledge, practice and power. To read such maps with mixed and differential literacies and without the totality, appropriations, apocalyptic disasters, comedic resolutions, and salvation histories of secularized Christian realism is the task of the mutated modest witness.

Time and Space

Figures always bring with them some temporal modality that organizes interpretive practice. I understand Foucault's (1978) concept of biopower to refer to the practices of administration, therapeutics, and surveillance of bodies that discursively constitute, increase, and manage the forces of living organisms. He gives shape to his theoretical concept through delineating the

nineteenth-century figures of the masturbating child, reproducing Malthusian couple, hysterical woman, and homosexual pervert. The temporality of these biopolitical figures is developmental.[7] They are all involved in dramas of health, degeneration, and the organic efficiencies and pathologies of production and reproduction. Developmental time is a legitimate descendant of the temporality of salvation history proper to the figures of Christian realism and technoscientific humanism.

Similarly, my cyborg figures inhabit a mutated time-space regime that I call technobiopower. Intersecting with—and sometimes displacing—the development, fulfillment, and containment proper to figural realism, the temporal modality pertaining to cyborgs is condensation, fusion, and implosion. This is more the temporality of the science-fictional wormhole, that spatial anomaly that casts travelers into unexpected regions of space, than of the birth passages of the biopolitical body. The implosion of the technical, organic, political, economic, oneiric, and textual that is evident in the material-semiotic practices and entities in late-twentieth-century technoscience informs my practice of figuration. Cyborg figures—such as the end-of-the-millennium seed, chip, gene, database, bomb, fetus, race, brain, and ecosystem—are the offspring of implosions of subjects and objects and of the natural and artificial. Perhaps cyborgs inhabit less the domains of "life," with its developmental and organic temporalities, than of "life itself,"[8] with its temporalities embedded in communications enhancement and system redesign. Life itself is life enterprised up, where, in the dyspeptic version of the technoscientific soap opera, the species becomes the brand name and the figure becomes the price. Ironically, the millennarian fulfillment of development is the excessive condensation of implosion.

Temporalities intertwine with particular spatial modalities, and cyborg spatialization seems to be less about "the universal" than "the global." The globalization of the world, of "planet Earth," is a semiotic-material production of some forms of life rather than others. Technoscience is the story of such globalization; it is the travelogue of distributed, heterogeneous, linked, sociotechnical circulations that craft the world as a net called the global. The cyborg life forms that inhabit the recently congealed planet Earth—the "whole earth" of eco-activists and green commodity catalogs—gestated in a historically specific technoscientific womb. Consider, for example, only four horns of this multilobed reproductive wormhole:

1 The apparatuses of twentieth-century military conflicts, embedded in repeated world wars; decades of cold war; nuclear weapons and their institutional matrix in strategic planning, endless scenario production, and simulations in think tanks such as RAND; the immune system-like networking strategies for postcolonial global control inscribed in low-intensity-conflict doctrines; and post-Cold War, simultaneous-multiple-war-fighting strategies depending on rapid massive deployment, concentrated control of information and communications, and high-intensity, subnuclear precision weapons (Helsel 1993; Gray 1991; Edwards 1995)

2 The apparatuses of hypercapitalist market traffic and flexible accumulation strategies, all relying on stunning speeds and powers of manipulation of scale, especially miniaturization, which characterize the paradigmatic "high-technology" transnational corporations (Harvey 1989; Virilio 1983; Martin 1992)

3 The apparatuses of production of that technoscientific planetary habitat space called the ecosystem, with its constitutive birth pangs in resource management practices in such institutions as national fisheries in the 1920s and 1930s; in post-World War II theoretical fascination with all things cybernetic; in the Atomic Energy Commission-mediated research projects in the 1950s for tracing radioisotopes through food chains in the Pacific ocean; in 1970s global modeling practices indebted to the Club of Rome and to international projects such as the United Nations Educational, Scientific, and Cultural Organization's (UNESCO) Man and the Biosphere program; and in the early salvos of widespread "green war" as a dominant New World Order security concern, with its diplomatic forms played out in 1992 at the Earth Summit in Rio de Janeiro (Escobar 1994; Taylor and Buttel 1992)[9]

4 The apparatuses of production of globalized, extraterrestrial, everyday consciousness in the planetary pandemic of multisite, multimedia, multispecies, multicultural, cyborgian entertainment events such as *Star Trek, Blade Runner, Terminator, Alien,* and their proliferating sequelae in the daily information stream, embedded in transnational, U.S.-dominated, broad-spectrum media conglomerates, such as those forged by the mergers of Time-Warner with CNN and of the Disney universe with Capital Cities, owner of CBS (Gabilondo 1991; Sofia 1992).[10]

The offspring of these technoscientific wombs are cyborgs—imploded germinal entities, densely packed condensations of worlds, shocked into being from the force of the implosion of the natural and the artificial, nature and culture, subject and object, machine and organic body, money and lives, narrative and reality. Cyborgs are the stem cells in the marrow of the technoscientific body; they differentiate into the subjects and objects at stake in the contested zones of technoscientific culture. Cyborg figures must be read, too, with the mixed, unfinished literacies Nili is ready to teach.

So, what kinds of kin are allied in the proprietary forms of life in these days near the end of the Second Christian Millennium? How do we, who inhabit such stories, make psychic and commercial investments in forms of life, where the lines among human, machine, and organic nature are highly permeable and eminently revisable? How useful is my abiding suspicion that "biology"—the historically specific, congealed embodiments in the world as well as the technoscientific discourse positing such bodies—is an accumulation strategy? The point is less disreputable if I write that "biotechnology"—both the discourse and the body constituted as a biotechnics—is an accumulation strategy. But much of what is accumulated is more strange than capital, more kind than alien, more alluring than gold. It is time to move from grammar to content, from syntactics to semantics, from logic to body.

Contents

Modest_Witness@Second_Millennium is organized around the anatomy of meanings. The book's sections correspond to the parts of the human science of semiotics. Part I, Syntactics: The Grammar of Feminism and Technoscience, corresponds to *syntactics*, or the formal structure of signification. Part II, Semantics: Modest_Witness@Second_Millennium.FemaleMan©_Meets_OncoMouse™ matches *semantics*, or the contents and figures of a communication. Part III, Pragmatics: Technoscience in Hypertext, recalls *pragmatics*, or the physiology of meaning-making. Inventing a fourth category of semantics and troping on the conventional parts of the subject, I end my book with *Diffractions*, Lynn Randolph's painting of a split figure moving through a screen into a world where interference patterns can make a difference in how meanings are made and lived. Each chapter can be read as a separate essay, but in sequence, the chapters are a kind of Pilgrim's Progress through the story fields, material-semiotic apparatuses, and political stakes where biologics and informatics cohabit and reproduce. Guiding the reader through the grammar of the title, Part I explains its e-mail address, the mixed and differential literacies necessary to evade millennarian closures, and the contaminated practice of figuration that pervades the

book. Interfacing and mixing narrative fiction, biological argument, historical analysis, political inquiry, mathematical jokes, religious reworkings, literary readings, and visual imagery, the book is itself generically heterogeneous. Its mixed genres and its interdigitating verbal and visual organs ask for a generous literacy from the reader. In its most basic sense, this book is my exercise regime and self-help manual for how not to be literal minded, while engaging promiscuously in serious moral and political inquiry about feminism, antiracism, democracy, knowledge, and justice in certain important domains of contemporary science and technology. I also want those who inhabit *Modest_Witness@Second_Millennium* to have a good time. Comedy is both object of attention and method.

Contesting the meanings of words, instruments, and figures, Part II brings the reader into the time zone of the Scientific Revolution through the figure of the modest witness, who bears testimony to matters of fact constituted by means of material, literary, and social technologies crafted in the experimental way of life. Drawing on approaches developed in feminist science studies to communities of practice, boundary objects, situated knowledges, agential realism, and strong objectivity, the chapter aims to mutate the modest witness into a more usable vehicle for entering the wormholes of contemporary millennarian technoscience. The second chapter of the Semantics section interrogates the kinship of the FemaleMan© and OncoMouse™. These late-twentieth-century figures inhabit the story fields and sociotechnical practices of feminism and biotechnology. Beginning with a comparison of transuranic elements and transgenic organisms and lingering in the biotechnological laboratory, the chapter examines a broad range of popular and official texts, careers, economic developments, global webs, research practices, visual materials, and efforts to construct a more democratic science. The purpose is to enliven our practical imagination of who the actors are and what is at stake in some of the material-semiotic domains of modern biology. By the end of Semantics, the family has been assembled and the action can expand.

Part III, a *pragmatics*, tinkers with mechanisms for unwinding sticky threads and making new articulations in the dense knots and hypertextual webs of technoscience. The topics are the Human Genome Project and its mapping practices; the transnational and transgeneric bond between reproductive technology and reproductive freedom projects; the changing discourses of human unity and difference in biological approaches to race across the twentieth century; and the kinship of diverse cyborg figures that populate ecology, medical technology, cinema, and evolutionary biology. Technoscientific visual culture;

inhospitable versions of fetishism; jokes, songs, and solemn pronouncements; the close weave of art, money, and science; and proliferating vampire figures all find their place in this Pragmatics section.

My invented category of semantics, *diffractions*, takes advantage of the optical metaphors and instruments that are so common in Western philosophy and science. Reflexivity has been much recommended as a critical practice, but my suspicion is that reflexivity, like reflection, only displaces the same elsewhere, setting up the worries about copy and original and the search for the authentic and really real. Reflexivity is a bad trope for escaping the false choice between realism and relativism in thinking about strong objectivity and situated knowledges in technoscientific knowledge. What we need is to make a difference in material-semiotic apparatuses, to diffract the rays of technoscience so that we get more promising interference patterns on the recording films of our lives and bodies. Diffraction is an optical metaphor for the effort to make a difference in the world. Lynn Randolph's suggestive painting on the last page concludes *Modest_Witness@Second_Millennium. FemaleMan*© *_Meets_OncoMouse*™ with an interference pattern, not with a reflection of the same displaced elsewhere. Randolph gave me a powerful figure for troping the end of my culture's parochial millennium, in both its feminist and its technoscientific versions. That is, Randolph's woman is a device for considering how to make the end swerve. What more could a people given to teleology ask for at the last?

Throughout *Modest_Witness@Second_Millennium*, the paintings of Lynn Randolph introduce and frame themes and arguments. Randolph's and my own metaphoric realism and cyborg surrealism are in punctuated conversation. Our verbal and visual figures were sometimes developed in direct response to each other's work. I have placed one of her paintings, paired with my commentary, at the beginning of each part and of two individual chapters. I am indebted to Randolph for conversations and letters in which she helped me see her art, which then infiltrated the tissue of my sentences. Similarly, some of her paintings were done in response to earlier versions of chapters. The book contains ten of Randolph's troubling and hopeful paintings, each exploring the material and psychic territory of technoscience. I am grateful to her with all my heart. Her willingness to let me weave her work into mine is a rare gift. It is through the eyes of her mouse-human hybrid in *The Laboratory, or the Passion of OncoMouse* that I watch Robert Boyle's experiments with the air-pump in seventeenth-century London, from which the modest witnesses of this book began their travels toward the end of the millennium.

7

FACTS, WITNESSES, AND CONSEQUENCES

I have tried to persuade my readers that several apparently counterintuitive claims should have the status of matters of fact—that is, crucial points of contingent stability for possible sociotechnical orders, attested by collective, networked, situated practices of witnessing. Witnessing is seeing; attesting; standing publicly accountable for, and psychically vulnerable to, one's visions and representations. Witnessing is a collective, limited practice that depends on the constructed and never finished credibility of those who do it, all of whom are mortal, fallible, and fraught with the consequences of unconscious and disowned desires and fears. A child of Robert Boyle's Royal Society of the English Restoration and of the experimental way of life, I remain attached to the figure of the modest witness. I still inhabit the stories of scientific revolution as earthshaking mutations in the apparatuses of production of what may count as knowledge. A child of antiracist, feminist, multicultural, and radical science movements, I want a mutated modest witness to live in worlds of technoscience, to yearn for knowledge, freedom, and justice in the world of consequential facts. I have tried to queer the self-evidence of witnessing, of experience, of the conventionally upheld and invested perceptions of clear distinctions between subject and object, especially the self-evidence of the distinction between living and dead, machine and organisms, human and nonhuman, self and other as well as of the distinction between feminist and mainstream, progressive and oppressive, local and global.

Queering all or any of these distinctions depends, paradigmatically, on undoing the founding border trace of modern science—that between the technical and the political. The point is to make situated knowledges possible in order to be able to make consequential claims about the world and on each other. Such claims are rooted in a finally amodern, reinvented desire for justice and democratically crafted and lived well-being. It is important to remember that these were also, often, the dreams of the players in the first Scientific

Revolution, that first time machine of modernity, as they sought to avert the terrors of civil war, absolutist religion, and arbitrary monarchs. Perhaps ironically, meeting the criterion of heightened, strong objectivity, rather than wallowing in the soft and flaccid swamps of ordinary technoscientific objectivity, depends on undoing the tricks of modernity's Wizard of Oz's masterpiece, called the air-pump. The air-pump is the synecdochic and originary figure in my story for the whole apparatus of production of what may count as reliable knowledge in technoscience.

I want to call the problematic but compelling world of antiracist feminist multicultural studies of technoscience "cat's cradle." Making string figures on fingers is cat's cradle (Westerveld 1979). Relying on relays from many hands and fingers, I try to make suggestive figures with the varying threads of science studies, antiracist feminist theory, and cultural studies. Cat's cradle is a game for nominalists like me who cannot *not* desire what we cannot possibly have. As soon as possession enters the game, the string figures freeze into a lying pattern. Cat's cradle is about patterns and knots; the game takes great skill and can result in some serious surprises. One person can build up a large repertoire of string figures on a single pair of hands, but the cat's cradle figures can be passed back and forth on the hands of several players, who add new moves in the building of complex patterns. Cat's cradle invites a sense of collective work, of one person not being able to make all the patterns alone. One does not "win" at cat's cradle; the goal is more interesting and more open-ended than that. It is not always possible to repeat interesting patterns, and figuring out what happened to result in intriguing patterns is an embodied analytical skill. The game is played around the world and can have considerable cultural significance. Cat's cradle is both local and global, distributed and knotted together (Haraway 1994a).

The mutated modest witness who plays cat's cradle games—rather than joining the strategic, agonistic contest of matching feats of strength and amassing allies, measured by strength and numbers, reputed to constitute ordinary science in action—cannot afford self-invisibility. And reflexivity is not enough to produce self-visibility. Strong objectivity and agential realism demand a practice of diffraction, not just reflection. Diffraction is the production of difference patterns in the world, not just of the same reflected—displaced—elsewhere. The modest witness in the cat's cradle game cannot breathe any longer in the culture of no culture.

Let me summarize a few of the terms circulating in the net of the virtual community of feminist science studies, where retooled modest witnesses surf: strong objectivity (Harding 1992); agential realism (Barad 1995a and 1995b); modest interventions (Heath forthcoming); boundary objects, borderlands,

communities of practice, articulation work, misplaced concretism, and feminist method (Star 1994); cyborgs and situated knowledges (Haraway 1991); border crossings and narrative strategies (Traweek 1992); science as social knowledge (Longino 1990). If any one thing pervades this heterogenous list, it is a commitment to avoiding what Whitehead called "the fallacy of misplaced concreteness" (1948:52), where simple location and a metaphysics of substantives with primary and secondary qualities—those fruitful but extreme abstractions that were critical to seventeenth-century innovations later narrated as the Scientific Revolution—get mistaken as reality. Attention to the agencies and knowledges crafted from the vantage point of nonstandard positions (positions that don't fit but within which one must live), including the heterogeneous locations of women, and questions about for whom and for what the semiotic-material apparatuses of scientific knowledge production get built and sustained are at the heart of feminist science studies. Interrogating critical silences, excavating the reasons questions cannot make headway and seem ridiculous, getting at the denied and disavowed in the heart of what seems neutral and rational: These notions are all fundamental to feminist approaches to technoscience (Keller 1992a:7392). I think what binds the lumpy community of modest witnesses called feminist science studies together is what bell hooks (1990) called "yearning." Yearning in technoscience is for knowledge projects as freedom projects—in a polyglot, relentlessly troping, but practical and material way—coupled with a searing sense that all is not well with women, as well as billions of nonwomen, who remain incommensurable in the warped coordinate systems of the New World Order, Inc.

Committed to cyborg articulations, I have tried to undermine the notion of *self*-evidence entirely by insisting, along with most other critical intellectuals and practitioners of science studies, that the shapes the world takes are conventional and revisable, if also eminently solid and full of consequences for unequally distributed chances of life and death. Valid witness depends not only on modesty but also on nurturing and acknowledging alliances with a lively array of others, who are like and unlike, human and not, inside and outside what have been the defended boundaries of hegemonic selves and powerful places. I am thinking, centrally, of selves such as scientists and places such as laboratories. By the end of the Second Millennium, it is past time to queer them permanently, to revise them generically, to color them back into visibility. The empty spaces of both the "culture of no culture" of self-invisible technoscientists and the "nature of no nature" of the chimerical entities emerging from the world-constructed-as-laboratory must be remapped and reinhabited by new practices of witnessing. With the evident implosion of nature and culture for those who

held the distinction sacred, the task of staking out common space is inescapable. What will count as modesty now is a good part of what is at issue. Whose agencies will revised forms of "modest witness" enhance, and whose will it displace? The kind of modest witness that attests the natural kinship of the fully artifactual FemaleMan© and OncoMouse™ is the kind that insists on an actor-network theory that traces the stakes, alliances, and action of a much-enhanced array of constituents and producers of what may count as fact. It is a kind of modest witness that insists on its situatedness, where location is itself always a complex construction as well as inheritance, and that casts its lot with the projects and needs of those who could not or would not inhabit the subject positions of the self-invisible and the discursive sites, the "laboratories," of the credible, civil man of science. *Modest_Witness@Second_Millennium* needs a new experimental way of life to fulfill the millennarian hope that life will survive on this planet.

Entities such as the fetus, chip, gene, bomb, brain, race, ecosystem, seed, and database are partly like Robert Boyle's air-pump: They are material technologies through which many must pass and in which many visible and invisible actors and agencies cohere. The air-pump was a device for establishing matters of fact, an instrument in a new way of life, called "experimental," based on the laboratory as a theater of persuasion. The air-pump was part of the armament enforcing the partition of the world into subjects and objects. Thus, my hypertext nodes and links or totipotent stem cells are also very unlike the air-pump because they are all part of a material technology for tearing down the Berlin Wall between the world of objects and the world of subjects, and the world of the political and the technical. They all attest, witness, to the implosion of nature and culture in the embodied entities of the world and their explosion into contestations for possible, maybe even livable, worlds in globalized technoscience.

To play with the hypertext made up of entities such as the gene, fetus, race, seed, and database, one must enter the Net from many sites. One must risk following the links among stem cells through indeterminate numbers of dimensions, perceiving and allying with agencies and actors too often excluded by scholars of technoscience. One must understand that the reality effect of "virtual reality" is no less and no more "real" than that made available—and enforced—by the material, literary, and social conventions of the first scientific revolutions and renaissances that make up the stories about European-derived apparatuses for the production of matters of fact and states of self-evidence. If the endeavors of antiracist feminist studies, cultural studies, and science studies are really to lose their status as preformed and mutually repellent categories, joined, if at all, by an exhausting series of coordinating conjunctions and defensive addenda and apologies, then entering the Net is going to require a radically reformed practice for finding our addresses and sending our messages into the ether. A livable worldwide web should be the mutated modest witness's game of cat's cradle, where the end of the millennium becomes a trope for swerving away from the brands that mark us all in the too persuasive stories of the New World Order, Inc. This is the cat's cradle game that the FemaleMan© and OncoMouse™ need to learn to play.

A Diffraction. Lynn Randolph, oil on canvas, 58" x 46", 1992.

Diffraction patterns record the history of interaction, interference, reinforcement, difference. Diffraction is about heterogeneous history, not about originals. Unlike reflections, diffractions do not displace the same elsewhere, in more or less distorted form, thereby giving rise to industries of metaphysics. Rather, diffraction can be a metaphor for another kind of critical consciousness at the end of this rather painful Christian millennium, one committed to making a difference and not to repeating the Sacred Image of Same. Diffraction is askew of Christian narrative and Platonist optics, in their sacred secular technoscientific story cycles as well as their more orthodox manifestations. Diffraction is a narrative, graphic, psychological, spiritual, and political technology for making consequential meanings.

About this painting for the Iusas series, Randolph writes:

> The screened memory of a powerful male figure in every woman's life marks a place where change occurs. The shifts that occur with age and psychic transformations, the multiple selves incorporated in one body, are embodied in the central figure with its two heads, extra fingers, and metaphysical space in between. Diffraction occurs at a place at the edge of the future, before the abyss of the unknown. The structural pattern of the matter in a galaxy may be repeated in a magnolia blossom, a vision perhaps peculiar to painters from Texas. I'm trying to create bodies that matter. Perhaps by placing women's reality into a SF world, a place composed of interference patterns, contemporary women might emerge as something other than the sacred image of the same, something inappropriate, deluded, unfitting, and magical—something that might make a difference. I believe that we need to be the active about this, not removed, . . . real (not natural) and soiled by the messiness of life. (1993:9)

NOTES

Part I. Syntactics: The Grammar of Feminism and Technoscience

1 To stress the Church's control of the power to enforce such names, I use the accusatory terms of the Inquisition for dissenters, Muslims, and Jews. Nili included the "infidels" in her category of heretics, but her Palestinian sisters would remind her that it is worthwhile to be more explicit when identifying the peoples of the book and their oppositional literacies.

2 Fernandez (1991 and 1995a) discusses the mixed cultural literacies necessary to navigating the material-semiotic webs of the contemporary United States. She inhabits a series of trickster figures to trouble conventional passages through literatures; museums; encyclopedias; dictionaries; theme parks; and multicultural canon, literacy, and pedagogy wars. Sandoval (1991 and forthcoming) theorizes oppositional and differential consciousness, rooted in the reading and writing practices of U.S. Third World women of color but able to be learned broadly. That kind of nonreductive, noninnocent, achieved political-semiotic sensibility—indebted to and articulated with those who learned to see and operate in the world in critical new ways—is central to feminist standpoint theories, including those in science studies.

3 ARPA is the acronym for (Defense) Advanced Research Projects Administration, later amended to DARPA.

4 The marvelous blend of hype, sober analysis, and policy development joining the rebirth of the nation to the new world information order is everywhere; for example, see the National Information Infrastructure: Agenda for Action (Information Infrastructure Task Force 1993). For the more suspicious, MicroAssociates, Box 5369, Arlington, VA 22205, keeps a power structure research database on disks. No Modest_Witness@Second_Millennium should be without those disks.

5 Marilyn Strathern inquires into the ways culture is "enterprised-up" in the enhancements of advertising, in particular, but also in the "enterprise culture" of the New World Order descended from Thatcher, Reagan, Bush, and their potent kin, more generally. "Marketed products are quality-enhanced." She sees such enhancement as peculiar to a world where "the natural, innate

property and the artificial, cultural enhancement become one. . . . This is not a new essentialism but a collapse of the difference between the essential and the superadded" (Strathern 1992:38–39). My interest in the zones of implosion of nature and culture is kin to Strathern's.

6 I am in conversation with Braidotti (1994) in this discussion.

7 Or, as Claudia Castañeda (in progress) put it, the child is the chronotope that organizes developmental time.

8 I owe "life itself" to Sarah Franklin (1993b).

9 The Maxis computer game *SimEarth* is one practical training exercise for learning to inhabit the systematically globalized "whole earth." Seldom has subject constitution been so literal, visible, and explicit. The game's promotional material on the box urges *SimEarth* players to "take charge of an entire planet from its birth to its death—10 billion years later. Guide life from its inception as single-celled microbes to a civilization that can reach for the stars." Players can "promote life, create and destroy continents, terraform hostile worlds." Finally, players are urged to "guide your intelligent species through trials of war, pollution, famine, disease, global warming, and the greenhouse effect." Nothing in *SimEarth* is abstract; the subjects and objects are materialized in located, particular practices. It is as if the chapter "Centers of Calculation" in Bruno Latour's (1987) *Science in Action* had been outlined by the software writers at Maxis: "View the entire world as either a flat projection or a spinning globe. . . . Close up views, for inspecting and modifying planets, display climate, life, and data layers."

10 Meanwhile, the Wells Fargo Bank is the biggest institutional shareholder of General Electric, which owns NBC. Notions of totalization come so naturally. Mixed and differential literacies for interpreting "global culture," and recognizing worlds outside the Net, must be deliberately cultivated.

Part II. Semantics: Modest_Witness@Second_Millennium.FemaleMan©_Meets_OncoMouse™

1 *General Hospital* and *Dallas* were popular soap operas in the 1980s and 1990s.

2 Inspired by Benjamin's *flâneur*, Ramona Fernandez (1991:1995a) explored the materialized narrative technology of Disney World by traveling through its sites in the persona of a family of figures—the *curandera*, cyborg, mestiza, and *pachuco*, who together forged a potent trickster literacy that helped me write my book.

Chapter 1. Modest_Witness@Second_Millennium

Modest Witness

1 Commerce is a variant of conversation, communication, intercourse, passage. As any good economist will tell you, commerce is a procreative act.

2 Traweek was studying the legitimate sons of Robert Boyle; her physicists' detector

devices are the mechanical descendants of his air-pump as well. Humans and nonhumans have progeny in the odd all-masculine reproductive practices of technoscience. "I have presented an account of how high energy physicists construct their world and represent it to themselves as free of their own agency, a description, as thick as I could make it, of an extreme culture of objectivity: a culture of no culture, which longs passionately for a world without loose ends, without temperament, gender, nationalism, or other sources of disorder—for a world outside human space and time" (Traweek 1988:162).

3 Of course, what counts as a warrant for disinterestedness, or lack of bias, changes historically. Shapin (1994:409–17) stresses the difference between the face-to-face, gentlemanly standards for assessing truth telling in seventeenth-century England and the anonymous, institutionally and professionally warranted practices of science in the twentieth century. Inside concrete laboratories, however, Shapin suggests that members of the community based on face-to-face interactions continue to assess credibility in ways Robert Boyle would have understood. Part of the problem scientists face today is legitimation of their criteria in the eyes of "outsiders." One of my goals in this book is to trouble what counts as insiders and outsiders in setting standards of credibility and objectivity. "Disinterested" cannot be allowed to mean "dislocated"; i.e., unaccountable for, or unconscious of, complex layers of one's personal collective historical situatedness in the apparatuses for the production of knowledge. Nor can "politically committed" be allowed to mean "biased." It is a delicate distinction, but one fundamental to hopes for democratic and credible science. Etzkowitz and Webster (1995) discuss how the "norms of science," and so of what counts as objective, have changed during the twentieth century in the United States. For example, in molecular biology university-based investigators formerly doing tax- and foundation-supported "pure science," which semiotically warranted their credibility and disinterestedness, as the grants economy eroded became much more closely tied to corporations, where intellectual property and science implode. Perhaps some of the anxiety about objectivity in the "science wars"—in which science studies scholars, feminist theorists, and the like are seen as threatening broad-based belief in scientific credibility and objectivity through their irresponsible "perspectivalism" and "relativism"—should really be traced to transformed standards of disinterestedness among scientists themselves. See especially the attacks by Gross and Levitt (1994).

4 Shapin (1994) writes almost exclusively about the social technology for warranting credibility. He analyzes the transfer of the code of gentlemanly honor, based on the *independence* of the gentleman, that man of means who owes no one anything but the truth, from established social regions to a new set of practices—experimental science. The most original contribution of Shapin and Schaffer (1985) is their analysis of the weave of all three technologies, and especially of the heart of the experimental life form—the sociotechnical apparatus that built and sustained the air-pump, which I take to be