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WHAT WAS ARTIFICIAL INTELLIGENCE?

Contents

Introduction

[Artificial intelligence is] the conjecture every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it.

—John McCarthy and Marvin Minsky, 1955[1]

[AI is] the scientific understanding of the mechanisms underlying thought and intelligent behavior and their embodiment in machines.

—Association for the Advancement of Artificial Intelligence, 2022[2]

AI is the ability of a machine to display human-like capabilities such as reasoning, learning, planning and creativity.

—European Parliament, 2020[3]

ARTIFICIAL INTELLIGENCE (AI) advocates generally describe it in the future tense. By inverting that convention in my 2002 essay, I intended to signal that AI also had a past—by then a half century–long history of extravagant forecasting—which was overdue for critical examination. I also wanted to suggest that, at that point, AI's future was uncertain, as the field was undergoing a period of critical reassessment.

Almost from artificial intelligence's inception in the 1950s, AI researchers had been periodically announcing that they were on the threshold of revolutionary discoveries that would radically transform human life as we know it, in ways that we could not begin to grasp. Artificial intelligence would, we were told, create a form of super intelligence many times greater than human intelligence, which would continue to perfect itself through machine learning, leaving us slow-witted humans behind. AI enthusiasts celebrated the prospect, seeing themselves as either creating or bearing witness to the next step in

[1] John McCarthy et al., "A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence" (unpublished manuscript, August 31, 1955). McCarthy and Minsky are normally credited with drafting the proposal, and McCarthy with coining the "artificial intelligence" phrase.
[2] "Welcome to the Association for the Advancement of Artificial Intelligence!" Association for the Advancement of Artificial Intelligence .

[3] "What Is Artificial Intelligence and How Is It Used?" European Parliament News, September 4, 2020.

evolution. Sci-fi narratives multiplied and greatly amplified AI futurism, whether as deliverance or as the impending doom of a robotic apocalypse.

Fact or fiction, good or evil: The audacity of the message seemed to infuse AI with independent agency, a godlike mind and destiny of its own. This deflected attention from the actual networks of military, political, and economic interests promoting its development. It also absolved the hubris of the scientists attending the nativity of the electronic marvel, because they seemed to cast themselves as mere messengers or apostles serving a higher power.

By the 1990s, however, the air was growing thin. A half century of extravagant promises, substantial public investments, and meager visible returns led to disenchantment with AI's top-down research paradigm. This early work drew on traditional philosophical studies of logic and reasoning processes to develop its models, with aspirations to formalize common-sense reasoning processes.[4] For AI, it was a time for rethinking and retooling, which suggested that AI's hold on the future tense was, at best, tenuous.

It was an opportune moment to rethink my own work on AI as well, which I had first undertaken in the mid-1980s, when enthusiasm for the promise of artificial intelligence was at a peak. The 2002 essay was not, however, intended as an obituary for artificial intelligence. No one expected its advocates to shut down shop. But at the time it did seem that the transcendent vision of the first generation of AI researchers—what is now sometimes referred to as "strong" artificial intelligence—was undergoing a radical deflation, and that it might be prudently retired.

The results of my millennial reassessment of AI, "What Was Artificial Intelligence?" is reproduced here in its original form, without any emendations.[5] It is not a history of the science or mathematics of AI. That lies far beyond my competence. Rather, it is an account of the stories the AI scientists have told themselves, each other, and the world about the form of intelligence they hoped to create. In telling those stories, they also tell us a great deal about themselves.

Artificial Intelligence Paratexts and Hype Cycles

In literary theory, a paratext is "a text that relates to (or mediates) another text (the main work) in a way that enables the work to be complete and to be offered to its readers and, more generally, to the public." It has been described metaphorically as a "threshold" or "vestibule" which allows readers to enter a text.[6]

[4] Selmer Bringsjord and Naveen Sundar Govindarajulu, "Artificial Intelligence," in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta, accessed August 16, 2020 .

[5] The essay originally appeared as Sue Curry Jansen, "What Was Artificial Intelligence?" in *Critical Communication Theory: Power, Media, Gender, and Technology* (Lanham, MD: Rowman & Littlefield, 2002), 123–54. Reprinted by permission.

[6] Roswitha Skare, "Paratexts," in *Encyclopedia of Knowledge Organization*, ed. Björn Hammarfelt and Claudio Gnoli (International Society for Knowledge Organization).

"What Was Artificial Intelligence?" offers a critical analysis of twentieth-century paratexts of the AI movement: the programmatic descriptions, manifestos, and interviews that AI scientists used to explain what they thought they were doing when they did their research. Parascientific texts are similar to corporate mission statements, which are designed to cultivate and promote positive responses to an enterprise. The target audiences for the parascientific texts of AI are potential public and private funding agencies like the National Science Foundation or the Defense Advanced Research Projects Agency (DARPA), policy makers and administrators of universities and scientific research institutes, as well as scientists in other areas of expertise, science buffs, and journalists. So these parascientific texts do not assume or require competency in the technical aspects of AI. They are, in effect, translations or narrative accounts of the techno-sciences.

Artificial intelligence advocates have been especially prolific in their production of paratexts, perhaps because the technology they are seeking to develop is unprecedented, esoteric, and ethereal, and its delivery date is indefinite (although almost always described as near). According to widely accepted market analytics, new technologies—those that make it to market—typically undergo "hype cycles" of initial over-enthusiasm, followed by disillusionment, and then a plateau of productivity as the product is realistically assessed and its utility demonstrated in the marketplace.[7]

It is generally agreed by AI chroniclers that the artificial intelligence movement has gone through two major hype cycles that have ended in disappointment. There is little agreement on exact dates or the specific AI visions that failed to meet expectations. There does, however, seem to be agreement that AI hype-cycle peaks are unusually steep and its descents exceptionally low. In fact, the lows are so low that the AI community refers to them as AI "winters," borrowing the seasonal trope from the Cold War concept of nuclear winter, when life on planet Earth is extinguished by nuclear devastation.[8]

The disparity in dating AI low points—AI winters—is a function of whether an analysis focuses primarily on (1) research funding, (2) breakthroughs or failures in specific AI-based technologies or promises, or (3) performance in the marketplace. While these dynamics are interrelated, their timing is sequential, which explains the dating disparities. For our purposes, (1) funding is most relevant since most early AI research relied heavily on government funding, and its ebbs and flows have immediate impact on AI researchers. This dates the first AI winter to the early 1970s, when mechanical translation, a Cold War priority, was declared a hopeless failure and US government funding dried up. AI research in the UK also declined during

[7] Jackie Fenn, "Understanding Gartner's Hype Cycles, 2007," Gartner Research, July 5, 2007.

[8] Bret Kinsella, "Gartner Hype Cycle Suggests Another AI Winter Could be Near," Voicebot, November 5, 2017.

the same approximate timeframe in response to disappointment in AI's military applications.[9]

[9] Gary Yang, "AI Winter and its Lessons," in *The History of Artificial Intelligence* (University of Washington, 2006).

By the end of the 1970s, however, there were buds on the AI tree again, in the US at least, with excitement about the potential of neural networks: AI modeling based on biological, rather than logical, models of intelligence. Interest peaked in the mid-1980s, but AI's second winter had set in by the early 1990s—and lasted so long that one observer referred to it as a "mini ice age instead of a winter."[10] Artificial intelligence research was not completely abandoned during AI winters, but funding was scarce and researchers tended to avoid the inflated "AI" label, adopting more modest descriptors such as expert systems, machine learning, informatics, pattern recognition, or knowledge-based systems.[11]

[10] Heikki Ailisto, "AI Winter is Coming Unless We Change Course," VTT, July 23, 2019.

[11] Yang, "AI Winter and its Lessons."

The second winter lasted through the 2008 global financial crisis. The past decade has, however, inaugurated a new AI hype cycle with momentum that dwarfs the two previous cycles. Not only are governments heavily investing in AI for strategic and economic purposes, but there have also been large infusions of Silicon Valley wealth and other private investments in AI research and development. Even more significantly, the US and China have entered into a global competition for AI supremacy, comparable to the US-USSR's Cold War space race.[12] The World Economic Forum has also cast AI in a central role in what it is calling the "Fourth Industrial Revolution."[13] In the current hype cycle, "AI is the new gold."[14]

[12] Nicholas Thompson, "The AI Cold War that Threatens Us All," *Wired*, October 23, 2018.

[13] Klaus Schwab, "The Fourth Industrial Revolution: What it Means, How to Respond," World Economic Forum, January 14, 2016.

[14] Andreas Triantafyllopoulos, "Why the Current AI Gold Rush Must Not Fail," Towards Data Science, August 30, 2019.

Fossil Poetry

My original engagement with AI evolved out of a long-standing interest in the sociology and politics of knowledge—in this instance, the human factors that shape scientific knowledge. In the mid-1980s, a number of path-breaking studies of gender and science were published. I followed that early literature closely until the floodgates it opened made it impossible for any single scholar to follow it all.

At the time, I thought artificial intelligence could offer an especially rich resource for studying the social constituents of science because of its future orientation, as well as its departure from the usual protocols of empirical science. That is, AI does not exist in nature. It can't be apprehended by the senses, observed in the wild, or dissected in the laboratory. Rather, AI is a projection of the hopes and dreams of AI researchers.

It is science in a formative stage. The development of artificial intelligence can be studied in real time, unlike so many classic studies in the history and sociology of science, which reach into the past to expose the social factors in the development of science, usually fo-

cusing on discredited or superseded scientific claims. So, artificial intelligence seemed an ideal case study for sociologists of knowledge.

AI was also of interest from another perspective. For four decades, global politics had been organized around the generative metaphor of the Cold War. The 1980s were a transformative period, from *glasnost* to the fall of the Berlin Wall and the demise of the Soviet Union. Change was in the air. Advances in computer technology, including the PC revolution, were also transforming business, as instant international cash transfers became possible. Policy makers and pundits were vying to name this new constellation, to capture its gestalt. The "information age" and "information economy" were gaining traction. If AI could keep its promises, it would be the engine of the future. Because of its resonance within popular culture, references to AI, no matter how vague, seemed to add scientific authority to the ideological thrust of political and economic claims. So the paratexts of AI possessed significant geopolitical relevance in the 1980s, as well as sociological interest, even though "globalization" ultimately won the naming game. Since then, new efforts to fill the void with AI futurism have gained traction.

To summarize, then, during my early studies of AI in the mid-1980s, AI was at the peak of its second hype cycle. My return to the topic in 2000 was at the low point in that cycle, AI's second winter. Today we are at or near the pinnacle of a third cycle. The tenor of the parascientific texts of AI reflect these temporal locations: The hyperbole soars approaching the peaks, and is chastened in the valleys.

Until recently, however, there has been relatively little critical scholarly analysis of artificial intelligence as a social construct and political force. That is now changing, and changing rapidly and dramatically. Writing in 2021, AI scholar Kate Crawford asserted, "A decade ago, the suggestion that there could be a problem of bias in artificial intelligence was unorthodox."[15]

In 1986, when I first broached the subject, it was not just unorthodox. To suggest that AI models might contain social fingerprints approached heresy. There were, however, a few prominent critics of AI's inflated claims, most notably computer scientist Joseph Weizenbaum and philosopher Hubert Dreyfus. Nevertheless, to suggest that AI was *gendered* was beyond the pale, although Weizenbaum seemed to intuit it in his reference to AI modelers as "big children" who have not given up their "sandbox fantasies" or dreams of omnipotence.[16] When he wrote this in 1988, there is no way that his metaphor would have evoked images of "big *girl* children" doing AI research, let alone indulging dreams of omnipotence. Elsewhere, Weizenbaum is unambiguous about the gender of the "unwashed and unshaven" who "are oblivious to their bodies and the world in which they move" and

[15] Kate Crawford, *Atlas of AI* (New Haven: Yale University Press, 2021).

[16] Joseph Weizenbaum, "Not Without Us," *Z Magazine*, January 1988, 94.

"exist, at least when so engaged, only through and for computers."[17]
In a 2006 interview, he explicitly identified the masculinist bias of AI
dreams of omnipotence and accused some AI extremists of "uterus
envy."[18]

I published some of my early work on artificial intelligence and
the information economy; however, these AI studies had almost no
resonance. AI was not yet on the radar of social science research. It
was only on my own radar because, at that time, my life was dis-
proportionately populated by engineers, programmers, and hardline
quantitative social scientists. My many part-time gigs as a gradu-
ate student had included drawing computer flowcharts and editing
field engineers' reports. So I was often immersed in tech talk, with
its instrumental values of parsimony, efficiency, and economy. To
navigate this unfamiliar terrain, I drew on my sociological training
and undertook an informal ethnographic study of the dialect of these
tribes. It sensitized me to tech talk's instrumental strengths as well
as its blindspots. I also worked on survey research projects and took
advanced courses in social science data analysis. As a result, I was
keenly aware of the "extracting and abstracting" processes necessary
to "clean up" survey research data in order to prepare it for com-
puter processing. I had strong reservations about those efforts, as I
suspected that some of the more revealing aspects of human behavior
could be found in the anomalies that the clean-up scrubbed away.

My interest in language had deeper roots. I learned early that sub-
texts are often as important as texts, and sometimes more important.
When I began studying AI, the linguistic turn in the social sciences
was just beginning. So my own approach to discourse analysis in
the 1970s and 1980s drew on an eclectic mix of sources drawn from
social science and the humanities. Ralph Waldo Emerson's descrip-
tion of language as "fossil poetry" and his conception of metaphors
as portals of knowledge also made a strong impression. In addition,
I benefited from the wisdom of my dissertation advisor, Llewelyn
Z. Gross (1914–2014), who studied "socio-logics"—the patterned
reasoning processes in natural languages that formal logic does not
accommodate—from philosophical and sociological perspectives.[19]
Later still, I discovered Lakoff and Johnson's *Metaphors We Live By*
(1980) and *Philosophy in the Flesh* (1999), which affirmed and legit-
imized my intuitive sense that "by their metaphors you shall know
them."[20] In the last thirty years there has been a revolution in the
analysis of conceptual metaphors, based on Lakoff and Johnson's
work, which has transformed thinking about thinking and textual
analysis in many fields.

These were the sensibilities, along with feminist standpoint theory,
that I brought to the analysis of the rhetoric of AI. Add the demo-

[17] Joseph Weizenbaum, *Computer Power and Human Reason* (San Francisco: W.H. Freeman and Company, 1976), 116.

[18] Joseph Weizenbaum, interview by Gunna Wendt, in *Islands in the Cyberstream: Seeking Havens of Reason in a Programmed Society*, trans. Benjamin Fasting-Gray (Sacramento, CA: Litwin Books, 2015), 106.

[19] Llewelyn Z. Gross, "Intellectual Journey," in *Sociological Self-Images*, ed. Irving Louis Horowitz (Beverly Hills, CA: Sage, 1969), 69–90.

[20] George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: Univer-sity of Chicago Press, 1980); Lakoff and Johnson, *Philosophy in the Flesh: The Em-bodied Mind and Its Challenge to Western Thought* (New York: Basic Books, 1999).

graphics of computer science in the 1980s. Unlike the earlier era, when women programmers played key roles in developing the field, computer science had become a boys' club that required round-the-clock devotion in the elite graduate centers—what is now known as living on "Silicon time." Epitomized by the legendary lore of MIT grad students' nocturnal antics, it was common practice to restrict student access to scarce mainframe computer time to late-night hours at most research universities and, more often than not, the atmosphere became hostile to women.

That, in summary, is the background to the essay: (1) the disparate timing of my two periods of AI inquiry—the first in the mid-1980s and the second in the early 2000s; (2) my perception of AI's relevance to the sociologies of knowledge, politics, and gender; and (3) my approach to the study of AI's power-knowledge through the metaphors of its parascientific texts.

Season Three: Return of the Astronauts

Most researchers revisit their early work with trepidation. We frequently encounter the voices of our former selves as alien, shudder at our stale epiphanies, and find perverse comfort in our low readership numbers on Google Scholar. Nonetheless, I went there again in 2021 because references to artificial intelligence suddenly seemed to be everywhere—not just in AI paratexts or science fiction—but in news stories, in international affairs reporting, in radio and television commercials, and in popular culture more generally. It seemed that globalization had been superseded by the AI gold rush.

The mainstreaming of a new, globalized artificial intelligence hype cycle was clearly underway. I assumed AI had finally crossed the long-awaited threshold and had discredited my early skepticism. I took a deep dive into current AI paratexts to catch up on these new developments and, unexpectantly, found myself in familiar territory: similar tropes, the same breathless expectancy, even more extravagant sandbox fantasies. The new buzz is big data—your data, reader, extracted from your online activity. The AI component is pattern recognition, which abstracts and sorts that data. The methods are statistics and probability.

Nonetheless, there has been substantial AI progress since my last visit. Much of that progress centers around developments in what is now known as "weak" or "narrow" AI, which can do specific tasks with far more speed, volume, and efficiency than any human. For example, Amazon's recommendations to users based on their past searches and purchases. There have also been major victories for "strong" AI, too. In 1997, IBM's Deep Blue computer famously beat

world chess champion Gary Kasparov. In 2017, a computer beat the top-ranked player in the game of Go, which is considered infinitely more mathematically complex than chess; it also requires strategizing and trial-and-error machine learning. These AI developments have applications that extend far beyond games. According to artificial intelligence enthusiasts, they move AI closer to passing the Turing Test, the standard for the achievement of artificial intelligence (thinking machines) set in 1950—the point when machines exhibit intelligible behavior that is indistinguishable from human behavior. Some predict that this AI threshold will be crossed before the end of this decade. Others remain resolute in their skepticism.

The emergence of AI skeptics is the real news—and from my perspective, the good news for humankind. If, as Crawford claims, criticism of AI bias was unorthodox a decade ago, it is becoming increasingly mainstream today. When I wrote "What Was Artificial Intelligence?" I had Weizenbaum, Dreyfus, and computer scientist Bill Joy to lean on.[21] Today there is a significant community of critical scholars studying many aspects of the artificial intelligence movement.

[21] All of these sources are discussed and cited in "What Was Artificial Intelligence?"

In a 2000 jeremiad in *Wired* magazine (cited more fully in my essay), Joy, co-founder and chief scientist of Sun Microsystems, warned that the technologies being developed in the twenty-first century—genetics, nanotechnology, and robotics—would be so powerful, accessible, and amenable to abuse that they could pose a greater threat to humankind than the weapons of mass destruction of the twentieth century. He saw the astronautic fantasies of late twentieth-century AI scientists, which called for abandoning an over-populated, contaminated, and warming Earth, in favor of interplanetary colonization—or, alternatively, merging with and becoming robots—as forms of denial that abdicate responsibility for life on earth. Joy pushed the panic button in hopes of initiating public dialogue about techno-futures which, to that point, had been shaped without it, by military strategists, military contractors, scientists, engineers, and by his fellow tech entrepreneurs.

That dialogue now exists and it is not confined to academic conferences, seminars, and computer labs, although robust research agendas are underway in those venues—far too robust to explore here, unfortunately. There is also a vibrant cyber-activist community responding to the surveillance regimes and authoritarianism enabled by digital technologies, working to create more just, equitable, transparent, and accountable forms of digital democracy. International critique and regulation of big tech companies is already well advanced; and the United Nations has made combating gender bias in AI a priority, noting that research has "unambiguously" found gen-

der biases in AI training data sets, algorithms, and devices.[22] Similar racial biases have also been well-documented, including in devices already deployed in policing and criminal justice contexts.

There are, however, very powerful forces aligned against these critical communities, with very deep pockets to fund political campaigns, lobbying, advertising, and public relations, to keep the current AI hype cycle spinning. The twenty-first-century titans of tech are the spiritual grandsons of the big-children-with-a-sandbox fantasies that Weizenbaum described. Unlike their forebears, however, they have the resources to indulge their astronautical fantasies of omnipotence and immortality. They are creating their own space programs, commissioning plans for colonizing the moon, and even exploring the possibility of producing an alternative universe, a virtual reality "metaverse," where the humans left behind can go for fun and games when the physical world becomes too boring or unpleasant. To wit, Jeff Bezos, Elon Musk, and Richard Branson have created their own space programs, and Bill Gates and Mark Zuckerberg are working on creating a "metaverse." Some of these men also generously fund philanthropic initiatives, some to advance their own policy initiatives, but others presumably from altruistic motives. They have many sand pails, but in a democracy, policy is made by representatives of the public, in theory at least to serve the common good.

Most of the new AI critics are not Luddites. They are not pushing to abandon advanced computer research or to retire the robots. They are, however, calling for rejection of artificial intelligence's post-human eschatology, and for replacing it with one that embraces and advances "[a] human form of life [that] is fragile, embodied in mortal flesh, time-limited, and irreproducible *in silico*."[23]

To begin this reclamation of our tools and toys, artificial intelligence critic and policy expert Frank Pasquale calls for replacing the hype of AI with IA, "human intelligence augmentation." He proposes a four-point set of "laws of robotics" to supersede science fiction writer Isaac Asimov's 1942 laws for machines, developed in his short story, "Runaround".

They are:

(i) "Robotic systems and AI should complement professionals, not replace them."
(ii) "Robotic systems and AI should not counterfeit humanity."
(iii) "Robotic systems and AI should not intensify zero-sum arms races."
(iv) "Robotic systems and AI must always indicate the identity of their creator(s), controller(s), and owner(s)."[24]

[22] UNESCO, *Artificial Intelligence and Gender Equality* (Paris: UNESCO, 2020).

[23] Frank Pasquale, *New Laws of Robotics* (Cambridge, MA: Harvard University Press, 2020), 211.

[24] Pasquale, *New Laws of Robotics*, 3–14.

Pasquale is writing from a different temporal and disciplinary location than my essay and he uses different words, but he draws the same conclusion as "What Was Artificial Intelligence?"

Coda

Rereading the 2002 essay, I did not blush. I found it timely, in places even eerily prescient. That is not a brag. It is a testament to the longevity of the hyperbolic mythopoetics of the artificial intelligence movement—from their embryonic inception in Turing's 1950 essay, to their embellishment by the self-proclaimed descendants of Golem, and their inheritance by the present masters of the digital universe. While the essay is of some historical interest, it remains a relevant brief for the kind of humane and inclusive IA that Pasquale and many other critical AI scholars are now seeking.

What Was Artificial Intelligence?

We are all astronauts in this technological age, but the astronautic body of technological functioning there on the launch pad prepared and ready to depart the earth is a masculine figure. And the shadow of the abandoned body, the body left behind, exiled, imprisoned, and enchained, is the figure of the woman.

—Robert D. Romanyshyn, *Technology as Symptom and Dream*, 1989[1]

Prometheus Rebound: Evolving Models of Mind

THE STRONG research program for developing artificial intelligence was a Cold War ideological formation. Describing the artificial intelligence movement in the past tense is an ironic reversal since it always described itself in the future tense. It never fully existed in the present. It was always becoming: its success forever contingent on a next step, a discovery that was just across the frontier of knowledge.

The artificial intelligence movement (AIM) emerged as an identifiable, if not yet organized, approach in the early 1950s. The computer, a technology with a long prehistory, became a reality at the end of World War II. With the subsequent invention of the transistor in 1949, the stage was set for the computer to become the defining technology of the late twentieth century.

Germinal ideas for artificial intelligence (AI) can be traced to separate but related attempts by Pascal and Leibniz to build machines that could calculate and thereby simulate functions of the human mind. The modern conception of artificial intelligence entered into the discourse of computer science with the 1950 publication of Alan Turing's manifesto, "Computing Machinery and Intelligence," which outlined a plan for creating computers that could think: a feat that Turing predicted would be achieved by the year 2000.[2] A two-month-long conference of leading computer scientists in 1956, the Dartmouth Summer Research Project on Artificial Intelligence, marked

[1] Robert Romanyshyn, *Technology as Symptom and Dream* (New York: Routledge, 2003), 171.

[2] Alan M. Turing, "Computing Machinery and Intelligence," *Mind* 59, no. 236 (1950): 455.

the formal emergence of artificial intelligence research as a "movement."[3]

Immediate inspiration for the project was drawn from the work of four generative thinkers of early computing. In addition to Turing, whose 1936 paper "On Computable Numbers" described the theory of, specifications for, and limitations of "logic machines,"[4] they included John von Neumann, who headed the research team that designed and developed the modern, memory-based computer central processing unit (CPU), the computer architecture that is still used today; Norbert Wiener, who envisioned a new science of "cybernetics"; and Claude Shannon, who developed information theory and inspired early interest in the social scientific study of communication. The researchers who actually formed and led the movement to develop AI included, among others, Alan Newell and Herbert Simon, both jointly affiliated with the RAND Corporation and Carnegie Institute of Technology (now Carnegie Mellon University); Marvin Minsky and Seymour Papert of Massachusetts Institute of Technology; and John McCarthy of Dartmouth and later Stanford. Most contemporary AI scientists have studied with one or more of these pioneers.

What brought these men together was a common commitment to move beyond the then-prevalent understanding of computers as mere tools, advanced adding machines which could only do what they were told to do. The dominant view of the time was expressed in the familiar programmer's motto: "garbage in, garbage out." The goal of the AIM was to create computers that could "think" and learn. As Simon put it, the statement that "computers can do only what they are programmed to do is intuitively obvious, indubitably true, and supports none of the implications that are commonly drawn from it."[5] AIM sought to create programs that would simulate the complexity of the human mind. These simulations would, however, amplify human reasoning powers, and would ultimately be more powerful than any single human mind: "It will be a program that analyzes, by some means, its own performance, diagnoses its failures, and makes changes that enhance its future effectiveness."[6]

AIM is now a half century old. Some former enthusiasts speak of it in the past tense: as a self-correcting intellectual movement that has transcended itself by serving as a launchpad to other endeavors.[7] Others conceive of the movement as ongoing, but view its history as made up of two distinctive periods. Various pairings of adjectives have been used to define the shift in emphasis. The first period, in which the "strong," "top-down," or "traditional" approach envisioned by Simon and Newell held sway, extended from the inception of the field to the mid-1980s. The second period of "weak,"

[3] The artificial intelligence movement has been widely chronicled. The brief overview of its history provided here draws primarily on the following sources: David Bolter, *Turing's Man: Western Culture in the Computer Age* (Chapel Hill: University of North Carolina Press, 1984); John L. Casti, *Paradigms Regained* (New York: Harper-Collins, 2000); Douglas R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Random House, 1979); George Johnson, *Machinery of the Mind: Inside the New Science of Artificial Intelligence* (New York: Random House, 1986); and Sherry Turkle, *The Second Self: Computers and the Human Spirit* (New York: Simon & Schuster, 1984).

[4] Alan M. Turing, "On Computable Numbers, with an Application to the *Entscheidungsproblem*," *Journal of Math* 58 (1936).

[5] Johnson, *Machinery of the Mind*, 37.

[6] Johnson, *Machinery of the Mind*, 37.

[7] Sherry Turkle, who has extensively chronicled the computer culture at MIT, reports, "Mainstream computer researchers no longer aspire to program intelligence into computers but expect intelligence to emerge from the interactions of small sub programs." That is, scientists are no longer seeking to

"bottoms-up," "emergent," or "new wave" approaches emerged in the mid-1980s. The bottoms-up approach does continue some of the research program launched by the older, top-down tradition—for example, developing expert systems, robotics, and other commercial applications of AI. What marks the new wave as distinctive, however, is the reconfiguration of the metaphoric definitions of the field of inquiry. Logico-mathematical models give way to or merge with bio-logical metaphors, as the research goal is reconceived as the creation of artificial life ("A-life") rather than artificial intelligence.[8]

The top-down approach focuses on patterns and rules operating at the high level, symbol-processing structures of the brain, while ignor-ing its lower-level physical processes. The bottoms-up approach was a reaction against the failure of the top-down approach to produce significant results after more than thirty years of research. Whereas the top-down approach ignored biology, the bottoms-up approach took the position that the physical structure of the brain may account for its cognitive capacities. The bottoms-up approach seeks to de-sign computing devices that mimic the structure of the brain's neural networks: that is, devices modeled on child development which can observe and learn.[9] This approach is also known as "connectionism" and is encompassed under the broad umbrella of the "new sciences of complexity."[10] Some chroniclers of the history of AI see the publi-cation of Minsky's *The Society of Mind* (1987) as the benchmark; some date it to a conference on A-Life in 1987.[11] Most regard it as a more gradual shift away from the original vision: an evolutionary shift rather than a revolutionary displacement of paradigms.

While the top-down versus bottoms-up distinction is useful for explaining the internal history of AI, it is already in some ways an arcane and, in the current fast-paced environment of technological change, archaic distinction. The end of the Cold War triggered a re-structuring of big science that was far more rapid, pervasive, and, by its own measures, much more successful than even the movers and shakers of this transformation anticipated in their most optimistic projections. The new research and development model streamlined and mainstreamed the old defense model for research and develop-ment by creating new, comprehensive partnerships of government, university, and corporate research and development initiatives—a model the Japanese had pioneered, to the dismay of the US govern-ment, in the 1970s and 1980s. Computer science and technologies, genetics, and bioengineering have been the leading edges of this new technological initiative; and commercialization of these fields fueled the unparalleled growth of US stock markets during the 1990s. The infusion of corporate capital has produced rapid advances in computer networking, robotics, and nanotechnologies that have tran-

produce AI but rather AL (artificial life). The A-Life movement builds on the work of emergent AI research: a tradition that had been abandoned in the 1960s, but was rejuvenated by the shift to the bottoms-up tradition of AI. See Sherry Turkle, *Life on the Screen: Identity in the Age of the Internet* (New York: Simon & Schuster, 1995), 20.

[8] I use Casti's shorthand terminology, top-down and bottoms-up, through-out rather than Turkle's AI and A-Life distinction, even though I am tempted by the greater drama of Turkle's terms. Casti's terms are cleaner and, in the case of bottoms-up, more encompass-ing. See Casti, *Paradigms Regained*. See also Hofstadter, *Gödel, Escher, Bach*; and Johnson, *Machinery of the Mind*.

[9] Casti, *Paradigms Regained*.

[10] Heinz Pagels, *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity* (New York: Simon & Schuster, 1988).
[11] Marvin Minsky, *Society of Mind* (New York: Simon & Schuster, 1987). See also Turkle, *Life on the Screen*.

scended AI without leaving it behind. Some of the leading AI scientists and all of the sites that housed leading AI laboratories continue to be key players in the creation of the scientific and technological infrastructure of the information economy. It is not too much of a stretch to say that many of the technovisions that were incubated in AI laboratories have been mainstreamed into our brave new info world. Just a decade ago, the utopian and dystopic projections of AI manifestos seemed unbelievable, woolly-headed sci-fi fantasies. Now, we are building the global infrastructure that supports them.

The rise and fall of the "strong" artificial intelligence program roughly parallels the duration of the academic careers of the founding generation, although Minsky, who was a graduate student when he participated in the formative Dartmouth summer project, serves as a bridging figure. Its rise and decline also appears to coincide with the influence of the unity of science movement, of which it was part. The funding and fate of top-down AI were closely tied to the duration of the Cold War, with the bottoms-up transitional period coinciding with the US government's expansion of its defense funding priorities to include economic "competitiveness." The competitiveness thrust created the preconditions for jump-starting the information economy by underwriting the so-called greening of artificial intelligence: the period when entrepreneurial AI scientists began aggressively promoting the commercial applications of their work, sometimes to the dismay of more idealistic AI founders like John McCarthy.[12]

[12] Johnson, *Machinery of the Mind.*

Pure Science and the Cold War

Like virtually all university-based computer science research during the Cold War, AI research was funded by the Department of Defense's Advanced Research Projects Agency (ARPA). Therefore, it was a player in the arms race with the Soviet Union and later the "competitiveness" race with Japan. Taken at face value, it was not a very effective player. In fact, it might have been viewed as an academic boondoggle: a metaphoric equivalent of a $7,000 Pentagon hammer. But taking AIM at face value grossly underestimates its accomplishments. Scientists associated with the movement made definitive contributions to the development of robotics and expert systems, which have had significant military and commercial applications. Top-down AI was also a very successful learning experience that taught scientists a great deal about the complexity of the brain and thereby provided the impetus for the development of what would become a new branch of psychology: cognitive science.

Artificial intelligence was part cover story as well as an important part of the real story of the early development of computer science. It leveraged the spectacular successes of the generation of Turing, von Neumann, Wiener, and Shannon, whose work had been supported by unlimited wartime resources, into an equally ambitious ongoing program for basic research in computer science. "Basic" and "pure" were crucial adjectives for naming and claiming significant degrees of intellectual autonomy for government-funded research during the Cold War. The terms referred to research that did not have immediately apparent instrumental applications: for example, developing a computerized chess game that was smart enough to defeat the world's top chess champions and thereby pass the Turing test for intelligence. This relative non-instrumentality was, of course, very instrumental to the research programs and careers of computer scientists.

"Basic" still retains some of this patina in scientific grantsmanship. "Pure" was, however, a crucial descriptor in the ideological and institutional struggles of the early Cold War period. Scientists, who chased defense dollars, professed their purity to try to fend off charges of scientific prostitution in the days when the government's growing presence in the funding of private universities was unsettling to many in the academy. The unsettled ranged from traditionalists, who wanted to preserve the relative insularity (*cum* purity) of the ivory tower, to liberals and leftists, critical of the Cold War policy and of threats to intellectual freedom posed by what President Eisenhower called "the military-industrial complex."[13]

When I use the term "pure" here, I am not suggesting a pristine practice free of social and political influences and interests. To the contrary, I treat it as a strategic, ideological stance that artificial intelligence and other scientists used during the Cold War to justify their dual careers as defense researchers and academics. The ideology of pure science also sometimes served as a temporary safe harbor during a politically complex and compromising era: the dark period of US government interrogations and purges of academics, intellectuals, writers, and other culture workers by the House Un-American Activities Committee and by Senator Joseph McCarthy.

Scientists doing defense work were, by definition, always under intense scrutiny as potential national security risks. Much of their work was classified and only accessible to those with government security clearances. In those days, the purer the science, the safer the scientist. I am not, however, suggesting that the scientists who embraced the sanctity of pure science were cynics, liars, propagandists, or scientific prostitutes, although some individual scientists may have been. Rather, I am saying that pure science was an ideal, an aspiration that

[13] For a chronicle of how the Cold War climate impacted university life in a variety of disciplines, as seen from left and liberal perspectives, see David Montgomery et al., *The Cold War and The University: Toward an Intellectual History of the Postwar Years* (New York: New Press, 1997).

had pragmatic as well as intellectual resonance. Like all potent ideological formations, it was a complex and fluid construct, part truth, part self-serving shield; it was a tool of power that could sometimes be used to hold the powerful accountable.

The technovisions that now support the growth of the domestic US economy and its globalizing thrust are inspired to a significant degree by the achievements of the pure and impure sciences of AIM.[14] Although some influential figures associated with AIM are now uncharacteristically modest about their achievements, and, it would seem, almost eager to acknowledge their "failures," the distance from the AI laboratories to the information economy is small. In fact, in some instances, it is just across the threshold: that much-vaunted next step. Both figuratively and literally, it is a step, sometimes direct, sometimes faltering, from publicly funded military research to publicly and privately supported applications of digital technologies, including the internet. "Convergence," the hot techno buzzword of the 1990s, is being actualized in this century as a reengineering of society as well as technology.[15]

The significance of this reengineering is profoundly transformative. An Wang, founder of Wang computers, maintained, "The digitalization of information in all of its forms will probably be known as the most fascinating development of the twentieth century."[16] Ivan Illich underscored the revolutionary structural changes that digitization is bringing about. Conceiving of computers as agents of a new enclosure movement, he warns that computers "are doing to communications what fences did to pastures and cars did to streets."[17] In short, the digital revolution marks a deep structural shift in how we think, what we think about, how we communicate, how we relate to the material world and to one another, how we organize our work, and how we construct communities.

CONTEXT AND LIMITS OF THIS CHAPTER

The purpose of this chapter is not to assess the successes or failures of AI science as science. That is beyond my expertise. My goal is much more modest: to explore the rhetoric and mythopoetics of the parascientific discourse of artificial intelligence scientists. By parascientific discourse, I mean the programmatic descriptions, manifestos, and interviews that artificial intelligence scientists have used to explain what they think they are doing when they do AI science.

This paradiscourse might be conceived as functioning in academic science in the way that mission statements function in the corporate world. Both articulate the values, means, goals, and hopes of their enterprises. Like corporate mission statements, parascientific state-

[14] Many of the same cutting-edge AI scientists interviewed by Turkle and Grant Fjermedal in the 1980s are the same cutting-edge computer scientists that Bill Joy, a cutting-edge corporate scientist, interviewed for his current work on scientific futures. See Turkle, *The Second Self*; Grant Fjermedal, *The Tomorrow Makers* (New York: Macmillan, 1986); Bill Joy, "Why the Future Doesn't Need Us," *Wired*, April 2000.

[15] Robert W. McChesney notes the migration of this term in *Corporate Media and the Threat to Democracy* (New York: Seven Stories, 1997).

[16] An Wang quoted in Tom Forester, *High-Tech Society: The Story of the Information Technology Revolution* (Oxford: Basil Blackwell, 1987), 1.

[17] Ivan Illich, "Silence is a Commons," *CoEvolution Quarterly* 40 (1983): 5. The analogy to the enclosure movement that Illich embraces has had currency in communications since the 1980s. More recently, and apparently independently, the trope has gained currency among legal scholars. For a summary of this work, see James Boyle, "Fencing off Ideas: Enclosure and the Disappearance of the Public Domain," *Daedalus* 131, no. 2 (2002).

ments are, in a special sense, also public relations efforts. That is, they are purposively constructed to cultivate and promote positive perceptions; in the case of the parascientific discourse of AI, the intended audience appears to be other scientists, potential government and private sponsors, science buffs, and the general public. During the heyday of top-down AI, the forefathers and the founders of AI functioned as the practical philosophers of computer science; their influence was not limited to AI practitioners.

The rhetoric of the parascientific discourses of the artificial intelligence movement is remarkable on a number of counts. It does not use the flat, carefully measured language that experts on scientific writing recommend. To the contrary, it is frequently provocative and hyperbolic. Aphorisms, puns, and slogans are common, as are learned allusions to philosophy, literature, art, and music. Intrinsically interesting numerical and visual puzzles and paradoxes are often used to illustrate points, and, I suspect, to engage and entertain readers who cannot fully follow or who might be bored by the accompanying technical explanations. Self-deprecating modesty and humor are sometimes deployed, but they are usually accompanied by dissembling winks. Expressions of self-doubt are, however, hard to find. Normally, authorial voices that aggressively flaunt their superiority, even hubris, disturb and alienate readers; however, in the parascientific discourse of AI, this mode of address functions as a seductive hook. It uses inclusive pronouns and generous displays of encompassing "of course" constructions to flatter readers. It models readers as peers, colleagues, knowing and supportive companions; if readers take the hook, this mode of address seems to say that they too will be admitted to Mount Olympus where they will also see like gods and be like gods (or astronauts). Some AI spokesmen have spent most of their careers modeling natural language; they are acutely aware of how languages work, and how irony, poetry, and Aesopean indirection resist, mislead, and charm AI modeling attempts. And some of these men are very adept at using these tropes to engage readers. For example, Minsky's discussion of metaphor is cutting-edge post-structuralism, but it has been cleanly shaven into clear, concise, and easily accessible prose.[18] When these writers use synecdoche, they mean it: For Minsky, mind is a "society." Top-downers are prone to what bottom-upper Douglas Hofstadter refers to as " 'Buck Rogers' fantasies."[19] Some of these fantasies are presented in whimsically engaging prose, prefaced by almost childlike "what ifs." Most of the writing is artful. A few authors need to be taken seriously as writers as well as thinkers: Hofstadter won a Pulitzer Prize for his remarkable book *Gödel, Escher, Bach* (1979). Clever, arrogant, self-serving, engaging, propagandistic, literate,

[18] Minsky, *Society of Mind*.

[19] Hofstadter, *Gödel, Escher, Bach*, 601.

playful, often facile, occasionally profound, sometimes outrageous, and usually interesting, the parascientific discourse of AIM inspires believers and incenses critics.

While parascientific texts are clearly intended as a form of scientific outreach, frequently even proselytization, nonscientists are not encouraged to critically interrogate them. The late Isaac Asimov, who is regarded as the patron saint of "robotic ethics" by the AI community, celebrated this resistance to external criticism of science in "Every Real Problem Can and Will Be Solved":

> I'm a great one for iconoclasm. Given half a chance, I love to say something shattering about some revered institution, and wax sarcastically cynical about Mother's Day or apple pie or baseball. Naturally, though, I draw the line at having people say nasty things about institutions I personally revere. Like Science and Scientist, for instance (Capital S, you'll notice).[20]

Parascientific discourse is frequently treated with the same reverence as science. Where in traditional (preconstructivist) philosophies of science, the scientist is seen as a kind of miner who goes off and discovers precious ore, the parascientific writer, even the nonscientists among them, seem to see themselves as sharing the charisma of scientific discovery.[21] They go off and mine the texts and the talk of scientists, translate what they find into reader-friendly language, and then offer to share that precious metal with readers. Sociological analysis and rhetorical criticism seems to be all but proscribed.[22]

Turing himself imputed theological and philosophical significance to AI modeling; as a result, philosophers, unlike sociologists, have been part of AI paradiscourse almost since its inception. They have extensively criticized the ontological, logical, and linguistic assumptions of the models of mind proposed by top-down AI scientists; see, for example, Dreyfus, Searle, Boden, Collins, and Pemose.[23] Elsewhere, I explored some of the ways that the logical structures of top-down AI models incorporate gendered assumptions.[24] See, for example, the comparisons and conflations of Maruyama's concept of "classificatory information" and Gilligan's typification of masculine modes of decision-making, or "morality of rules."

My purpose here is not to reiterate the philosophical critiques, but rather to use some of their scaffolding as support for investigating some of the underexamined social constituents of the AI project. These constituents include the gendering of the language and assumptions of AI paradiscourse, and, to a lesser extent, the historically specific Cold War social formations of that gendered language—for example, doomsday thinking.[25]

AIM is an especially rich and unusually accessible site for excavating the poetry in the paradigms of scientific thought. The nature of

[20] Isaac Asimov, "Every Real Problem Can and Will Be Solved," in *2,500 Years of Science Writing*, ed. Edmund Blarr Bolles (New York: W. H. Freeman, 1999), 5–6.

[21] George Johnson points out, "In our society, we make a distinction between the history of science and the history of everything else." Within this proscription, only scientists are empowered to criticize science. Science writers, who assume the role of interpreters within the boundaries of this proscription, appear to share its protections. See Johnson, *Fire in the Mind: Science, Faith, and the Search for Order* (New York: Random House, 1996), 5.

[22] For an example of this proscription at work, see the hierarchical framing of references to (e.g., "down among the sociologists") and expressions of contempt for sociologists (Edinburgh constructivists) who presume to question science, in Paul K. Gross and Norman Levitt, *Higher Superstition: The Academic Left and its Quarrels with Science* (Baltimore: Johns Hopkins University Press, 1994).

[23] Hubert L. Dreyfus, *What Computers Can't Do: A Critique of Artificial Reason* (New York: Harper & Row, 1979); Hubert L. Dreyfus, *What Computers Still Can't Do* (Cambridge, MA: MIT Press, 1992); John Searle, *Intentionality: An Essay in the Philosophy of Mind* (Cambridge: Cambridge University Press, 1983); Margaret A. Boden, *Computer Models of Mind* (Cambridge: Cambridge University Press, 1988); and Harry M. Collins, *Artificial Experts: Social Knowledge and Intelligent Machines* (Cambridge, MA: MIT Press, 1993).

the AI project itself, simulating or modeling minds, forced artificial intelligence scientists to consciously reflect upon the godlike roles they were playing in daring to try to create artificial life. It also required them to carefully weigh the qualities of the human mind they wanted to incorporate in their models and the qualities they wanted to leave behind.

AI science is unusual—an extreme case—in the history of Western science's long struggle with dualism. As a mind modeling mind, the artificial intelligence scientist is both subject and object: the observer and the observed.[26] He cannot deny his agency. Unlike other forms of scientific discourse, which attempt to erase all social fingerprints from scientific reason, artificial intelligence scientists recognize that their fingerprints are indelible. Some even seem to celebrate their presence: to engage in conscious myth-making about the significance of their work. For these reasons, the extreme case is also an ideal case for exploring the mythopoetics of scientific vision.

AI scientists have spoken very freely and often quite extravagantly about their roles as modelers and about the qualities of their models. During World War II, women played substantial roles in wartime computing; however, nearly all artificial intelligence scientists during the Cold War era were men. They formed the so-called nerd or, until it became a pejorative term, hacker masculine subcultures of elite science and engineering schools; it is therefore not surprising that the AI manifesto writers are all male.

Indeed the subworld of pre-PC academic and scientific computing was perhaps the purest post-World War II articulation of the monastic culture of science so painstakingly documented by David Noble in his underappreciated but groundbreaking contribution to both the history of science and the feminist critique of science, *A World Without Women: The Christian Clerical Culture of Western Science* (1992).[27] The nature of early computer technology and the rigid gender socialization of the Cold War era combined to make the subworlds of serious academic and scientific computing an exclusively male preserve. Use of mainframe computers was based on time-sharing. Typically, by day the mainframe did the routine business of the university, its instructional and administrative tasks, and perhaps some of the work of senior researchers. By night, computer centers belonged to engineering and computer science graduate students, who basically lined up to run, then debug, then re-run the complex programs that demanded a lot of the computer's time and memory. These graduate students, who attended and taught classes by day, did their real work in and near the computer labs by night. Within the computer subculture, the mainframe was referred to as God, who determined the life (a successful run) or death (a glitch that needed debugging) of programs.

[24] Sue Curry Jansen, "Is Information Gendered?" in *Critical Communication Theory: Power, Media, Gender, and Technology* (Lanham, MD: Rowman & Littlefield, 2002). See also Jansen, "The Ghost in the Machine: Artificial Intelligence and Gendered Thought Patterns," *Resources for Feminist Research/Documentation sur la recherche feministe* 17, no. 4 (1988): 4–7.

[25] Cynthia Enloe, *The Morning After: Sexual Politics at the End of the Cold War* (Berkeley: University of California Press, 1993).

[26] Hofstadter, *Gödel, Escher, Bach.* From the beginning, AI theorists were aware of this conundrum, but Hofstadter explores its implications with stunning virtuosity.

[27] David F. Nobel, *A World Without Women: The Christian Clerical Culture of Western Science* (New York: Alfred A. Knopf, 1992).

The lumbering technology of the machines themselves demanded a kind of de facto near-equivalent of a vow of celibacy from their supplicants. They were expected to demonstrate their seriousness by periodically eating, sleeping, and socializing in the building that housed the computer. The overachievers, the nerds and hackers, virtually lived in and for the nighttime worlds of the labs. Like most all-male subcultures, this one had a dark underside in which male bonding was frequently mediated by shared misogynist and re-pressed homoerotic fantasies, jokes, and storytelling. Technology itself is sometimes eroticized within the subcultures of elite science, creating a kind of technoporn "that rouses prurient interest, demeans the powerless, eroticizes domination," and sets up boundaries that signal they are off-limits to women and other outsiders.[28]

My analysis opens a rather narrow window onto that masculine subculture by exploring the mythopoetics of the technovisions of AI. It also examines the anxious image of masculinity that accompanies the generative metaphors that animate these visions.

Dreams of Reason: When Dreamers Dream They Are Dreaming, Are They Awake?

Working largely independently of each other, constructivist and feminist analyses of science have exposed the fiction of "pure" science.[29] They have established that science, like other noble and ignoble human enterprises, is the work of mortal men and women, not of gods. Science is a social and cultural practice, which supports some of humankind's highest aspirations to and achievements of excellence.

Until the twentieth century—and then only in atypical cases, for example Heisenberg's physics, Gödel's Theorem, and AI modeling—science has been a practice that has been secured in denial of its own nature.[30] This denial has been deftly concealed and papered over for centuries by official histories and laundered origin stories. Anchored in the Western mind-body dualism, this denial makes doing science an "out-of-body experience." The scientist seeks domination over nature by denying, implicitly or explicitly, that he is part of nature. His pretense to objectivity is maintained by detaching his mind from his body and the world, and by denying his mortality. This stance allows the scientist to believe that he is spying on the world from afar: viewing it dispassionately through God's eyes or through the eyes of an astronaut. The gendering of the pronouns in this paragraph is conscious and purposeful, for in Western culture this kind of disembodied Promethean objectivity has been a masculinist preserve and privilege. Within its assumptions, woman has been conceived as part

[28] Sally Hacker, "The Eye of the Beholder: An Essay on Technology and Eroticism," in *Doing it the Hard Way: Investigations of Gender and Technology*, ed. (posthumously) Dorothy E. Smith and Susan M. Turner (Boston: Unwin Hyman, 1990), 214.

[29] These perspectives were pioneered by sociologists associated with the Edinburgh School as well as by feminist scholars Dorothy Merchant, Donna Haraway, Ruth Hubbard, Evelyn Fox Keller, Sandra Harding, and many others. See David Bloor, *Knowledge and Social Imagery* (London: Routledge & Kegan Paul, 1977); Donna Haraway, "A Manifesto for Cyborgs," *Socialist Review* 80 (1985); Sandra Harding, *The Science Question in Feminism* (Ithaca, NY: Cornell University Press, 1986); Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven, CT: Yale University Press, 1985); and Carolyn Merchant, *The Death of Nature: Women, Ecology and The Scientific Revolution* (New York: Harper & Row, 1985).

[30] Hofstadter, *Gödel, Escher, Bach.*

of nature, as "the sex," and always embodied. In his *Sixth Meditation*, René Descartes provides the definitive articulation of this (masculine) stance when he asserts, "I am truly distinct from my body, and . . . I can exist without it."[31]

AI's positioning vis-a-vis the mind-body problem is shot through with contradiction. On the one hand, the Cartesian flight from embodiment and materialism reaches one of its clearest and most thorough articulations in the visionary statements of AIM, because the computer is "the embodiment of the world as the logician would like it to be," not as it is.[32] The goal of the AI scientist is to release mind from body: to download its contents into programs. On the other hand, however, AI and the new sciences of complexity are futuristic visions: "dreams of reason." They are exercises of scientific imagination rather than faithful codings of empirical reality. The dreamers know they are dreaming: They are not in denial about that.

They simultaneously share and surrender the Cartesian dream of pure reason, of a "Promethean flight from embodiment," to borrow Susan Bordo's words.[33] Their top-down struggle to release mind from body has, in the course of the history of AI research, paradoxically pulled AI researchers back to biology. It is the body, the human biological system, with its brain, nervous system, nerve endings, and mercurial emotional apparatus, that weighs so heavily against AI and keeps its flight grounded. The more successful AI scientists are in advancing the Promethean dream, the more the model comes to resemble what they want to escape. From a bottoms-up perspective, Hofstadter describes the paradox that locks the AI scientist in a recursive loop: "[A]ll intelligences are just variations on a single theme: to create true intelligence, AI workers will just have to keep pushing to ever lower levels, closer and closer to brain mechanisms, if they wish their machines to attain the capacities which we have."[34] The better the bottoms-up machines get, the slower they will get. The microworlds of the bottoms-up dream are the complete antithesis of the Buck Rogerian top-down supercomputer.

The resulting discourse is, understandably, profoundly ambivalent about embodiment. The body is the enemy as well as the portal to knowledge that can transcend the body. In the Buck Rogers versions of the dream, the program becomes the spaceship that allows the AI scientist-astronaut to escape from the enemy (e.g., the body, woman, morality, or nuclear annihilation). The scientist moves into another dimension, no longer human or embodied. The best of what he has to offer survives in this new dimension. In Hofstadter's scenario, however, the scientist assumes a Zen-like stance and learns to live with, even savor, the intellectual and aesthetic pleasures of contradiction. He faces the paradox of the recursive loop head-on

[31] For a discussion of the Cartesian principle in relation to the sciences of complexity, regarding the bottoms-up approach, see Pagels, *The Dreams of Reason.*

[32] Bolter, *Turing's Man,* 73.

[33] Susan Bordo, *The Flight to Objectivity: Essays on Cartesianism and Culture* (Albany: State University of New York Press, 1987).

[34] Hofstadter, *Gödel, Escher, Bach,* 579.

and demonstrates the intellectual and aesthetic pleasures of life lived on its rim.[35]

[35] Hofstadter, *Gödel, Escher, Bach*.

Whether Hofstadter's version marks the end of AIM, the point where it transcends itself and mutates into the new sciences of complexity, or whether it marks AI's rebirth as a mature research program, may still be an open question. He describes the top-down approach as over—"Retrospects"—and the bottoms-up perspective in the future tense—"Prospects." These prospects are based on wholism rather than on reductionism, in computerese, parallel processing units and neural nets: "[M]any trains moving simultaneously down many parallel and crisscrossing tracks, their cars being pushed and pulled, attached and detached, switched from track to track by a myriad neural shunting-engines."[36]

[36] Hofstadter, *Gödel, Escher, Bach*, 623.

The Poetry in the Paradigms

Like Descartes and Boyle, AI researchers embrace mechanical metaphors of mind. They conceive of mind as machine: a computer, a grid of electrical relay switches, "many trains moving simultaneously," and so on. While some, like Turing, acknowledge the limitations of this conception within AI parascientific discourse and top-down AI modeling, the "program" is a metonymic surrogate for intelligence. AI constructs computer models of operations of mind by reducing its cognitive and biological processes to machine-recognizable inputs. AI modelers assume that all interesting manifestations of intelligence can be "captured" and "contained within" programs.[37] According to one journalistic chronicler of AI, some AI modelers even believe it is possible to precisely quantify and program the "odd little chemical electrical cloud of activity that is our personality."[38]

[37] Minsky, *Society of Mind*.

[38] Fjermedal, *The Tomorrow Makers*, 7.

Metaphors are usually thought of as tools of humanists, not scientists. The eighteenth-century English poet William Wordsworth was apparently the first thinker to argue that poets and scientists share similar relationships to nature, even though their languages differ. The scientist uses Royal Academy prose and the poet uses meter to interpret nature.[39] Both approach the unknown through the portals of the known, and scientist, no less than poet, uses analogies to construct bridges between the two. Although scientists from Francis Bacon to the present wish it were not so, the bridges the scientist builds between the familiar and the mysterious, like the poet's spans, are constructed of bricks baked in the cultural and linguistic kilns of historical time.

[39] Hugh Kenner, *The Mechanic Muse* (New York: Oxford University Press, 1987).

Scientific vision, like poetic vision, is expressed most palpably through metaphors. The metaphors used by scientists are not, however, incidental to the scientific enterprise. To the contrary, they em-

power scientific vision; they provide the scaffolding for arguments, color the language of assertion, and guide inquiry. Indeed, Richard Dawkins claims, "Skill in wielding metaphors and symbols is one of the hallmarks of scientific genius."[40] In short, they are the magic carpets that make science possible.[41]

Metaphors are not, however, all that make science possible. Mathematics formalizes and refines scientific vision; instrumentation amplifies and standardizes it; and systematic, repetitive, and controlled observation tests its reliability. Yes, metaphors lurk within and enable these practices too—like Gödel's Theorem, reminding us of the limits of all human knowledge. But lost at sea, who amongst us would not rather have a compass than a sonnet? Science has demonstrated its potency in practice. Studies in the history, philosophy, and sociology of science have nonetheless firmly established that metaphors are a necessary, though far from sufficient, component of scientific thought. Bacon was right! They are also mischief-makers that smuggle "the idols of the tribe" into science.[42] This mischief does not negate or invalidate scientific claims, but it does humanize them.

Social constructivist unpackings of the poetry in the paradigms have knit many scientific brows into exasperated consternation. But mythology! What are scientists to make of it? Hofstadter would probably advise art, music, or some more science; and he would be right. Mythology is a testament to human aspirations, not just a graveyard of human fallacies and foolishness. We are all, in some sense, poets, although there are very few Wordsworths, Shakespeares, Byrons, Bacons, Turings, or von Neumanns among us.[43] All of our poetry, including the poetry of science is, however, a record of what humans value, aspire to, and fear.

The Enlightenment cast scientists in the role of supermen. In its cosmology, nature displaced God as first principle; the scientist replaced the priest as authoritative interpreter of the reality. Scientists were expected to see with the eyes of gods and to be nature's ventriloquists. The voice of scientific reason was conceived—impossibly—as the unmediated and therefore objective voice of nature. Scientific instrumentation and calculations created and preserved this construction of objectivity, which did, in fact, prove to be an extraordinarily productive way of interpreting and imputing patterns to nature. In short, the Kantian trick usually worked.[44]

In making their daring claims at the height of the Inquisition, the members of the Royal Society not only risked the wrath of the God (if they were wrong) but the swords of inquisitors (if they were right). To weather the fury of the storm, fear was repressed in the tough-minded, even macho, Baconian vision of the masculine future of science. It was a brave vision that took modern science far. Like

[40] Richard Dawkins, *Unweaving the Rainbow: Science, Delusion, and the Appetite for Wonder* (Boston: Houghton Mifflin, 1998), 186.

[41] Mary Hesse, *Models and Analogies in Science* (South Bend, IN: University of Notre Dame Press, 1966); Bloor, *Knowledge and Social Imagery*; and Richard Rorty, "The Contingency of Language," *London Review of Books* 17, April 17, 1986.

[42] Bacon recognized that language contaminated the purity of science and longed for a purely scientific language, which would be culture-free. Most practicing scientists have, however, bracketed the problem of language and reported their results as if language were a neutral instrument.

[43] George Lakoff has exhaustively explored the role metaphor plays in making ordinary language and thought possible. See George Lakoff and Mark Turner, *More than Cool Reason: A Field Guide to Poetic Metaphor* (Chicago: University of Chicago Press, 1989). See also George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: University of Chicago Press, 1981); George Lakoff and Mark Johnson, *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought* (New York: Basic Books, 1999); and George Lakoff, *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind* (Chicago: University of Chicago Press, 1981).

[44] That is, at least at the level of empirical science, there appeared to be consonance in the patterns scientists discovered in or imputed to nature and the patterns perceived or constructed by the human mind.

most brave visions, however, its monological and monovocal structure and resonance left their imprimatur on both the vision and the visionaries.

Fear is, of course, a proscribed emotion for men in the West (perhaps for men everywhere); if they have it, they are supposed to repress it. Repressed sentiments and ideas do, however, have a habit of returning; mythology is a primary staging ground for this return. Male fear seems almost to be the axis upon which modern science has turned; and the momentum generated by this axis has been simultaneously constructive and destructive to the species and the planet. For example, scientists did not seek to understand natural disasters just because they posed interesting scientific problems. Well-warranted fear, as much or more than cool-headed rationality, provided the momentum for the quest for scientific predictability and control. Earthquakes, hurricanes, volcanic eruptions, fires, floods, deadly diseases, nuclear explosions, and, yes, women have variously terrified many scientists as well as fascinated them. Not surprisingly, both terror and fascination are encoded in the mythopoetics of scientific thought.

Metaphors and Minds

Metaphors based upon images of sexual relations and reproduction are both common and deeply embedded in the discourses of Western science and culture.[45] Bacon himself incorporated them in the foundation documents of modern science, including his fragmentary *The Masculine Birth of Time* (1602 or 1603).[46] These metaphors place the scientist in a hierarchical relationship of domination and control of nature.[47] Within the mythopoetics of computer scientists, reproductive metaphors occupy a much more prominent position than copulative imagery, although the latter are invoked in predictable ways to represent inputs, circuitry, and connections.

Images of male birthing have been a common motif (even, for those so inclined, a Jungian archetype) of Western origin stories—for example, Zeus giving birth to Athene from his head and God creating Eve from Adam's rib. Lionel Tiger claims rites of male bonding are "the male equivalent of child reproduction, which is related to work, defense, politics, and perhaps even the violent mastery and destruction of others."[48] Brian Easlea makes a similar point when he asserts:

> Men in prescientific societies, it may be generally argued, attempt to affirm masculine and, for them therefore, dominant status through secret exclusively male rituals. Quite often these rituals have a very direct "pregnant phallus" aspect to them, the male participants thereby

[45] Such understandings of generative metaphors are shared by nonfeminists as well as feminists. See, for example, Arthur Koestler, *The Act of Creation* (New York: Macmillan, 1967); Simone de Beauvoir, *The Second Sex* (New York: Vintage Books, 1974); Susan Stanford Friedman, "Creativity and the Childbirth Metaphor," *Feminist Studies* 13, no. 1 (1987); and Evelyn Fox Keller, *Reflections on Gender and Science*.

[46] Merchant, *The Death of Nature*; and Keller, *Reflections on Gender and Science*.

[47] Merchant, *The Death of Nature*; Keller, *Reflections on Gender and Science*; Harding, *The Science Question in Feminism*; and Theodore Roszak, *The Gendered Atom: Reflections on the Sexual Psychology of Science* (Berkeley, CA: Conari Press, 1999).

[48] Lionel Tiger, *Men in Groups* (New York: Random House, 1969).

demonstrating that through their special phallic powers they, like women, are able to give birth.[49]

[49] Brian Easlea, *Fathering the Unthinkable* (London: Pluto, 1983), 17.

Both Easlea and Evelyn Fox Keller demonstrate the continuing presence of the images of the "pregnant phallus" in the mythopoetics of contemporary science.[50]

[50] Easlea, *Fathering the Unthinkable*; and Keller, *Reflections on Gender and Science.*

Birth is the primary (perhaps even primal) source of most of the poetry in the paradigms of computer science. Computers are the sites of the generative process. They are, in the words of AI scientists Roger Schank and Harold Abelson, "omnipotent"; Schank and Robert Abelson describe them as "god."[51] They are also incubators, (male) wombs that are conceived as mediums for generating new forms of life. According to David Gelernter, these incubators will soon produce "mirror worlds": You will be able to look into a "genie bottle on your desk" and see "reality." Computers will soon become "crystal balls, telescopes, stained glass windows—wine, poetry or whatever—things that make you see vividly." They will put "the universe in a shoebox." Why? Because "[a] bottled institution cannot intimidate, confound or ignore its members; *they dominate it*" (emphasis in original).[52]

[51] Roger C. Schank and Robert P. Abelson, *Scripts, Plans, Goals and Understandings: An Inquiry into Human Knowledge Structures* (Mahwah, NJ: Lawrence Erlbaum Associates, 1977).

[52] David Gelernter, *Mirror Worlds or the Day Software Puts the Universe in a Shoebox . . . How it Will Happen and What it Will Mean* (New York: Oxford University Press, 1991), 1.

The virility and reproductive prowess of computers is expressed through three interconnected sets of birth images: images representing creativity, immortality, and progress.

Images of Creativity

Much of the mythologizing of the computer science fraternity is conscious, intentional, and programmatic: It serves a community-building function in AIM. It makes the work and the sacrifices it requires—the deferred gratification of always becoming, never fully arriving—special, ordained, daring, and even godlike. In *God and Golem, Inc.* (1964), Norbert Wiener, widely referred to as the "father of cybernetics," maintains that machines that learn, reproduce themselves, and coexist with men pose profound theological questions. Wiener points out that if a contemporary of Francis Bacon had claimed to be able to make machines that could "learn to play games or that should propagate themselves," he would surely have been burned by the Inquisition, "unless he could convince some great patron that he could transmute the base metals into gold, as Rabbi Low of Prague, who claimed that his incantations blew breath into the Golem of clay, had persuaded the Emperor Rudolf."[53]

[53] Norbert Wiener, *God and Golem, Inc.: A Comment on Certain Points Where Cybernetics Impinges on Religion* (Cambridge, MA: MIT Press, 1964), 49–50.

According to the folklore of the computer science subculture, Wiener, John von Neumann, Gerald Sussman, Marvin Minsky, and Joel Moses all claimed to be actual descendants of Rabbi Low, per-

haps the first mortal man to be credited with creating life without using woman as a vessel.[54] Moreover, Low's descendants believe they are carrying on the family tradition. By the mid-1980s, these latter-day alchemists maintained that they had already given birth to four generations of Golem. The labor pains they were then experiencing in their attempt to give birth to "the fifth generation" of computers were extraordinary because the "pregnant phallus" was more pregnant than usual.[55] It was struggling to bring forth very special progeny: a superchild who will be able to reproduce itself without the agency of either man or woman.[56]

Some enthusiasts herald "neural nets" as this special progeny. Indeed, to cross the border from one genre of scientific vision to another, an episode of *Star Trek* featured conscious, intentional, and ethical neural nets contemplating the injustices of their human sires. The crossover from science to science fiction is a common one: Science feeds the imagination of science fiction writers, and many scientists feed off of science fiction. As Freeman Dyson puts it, "Science is my territory, but science fiction is the landscape of my dreams."[57] Scientist and science fiction writer share the same imaginative field and vocabularies of motive: They are both posed on the precipice of the possible and asking, "What if . . . ?" In Greek mythology, the lesser Greek god Prometheus incites the wrath of Zeus by giving fire to man. Contemporary Prometheans invert the flight trajectory: Their leaps of imagination are intended to make them godlike. They seek to transcend embodiment, biology, and gravity, and give birth to a new, superior species of ideational forms.

IMAGES OF IMMORTALITY

According to the fathers-to-be, this much-anticipated superchild may cut through the genetic coding of the universe and produce "the next step in human evolution."[58] Some computer scientists believe this generation of computers will possess the power to transform their fathers into "supermen."[59] They claim this vaunted son of the computer god will allow them to download the contents of their own minds into programs and thereby achieve immortality.

One proud papa, Hans Moravec, director of the Mobile Robot Laboratory at Carnegie Mellon University, maintains, "The things we are building are our children, the next generations. They're carrying on all our abilities, only they're doing it better."[60] In *Mind Children: The Future of Robot and Human Intelligence* (1988), Moravec acknowledges that today "our machines are still simple creations, requiring the parental care and hovering attention of any newborn, hardly worthy of the word 'intelligent.'" Within the next century, however,

[54] Turkle, *The Second Self.*

[55] Easlea, *Fathering the Unthinkable.*

[56] Edward A. Feigenbaum and Pamela McCorduck, *The Fifth Generation: Artificial Intelligence and Japan's Challenge to the World* (New York: New American Library, 1984).

[57] Freeman Dyson, *Imagined Worlds* (Cambridge, MA: Harvard University Press, 1997), 9.

[58] Hans Moravec, *Mind Children: The Future of Robot and Human Intelligence* (Cambridge, MA: Harvard University Press, 1988).

[59] Michael Hirsch, "Computers Envisioned as Successors to Humans," *Buffalo News*, June 14, 1987, 16(E).

[60] Hirsch, "Computers Envisioned as Successors," 16(E).

he promises "they will mature into entities as complex as ourselves, and eventually into something transcending everything we know— in whom we can take pride when they refer to themselves as our descendants."[61]

The gender of these children is seldom in doubt. When references to AI or robotics are personified, male pronouns are typically used. Within the often too transparently Freudian imagery of the lore of infotech, however, software and software designs are sometimes personified as females—for example, Eliza and Linda. This practice departs from common, humanistically inspired conventions of tech-talk because technology is usually personified as female.[62] Andreas Huyssen attributes this practice to fear of autonomous technology: "As soon as the machine came to be perceived as a demonic, inexplicable threat and as the harbinger of chaos and destruction . . . writers began to imagine the *Maschinenmensch* as woman."[63] This move also has mythological precedence, as, for example, Pandora's box.

For top-down AI, the signs are changed: The prospect of autonomous technology is exciting, a source of wonder and daring defiance of Judeo-Christian understandings of life and death and of conventional American values like God, motherhood, and apple pie. Sometimes this defiance gives practitioners pause, leads to self-interrogations of the ethical implications of AI. Yet, self-interrogations of the godlike powers of mind-makers are also, by definition, celebrations of those godlike powers, which separate the dilemmas of AI scientists from the problems of ordinary folks, who are still stuck back in an earlier stage of evolution. An exception to top-downers' embrace of autonomous technology is, however, made in the case of computer viruses, which carry the regressive stigma of biological life and usually infect only (female) software.

The telos of AI is *autonomous technology*. It is AI's ticket to immortality. Marvin Sussman, for example, conceives of the mind children, produced by AI, as delivering their fathers to the threshold of life everlasting: "[T]he machine can last forever," and "if it doesn't last forever, you can always dump it out onto tape and make backups."[64] As we shall see, bottoms-up AI is having difficulty sustaining this optimism. The return of biology not only refills Pandora's box; it also opens the door to Mary Shelley's humanist and feminist nightmare of the deformed progeny of phallic pregnancies: the Frankenstein monster.[65]

The Cartesian disconnection of AI researchers that permits them to conflate mind and machine also allows them to conceive of biological death as a minor episode in the life cycle of a superman: "If you make a machine that contains the contents of your mind, then that machine is you."[66] Indeed, within the mythos of AI modelers, bio-

[61] Moravec, *Mind Children*, 1.

[62] Judy Wajcman, *Feminism Confronts Technology* (University Park, PA: Pennsylvania State University Press, 1991); and Andreas Huyssen, "The Vamp and the Machine: Fritz Lang's Metropolis," in *After the Great Divide: Modernism, Mass Culture, Postmodernism*, ed. Andreas Huyssen (Bloomington: Indiana University Press, 1986).

[63] Huyssen, "The Vamp and the Machine," 70; see also Judith Halberstam, "Automating Gender: Postmodern Feminism in the Age of the Intelligent Machine," *Feminist Studies* 17, no. 3 (1991).

[64] Sussman quoted by Fjermedal, *The Tomorrow Makers*, 8.

[65] Mary Shelley, *Frankenstein* (New York: St. Martin's Press, 2000, original 1818).

[66] Sussman quoted by Fjermedal, *The Tomorrow Makers*, 8.

logical man (as well as woman) becomes an obstacle to be conquered and rationalized.

The contents of the mind cannot be downloaded into immortality until the information channels are cleaned up. For this reason, AI simulation requires modelers to subject cognitive processes to the Law of the Hammer, albeit reluctantly and only for the time being until more complex forms of modeling become possible. The AI modeler must reduce complex cognitive and biological processes to a series of discrete and univocal binary commands. Modeling even a very simple movement like raising the arm of a man to press a lever may require identifying, mapping, and simulating hundreds, even thousands, of cognitive and neurological messages. Add to this the fact that within biological man, these messages are often confounded by the "noise" of indecision, procrastination, memory, reflection, love, lust, and other sentiments, values, and intentions that appear to be irrelevant to the immediate task at hand.

Cleaning up the information channels to create models that will program a robot to push a lever with the same cool efficiency, regardless of whether the lever releases bombs or coffee cups, is therefore a genuine achievement of Cartesian logic. Faulting the AI modeler for preferring clean channels to cluttered ones is like faulting the plumber for preferring clean drains to clogged ones. Both find their efforts blocked by the waste products of biological man. The AI modeler's dream of a clean machine is a dream of Cartesian transcendence, perhaps even redemption. But where Descartes wanted to control the noise of embodiment, AI researchers frequently express a desire to eliminate the body. The late Heinz Pagels, then-director of the New York Academy of Sciences, found serious humor in the Cartesian mind-body problem: the incompatibility of rationality and sexuality, in this instance male sexuality. He opens his survey of the sciences of complexity, *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity* (1988), with a quotation from Robert Hutchins: "When the penis goes up, reason goes out the window."[67] Computers, it seems, can eliminate this distraction.

Rodney Brooks explains why he wants to eliminate "the wet stuff"—human bodies—from the equation: "We are sort of locked into our genetic structure. At the moment we might be able to tweak our genetic structure a little bit, but nothing severe."[68] Brooks sees "an advantage to building robots out of silicon and stuff like that, because we know how to control that fabrication process pretty well," whereas we have "trouble with" biology: "We can't add more brain cells to us, but we can add more processors, more silicon, to a robot."[69] In short, robots are easier to expand, repair, and control than their messy and unpredictable prototypes.

[67] Hutchins quoted by Pagels, *Dreams of Reason*, 19.

[68] Brooks quoted by Fjermedal, *The Tomorrow Makers*, 33.

[69] Brooks quoted by Fjermedal, *The Tomorrow Makers*, 33.

Because the legend of the pregnant phallus requires the scientist to make love to himself—to give birth to a "sacred image" of himself—it encourages narcissism.[70] Sherry Turkle reports the following conversation between AI scientists. Don Norman says, "I have a dream to create my own robot. To give it my intelligence. To make it mine, my mind, to see myself in it. Ever since I was a kid." Roger Schank responds, "So who doesn't? I have always wanted to make a mind. Create something like that. It is the most exciting thing you could do. The most important thing anyone could do." Gary Drescher tells Turkle, "We have the right to create life, but not the right to take our act lightly."[71] Drescher believes scientists have ethical obligations in a society where human and artificial intelligence live together.

Following the lead of science fiction writer Isaac Asimov, Drescher entertains the idea that AI may make a new form of murder possible:

> People always talk about pulling the plug on computers as though when it comes to that they will be saving the world, performing the ultimate moral act. But that is science fiction. In real life, it will probably be the other way around. We are going to be creating consciousness, creating lives, and then people may simply want to pull the plug when one of these intelligences doesn't agree with them.[72]

IMAGES OF PROGRESS IN AI DISCOURSE

Some AI scientists acknowledge that the next step in evolution may render humans obsolete. Marvin Minsky thinks "people will get fed up with bodies after a while."[73] He predicts that like the dinosaurs we might disappear, leaving behind a "society" of interacting and self-generating computer systems.[74]

Evolutionary analogies are common in AI discourse. They appear to represent a form of masculine display: a way of saying my science is bigger (more potent or pregnant) than yours. However, evolutionary images are also used to convey disdain for and distance from conventional conceptions of life, death, thought, and morality. That is, they are used to signal a radical departure from all previous ways of knowing and being in the world. Thus, Moravec asserts, "I have no loyalty to DNA," and Mike Blackwell claims, "Bodies have served their purpose."[75]

Moravec valorizes the departure, the irrevocable break with the past: "We are on a threshold of a change in the universe comparable to the transition from non-life to life."[76] On one level, AI scientists seem to be embracing a return to pre-Baconian animism in which matter, *cum* machine, is endowed with life and anthropomorphosized. There is, however, more to the equation. The transition is not to life. There is a change in signs, which negates the value of human

[70] Donna Haraway, presentations and discussions at Science as Cultural Practice, a summer institute sponsored by the National Endowment in the Humanities, Wesleyan University, Middletown, CT, July 1991.

[71] Drescher quoted by Turkle, *The Second Self*, 261.

[72] Drescher quoted by Turkle, *The Second Self*, 262.

[73] Minsky quoted by Fjermedal, *The Tomorrow Makers*, 7.

[74] Minsky, *Society of Mind*.

[75] Moravec and Blackwell quoted by Fjermedal, *The Tomorrow Makers*, 60.

[76] Moravec quoted by Fjermedal, *The Tomorrow Makers*, 60.

life: Machines evolve, humans download or die. Within AI's mechanistic reconstruction of evolutionary theory, the pregnant phallus
finally achieves deliverance: Mind is released from body and man
is released from his biological dependence on woman. Moravec describes the brave new "post-biological" world of AI:

> All our culture can be taken over by robots. It'll be boring to be human.
> . . . We can't beat the computers. So it opens another possibility. We
> can survive by moving over into their forms . . . because we exist in a
> competitive economy, because each increment in technology provides
> an advantage for the possessor. . . . Even if you can keep them [the
> machines] slaves for a long time, more and more decision-making will
> be passed over to them because of the competitiveness.

> We may still be left around, like the birds. It may be that we can ar
> range things so the machines leave us alone. But sooner or later they'll
> accidentally step on us. They'll need the material of the earth.[77]

[77] Moravec quoted by Hirsch, "Computers Envisioned as Successors," 16.

Reproduction as Destruction in AI Discourse

In the transition from life to program, the clean machine supersedes
its sweaty, plodding, loving, lusting, and aging progenitor. And, the
pregnant phallus eliminates the "wet stuff" that permitted its prototype to penetrate Baconian "holes and corners."[78] The violence
of the vision is neatly occluded by comic strip captions. Robots will
accidentally step on "us," but that's okay because "we" won't really
be there anyhow: "our" now immortal minds will be able to abandon mother Earth entirely. Indeed, some AI scientists invoking the
doomsday scenario believe it is imperative that "we" get some minds
off of this nuclear and ecologically endangered planet and into space
colonies before it is too late.

[78] Bacon quoted by Merchant, *The Death
of Nature*, 168.

Inevitably, the question must be raised: Which minds? Since the
capacity of the most powerful parallel processing machines (connection machines) will be finite, not everyone will be able to get out of
their bodies or off of the planet. Some of "us" will be stepped on,
incinerated, or poisoned by toxic waste. So, who gets downloaded
into the programs? The new evolutionary logic dictates the answer.
The best minds, of course, the kinds of minds that are most readily
available for modeling in the AI laboratories at MIT, Stanford, and
Carnegie Mellon University: minds of upper middle-class, white,
American, predominantly male computer scientists. These are, not
incidentally, some of the same minds and bodies that are most sought
after by sperm bank entrepreneurs and their customers.

These are also some of the same minds that envision a future
in which AI will render participatory democracy obsolete. Among

them are minds that herald the coming of a time when machines, not people, will control the world's nuclear arsenals; when new forms of slavery will be introduced in which living machines (cyborgs) programmed to be "ethical" will serve as slaves; when robots will be programmed to meet all (in- and out-of body) erotic needs and thereby render human intercourse and biological reproduction redundant.[79] In short, these are minds that embrace what Neil Postman calls "technopoly," or totalitarian technocracy.[80]

The mythos and metaphors of AI talk and texts display a familiar design. AI discourse is a discourse of control; it builds hierarchy into the hard-wiring of its circuitry. The robotic fantasies of AI researchers presuppose the necessity of "the violent mastery and destruction of others."[81] Comic book talk papers over the perversity of AI concepts of creativity, immortality, and progress, but MIT researcher and outspoken in-house critic of AI ideology and eschatology, Joseph Weizenbaum, cuts through the cartoon images and conceives the perversity within the same frame history has used to comprehend its previous incarnations: genocide.[82]

The faded mythology encoded in AI talk and texts demonstrates that AI is not the univocal discourse—not the pure Cartesian reason—that its architects thought they were encoding. Like the technostrategic discourse of the Cold War defense intellectuals analyzed by Carol Cohn, AI is also a discourse, which fails according to its own criteria: It is as far from a "paragon of cool headed rationality" as was Francis Bacon's belief in the diabolical powers of witches.[83] Weizenbaum's characterization of AI scientists as big children who have not given up their "sandbox fantasies" or sublimated their dreams of omnipotence may be correct.[84] But lest we swell with the satisfaction of one-upping would-be gods, we should remember that we all harbor lost children within us, and that fear can usually be counted upon to release them from captivity. And fear was the generative core of Cold War cosmology.

Let us remind ourselves that the big children of AIM possess some of the best scientific and mathematical minds of the age. They are members of a powerful scientific elite: researchers, teachers, and gatekeepers of the most advanced and prestigious academic and commercial computer research centers in the world. The metaphors these men use to conceive nature, gender, and computer architectures are far more potent (and pregnant) than yours or mine. Donna Haraway contends that biology has already undergone a cybernetic revolution, in which natural objects have been retheorized as "technological devices properly understood in terms of mechanisms of production and storage of information."[85] This metaphoric reconfiguration of the territory of science has fundamentally changed the character of scientific

[79] Fjermedal, *The Tomorrow Makers*.

[80] Neil Postman, *Technopoly: The Surrender of Culture to Technology* (New York: Alfred A. Knopf, 1992).

[81] Tiger, *Men in Groups*, 69.

[82] Joseph Weizenbaum, *Computer Power and Human Reason* (San Francisco: W. H. Freeman, 1976).

[83] Carol Cohn, "Sex and Death in the Rational World of Defense Intellectuals," *Signs* 12, no. 4 (1987): 717.

[84] Joseph Weizenbaum, "Not Without Us," *Z Magazine*, January 1988, 94.

[85] Donna Haraway, "The Biological Enterprise," *Radical History Review* 20 (1979): 223.

interventions in the biological and material worlds, and has thereby changed the nature of those worlds. The generative metaphors of information processing have transformed humans into cyborgs and astronauts—all of us: technophiles and technophobes, feminists and misogynists, acrobats and apple growers too.[86]

Unlike Bacon's patriarchal metaphors, which saw knowledge issuing from a chaste marriage between men's mind and nature, top-down cybernetic metaphors locate the genesis of knowledge in the marriage of men's minds and male machines. The mythos of male bonding encoded in AI discourse bears little resemblance to Plato's homoerotic vision. AI metaphors replace Eros with objects: fetishes made of circuits and chips. Where Baconian epistemology suppressed the female principle, AIM's technovisions negate the human principle, and as Weizenbaum points out, "There's nothing left after you've destroyed the human species."[87]

Coitus Interruptus

The strong top-down AI research program is both a tribute to and testimony against Western dualism and Enlightenment conceptions of reason. The self-correcting elements in the hyperrationality of the top-down AI program were powerful enough to discover AIM's own limits. This discovery, in turn, invalidated the essential tenet of AI's premise: that reason exists in a dimension apart from and beyond history, culture, and sentient beings. The failure of the top-down program was a triumph for biology: a regrounding of mind in body and of mental processes as human, learned, and socially situated. Promethean man was pulled back to earth, as he always is when he flies too high: too far from his origins. In the mythopoetics of Western dualism, the triumph of the body is a triumph of the feminine principle.

In AI parascientific discourse, the latent symbolic ascent of the feminine that accompanied the paradigmatic shift to the bottoms-up approach was never grasped, and appears in any case to have been ephemeral: a transitory return of the repressed feminine dimension. It was briefly ascendant at the point of impact and (yes, I will say it) intercourse of thesis (top-down) and antithesis (bottoms-up), and in the period of the reconceptualization and rebirthing of research programs for AI that immediately followed. That this moment of opening occurred at the same time that the larger social, cultural, and political formations of global power were also undergoing profound, even epochal, transformations is, as we have seen, not coinciden- tal. The crises that the end of the Cold War posed for the defense industry and for research funded by the Defense Department were

[86] Donna Haraway, "A Manifesto for Cyborgs"; and Romanyshyn, *Technology as Symptom and Dream.*

[87] Weizenbaum quoted in Fjermedal, *The Tomorrow Makers*, 140.

widely chronicled in the media in the late 1980s and early 1990s. The permanent war economy had been very costly, but it had insulated postwar America against the extremes of the boom and bust cycles of capitalism. What was at the time dubbed by *The New York Times* as "risks of peace" included not only displacing the economic stabilization of defense spending but also displacing defense workers, which included a highly educated techno-scientific strata that could be very dangerous if it became alienated.[88]

The dramaturgical accompaniments of the Persian Gulf War launched what President George Bush called a "new world order," which, counterfactually, sought to keep the old power-knowledge of the military-industrial complex intact. It did not work, except as television, and it was not, in any case, a strategy that held much long-term promise: It was too expensive and morally repellent. For example, the US military estimates that the brief war took somewhere between one hundred thousand and two hundred thousand Iraqi lives, most of them civilians. As a dazzling, well-edited, globally broadcast television display of the triumphs of American techno-culture, it did, however, foreshadow the future. The Clinton-Gore Administration defined that future in its technovision, the National Information Infrastructure, and in its policies, treaties, and legislative initiatives (NAFTA, GATT, and the omnibus US Telecommunications Act of 1996), which supported the creation of a US-dominated global information economy. Clinton-Gore went where no Republicans could have dared to go in accelerating the growth of corporate power and in defining corporate "competitiveness" as a defense initiative.[89]

The "smart" bombs profiled in the Persian Gulf War drama were prototypes for the smart technologies that would build the new information economy. By the early 1990s, the bombs were almost smart enough; and the research that produced them had already had some success in the consumer marketplace—for example, the original computer game, Flight Simulator, and search-and-destroy video games. Virtual reality simulations showed commercial promise as techno-entertainments as well. AI research, like other forms of defense research, was encouraged to redefine itself, and generous government funding was dedicated to moving American science, scientists, and defense contractors through the transitional period. Research agendas were expanded to include educational, entertainment, biotechnologies, and other commercial applications. Visionary high-tech ideas were brought to bear on mundane tasks. Military and commercial agendas were often pursued in tandem. The development of robotic vision, for example, retains military applications, making those smart bombs even smarter in hitting targets, but its potential applications as prosthetics for the blind are also smart commercial (and humane) investments.

[88] See Sue Curry Jansen, "When the Center No Longer Holds: Rupture and Repair," in *Critical Communication Theory: Power, Media, Gender, and Technology* (Lanham, MD: Rowman & Littlefield, 2002), for a fuller discussion of news-framing at the end of the Cold War.

[89] Department of Defense (website), accessed March 2000, https://www.defenselink.mil.

This commercialized technovision appears to support somewhat more humane agendas than the mature top-down AI approach, insofar as it is less overtly tied to the monovocal agenda of Cold War demonology—for example, eradicating the "evil empire." The level of fear and doomsday paranoia that accompanied the Cold War vision had largely disappeared from mass-mediated articulations of ideology and public policy until the 2001 terrorist attacks on the US and the US's subsequent launching of its global War on Terrorism. This demonology continued to thrive in defense think tanks, and it prospers among fringe militia, survivalist, and white supremacist groups: groups made up primarily of white males who claim to be disenfranchised by the moderately more inclusive post-Cold War definitions of social reality.

Within computer science, doomsday scenarios have, interestingly enough, been transferred to the programs themselves. They revolve around fears of techno-terrorism, including hacker breaches of government and corporate security, scenarios of contamination of networked systems by massive self-replicating viruses, and dystopias involving techno-wars and extermination of the human race by a future species of intelligent robots.

WILL THE PREGNANT PHALLUS DELIVER SELF-REPLICATING POWERS AND A NEW GENERATION OF ANTI-HUMAN TERRORS?

What does the future hold? That is the perennial question that is posed to, and by, AI and robotics research and development scientists. The AI research community is no longer fully a male preserve, "a world without women." Women are a growing, though still small, presence within the ranks of AI and robotics research and development, although they have not yet issued any manifestos. Whether they will ultimately forge new metaphors and new ways of thinking about conceiving artificial life remains an open question.

At present, the US government under President George W. Bush is gearing up once more to strongly reassert its presence in computer science research and development by reviving development of the ill-fated (and, many scientists believe, ill-conceived) Cold War Star Wars missile defense system, originally proposed and funded under the Reagan-Bush I Administration.[90] It appears, at this point, that the War on Terrorism has given the Bush Administration the mandate it needs to override scientific reservations and congressional opposition to reviving the missile defense program. Moreover, the US government has announced that it now needs aggressive as well as

[90] For a critical analysis and summary of the scientific and political debates about the Star Wars program, see Frances Fitzgerald, *Way Out There in the Blue: Reagan, Star Wars, and the End of the Cold War* (New York: Simon & Schuster, 2000).

defensive weapons to conduct cyber-warfare. The huge reinfusion of defense funds will define the futures of AI and AL.

Will the mature research program of the bottoms-up approach of AI be more humane than the mature program of the top-down approach? There is no reason to assume it will be; indeed, it could be more inhumane. The sandbox fantasies have not disappeared; in fact, they may have moved closer to becoming technological realities. Hans Moravec is still around, and still believes that "biological humans" will "be squeezed out of existence."[91] Danny Hillis, now known as the father of parallel processing, is still thinking about escaping the grim reaper: "I'm as fond of my body as anyone, but if I can be 200 with a body of silicon, I'll take it."[92] Ray Kurzweil is predicting we will become robots or fuse with robots.[93]

In "Why the Future Doesn't Need Us" (*Wired*, March 2000), Bill Joy, cofounder and chief scientist of Sun Microsystems and co-chair of a presidential commission on the future of information technology research, wonders how other techno-wizards can silently live with their fears. Joy reports that the kind of technology Moravec envisions will be feasible by 2030:

> What was different in the 20th century? Certainly, the technologies underlying the weapons of mass destruction (WMD)—nuclear, biological, and chemical (NBC)—were powerful, and the weapons an enormous threat. But building nuclear weapons required, at least for a time, access to both rare—indeed, effectively unavailable—raw materials and highly protected information; biological and chemical weapons programs also tended to require large-scale activities.
>
> The 21st-century technologies—genetics, nanotechnology, and robotics (GNR)—are so powerful that they can spawn whole new classes of accidents and abuses. Most dangerously, for the first time, these accidents and abuses are widely within the reach of individuals or small groups. They will not require large facilities or rare raw materials. Knowledge alone will enable the use of them.

Thus we have the possibility not just of weapons of mass destruction but of knowledge-enabled mass destruction (KMD), this destructiveness hugely amplified by the power of self-replication.

I think it is no exaggeration to say we are on the cusp of the further perfection of extreme evil, an evil whose possibility spreads well beyond that which weapons of mass destruction bequeathed to the nation-states, on to a surprisingly terrible empowerment of extreme individuals.[94]

Where the NBC technologies of the twentieth century were largely developed by the military in government-controlled laboratories, Joy points out, "We are aggressively pursuing the promises of these new technologies within the now-unchallenged system of global capitalism and its manifold financial incentives and competitive

[91] Joy, "Why the Future Doesn't Need Us," 2.

[92] Joy, "Why the Future Doesn't Need Us," 2. For a recent account, which demonstrates that AI's self-promoting hype continues despite claims of a new humility within AI and AL, see Jim Krane, " 'Human' Robots March Forward—on Movie Screen and Off," *Morning Call* (Allentown, PA), June 26, 2001, 8(D).

[93] Joy, "Why the Future Doesn't Need Us," 2.

[94] Joy, "Why the Future Doesn't Need Us," 3.

pressures."[95] He envisions scenarios where corporations may be forced into something like voluntary disarmament or the equivalent of biological weapons inspections if the species is to survive. Lest we blame the messenger, Joy is pushing the panic button precisely because he wants to initiate public dialogue about techno-futures, which, to date, have been shaped without it. He sees the astronautic fantasies of scientists, which call for evacuating the earth, as forms of denial that abdicate responsibility.

In the aftermath of the anthrax attacks on the US Postal Service, Congress, the media, and the public that immediately followed the September 11, 2001 terrorist attacks in New York, Washington, and Pennsylvania, Joy's jeremiad resonates with even greater gravity. No one has taken responsibility for the anthrax attacks, which are at present assumed to be the work of a domestic terrorist, not the al-Qaida network. Government forces, from federal to local levels, remain on high alert for further biological and chemical terrorist attacks. As a result, the scenario Joy describes takes on a new and chilling sense of reality.

Joy does not address the gendered components of these technovisions or the gender orders they will support, but he does try to see beyond the conventional horizons of Western science and culture. Siding with the biological life on planet Earth, he is a de facto ally in the struggle for a more human, and therefore a future friendlier to women, the species, and the planet. Moreover, by virtue of the authority his background gives to his argument, it is a valuable addition to the arsenal of ideas that can be mobilized in "the semiological warfare" that is required to interrupt the privatization of policy making that the new enclosure movement has empowered and normalized.[96] Joy's goal is to open up a broadly based dialogue about the deployment of technologies before they are deployed, not to provide lay readers with a definitive take on the science of the future. If his scenario is alarmist, then open, informed, critical, democratic dialogue can serve as a corrective. In any case, democratic dialogue about techno-futures is urgently needed if democracy is to retain (or recover) any meaning beyond the symbolic or spectral.[97]

New Science Requires New Poetry: Returning to the Launch Pad

The process of interrupting and correcting the talk and texts of technoscience has just begun. Haraway describes such interventions as forms of practicing "politics by other means."[98] Yes, and poetry too! For the first step in scientific revolutions (as in political

[95] Joy, "Why the Future Doesn't Need Us," 7.

[96] Umberto Eco, *Travels in Hyper-Reality* (New York: Harcourt Brace Jovanovich, 1986).

[97] Guy Debord, *The Society of Spectacle* (New York: Zone Books, 1995).

[98] Donna Haraway, "Primatology is Politics by Other Means," in *Feminist Approaches to Science*, ed. Ruth Bleier (New York: Pergamon Press, 1986), 77–118.

revolutions) is to change the names, because scientific revolutions are metaphoric redescriptions of nature, not (or not only) codings of revolutionary new insights into the intrinsic nature of phenomena.[99]

Most, though certainly not all, constructivist and Western feminist conceptions of nature and humankind break with the astronautic vision. Feminist perspectives support metaphors, models, and taxonomies for describing nature that are less hierarchical, more contextual and permeable, and perhaps more reflexive than their masculinist predecessors. The achievements (and perversions) of Western science have been possible because they have taken flight on transcendent metaphors—for example, Prometheus, Icarus, Faust, Superman, cyborg, and astronaut.[100] These metaphors deny embodiment and mortality, whereas images of domesticity, embodiment, and material necessity—images drawn from women's experience—keep our feet on the ground. Fully human conceptions of nature and being must do both or both/and.[101] That is, they must allow us—all of us!—to dream dreams that make the impossible possible. But they must also recognize that it takes many dreamers—many diverse, self-reflexive, human agents—to dream life-affirming dreams: women and men in life-sustaining communities, not insular enclaves of scientific geniuses or self-replicating forms of hardware and software.

This new way of thinking is, however, unlikely to emerge from truces, whether voluntary or mandated, in the so-called scientific wars. Adding women to science and stirring will not do the job. Indeed such a strategy, no matter how well intended, is likely to either kill the spirit of the women who are added to science or kill the spirit of science. Rather, species-friendly conceptions of nature are far more likely to find incubation within new generative metaphors that will, in turn, prove to be more illuminating, inspiring, and effective in meeting the life-sustaining challenges that lie ahead. Or, to put it pragmatically, expanding the landscape of the scientific imagination may prove to be more important to twenty-first-century earth science than it was to twentieth-century space science.

If scientists like Moravec, Kurzweil, Joy, and others are right about the future, survival of the planet now requires terminating the exterminating elements in the self-replicating technologies of genetics, nanotechnology, and robotics.[102] Our interventions need to attend to the problem from the launch pad rather than the space station. We need to cast our collective lot with Earth, not the stars. We need to find our metaphors closer to home: to come back to Earth, back to our aging, sweating, imperfect, mortal bodies. We need to face the responsibilities, tensions, ambiguities, and pleasures of a fully human life and death. In short, we need to dream a new cultural dream: a dream that requires nothing less than interruption and redirection of the out-of-body experiences of modern and postmodern science.

[99] Mary Hesse, *Revolutions and Reconstructions in the Philosophy of Science* (Bloomington: Indiana University Press, 1980); and Rorty, "The Contingency of Language."

[100] See discussion in Sue Curry Jansen, "Introduction: Scholarly Writing Is an Unnatural Act," in *Critical Communication Theory: Power, Media, Gender, and Technology* (Lanham, MD: Rowman & Littlefield, 2002), as well as Eve Tavor Bannet, "The Feminist Logic of Both/And," *Genders* 15 (1992).

[101] Bordo, *The Flight to Objectivity*; Clive Hart, *Images of Flight* (Berkeley: University of California Press, 1988); and Romanyshyn, *Technology as Symptom and Dream*.

[102] Joy, "Why the Future Doesn't Need Us."