RISE OF THE MACHINES

A CYBERNETIC HISTORY

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5. CULTURE

THE COMPUTER, THE “THINKING MACHINE,” WAS SO NEW and unknown in the years following World War II that progress seemed unlimited. The new thinking machines could calculate how to build skyscrapers, how to run stock exchanges, and how to fly to the moon. The only limit was the imagination. The “big brains” were a miracle in the waiting that would change everything: war and work would become automated; organisms and machines would merge, creating new forms of life. But many of these midcentury visions of the modern future were decades ahead of the actual technology of the time. The vast, room-filling IBM machines had very limited computing power. The giant thinking machines of the 1950s were far dumber than tiny smartphones half a century later would be.

But the machines, it turned out, had nearly unlimited metaphorical power. The most obvious comparison was the human brain. If the thinking machine was a simplified brain, then the reverse question was practically asking itself: Wasn’t the actual brain just a complex machine? The mind suddenly became something that could be understood and described and analyzed with language borrowed from engineering. And cybernetics provided that language: input and output, negative feedback, self-regulation, equilibrium, goal, and purpose. All this had a literally spiritual, drug-like appeal.

Seeing the mind as a machine was liberating. The reason was simple. Man could understand machines, make them, control them, tweak them, fix them, and improve them. If the mind was simply a kind of machine, then humans could understand it, control it, tweak it, fix it, and improve it. Doing so was only a matter of finding the right levers to pull and cogs to turn. No longer was human psychology something mysterious, something unknown, something beyond the comprehension and imagination of ordinary people.

The next logical step was to extend that comparison. If the individual mind was a self-regulating system that could be tweaked by oiling the feedback loops, what else was?

Norbert Wiener's and Ross Ashby's ideas immediately had a spiritual and quasi-religious appeal that went far beyond the fear of automation, or the fear of machines organically merging with humans. Soon, creative minds beyond the confines of the hard sciences discovered the power of cybernetics—especially in counterculture. By the late 1970s, cybernetics had gone viral. Sometimes in disguise. Entire communities functioned like whole systems, many in the countercultural avant-garde came to understand: there was a different way of seeing things, a circular way, where everything was connected, connected by feedback, kept in balance, in touch with the environment, even with animals and plants and rocks, in unity, as one single whole, one planet, shrunk into a village by communication technology. A veritable cult emerged. Seeing communities as self-regulating feedback systems was liberating, driven by a theory of machines that was quite literally "out of control," in the memorable phrase of the founding editor of *Wired* magazine, Kevin Kelly.[1]

The cybernetic myth had a major cultural impact. Wiener's work, in its countercultural and highly symbolic reading, forms one of the oldest and deepest roots of that firm belief in technical solutions that would later come to characterize the culture of Silicon Valley.

I

One of the earliest and most eminent writers roused by cybernetics was L. Ron Hubbard, then an immensely prolific science fiction author. Hubbard was fascinated by the new science, and especially by the idea that the mind was a thinking machine.

Hubbard was also a member of the Explorers Club, a New York–based society dedicated to expeditions to the world's unknown frontiers. The club had its own journal, the *Explorers Journal*. In the winter issue that came out in late 1949, Hubbard set out to explore the human mind, that vast and unknown frontier "half an inch back of our foreheads." Hubbard read Wiener and was hooked. Inspired by the MIT professor, the would-be prophet considered the brain "an electronic computing machine" and told fellow explorers that his own approach was a "bridge" to "Cybernetics," as he explicitly pointed out. Engineering equipped him with the tools that he needed to penetrate that half inch of skull bone.

The mind could do all the tricks of a computer, Hubbard wrote—the tricks of a good computer. But going even further, he said, "The analytical mind is not just a *good* computer, it is a *perfect* computer."[2] Therefore, the mind would be incapable of error, Hubbard reasoned. Error and imperfect human behavior would be introduced through "wrong data," just as in the case of an actual machine. The human mind, he implied, wasn't flawed in itself. It was indeed perfect. But like any other tool, it was subject to user error.

Hubbard later expanded the argument first outlined in that article into a book, *Dianetics*. Published in 1950, *Dianetics* would become one of the most translated books of all time, with editions in sixty-five languages, and allegedly more than twenty million copies sold. The 680-page tome is one of the best-selling self-help paperbacks of the twentieth century. It is also one of the founding texts of the Church of Scientology.[3]

Hubbard's example, right at the heart of his argument, was simple addition with a calculating machine. Input 6 times 1 and you get 6. This is the situation when the machine is receiving correct data. But what if the "7" key is stuck? If you input the same command, the calculator will receive the wrong data (6 times 7) and display the answer 42 instead. Any calculation entered on that keyboard, with the "7" stuck, would produce the wrong result, the wrong output.

In the same way, Hubbard was convinced, faulty data would trick the human mind. "Incorrect data gets into the machine. The machine gives wrong answers. Incorrect data enters the human memory banks, the person reacts in an 'abnormal manner,'" Hubbard explained. The situation was plain and simple. And it was liberating. Abnormal human behavior wasn't the result of a construction error in the unalterable mechanics of the mind, the central text of the Church of Scientology implied. Aberration, Hubbard preached, was a result of bad input data. Bad input equaled bad output. "Essentially, then, the problem of resolving aberration is the problem of finding a 'held-down 7,'" he wrote.[4] And so on.

The cyberneticists of the first hour were appalled. Hubbard and some of his employees had implied that Wiener enthusiastically endorsed the new science.[5] When Wiener found out, he was incensed. He had not the slightest confidence in Hubbard, he wrote in a letter, and he had doubted Hubbard's good faith from the beginning.[6] In other letters he compared Dianetics to voodoo and mesmerism, an eighteenth-century belief in the healing forces of animals.[7] Wiener had no patience for the man he considered a charlatan. On July 8, 1950, he wrote a short and terse letter to the later founder of the Church of Scientology, addressing him simply as "Sir."

"Be advised that I most definitely do *not* endorse your pretended science, your book, your system of therapy, your foundation, yourself, nor Dr. Powell," Wiener wrote in an enraged tone, referring to one of the foundation's representatives who had falsely implied he, Wiener, supported their cause. Wiener was so upset he couldn't type straight: "I hereby forbid either of you to make any explicit or implicit use of my name as endorser of any or all of these."[8]

Hubbard responded two weeks later. "My dear Dr. Wiener," he started out, "I am sorry if any action on the part of dianetics has disturbed you."[9] Hubbard promised not to use Wiener's name in the future. But he was a fan and could not resist pointing out how important cybernetics had been for his own work. "Some of your conclusions have been useful to dianetic development," Hubbard told Wiener, and he assured the professor that he would "set policy" not to mention his name. Nevertheless, Hubbard saw his own new field—what a few years later would form the intellectual foundation of the Church of Scientology—as "an engineering type science" that "dovetails nicely with Cybernetics" as he told another leading MIT mathematician in a letter in December 1949.[10]

This link wasn't news to Wiener. He had skimmed Hubbard's book, and the superficial similarities to his own work didn't escape him. "DIANETICS sounds like the attempt of an illiterate to capture the swing of CYBERNETICS," Wiener wrote to a colleague in July of 1950.[11]

Two months after the terse exchange with Hubbard, Wiener published a thoughtful and polemic warning against the temptations of pseudoscience. He lashed out against "the confused work of amateurs" who were using precise mathematical language without understanding what they were talking about. Wiener reserved his full ire for a set of ideas that he called "wholism," the notion that a system could be understood only as a whole system, as an entity that is more than the sum of its parts. That, to him, was the worst kind of false science.

"Let me lay the ghost of another pseudo-scientific bogy: the bogy of 'wholism,'" he wrote in a prominent philosophy journal in September.[12] "If a phenomena [*sic*] can only be grasped as a whole," he argued, "it is completely unresponsive to analysis." And if whole systems were unresponsive to scientific analysis, then whole systems were simply not available for serious inquiry. "The whole is never at our disposal."[13] The MIT professor, perhaps because he himself felt guilty of the crime he was accusing others of, closed his polemic against the faux use of mathematical language with what seemed like faux outrage: "Let us have done with this sorry profanation."[14]

W. Grey Walter, one of Britain's leading figures in the new field, had a hard-nosed scientific view of the world, and equally little patience for pseudoscience and charlatans. He knew about the frequent attempts to integrate the sundry schools of scientific disciplines into a larger whole. And he had seen the seductive power of cybernetics. Walter, who three years later cofounded the International Association for Cybernetics, was vigilant and circumspect. The "loop of cybernetics," he warned in 1953, had cultish potential. The science of feedback loops had such seductive appeal that less disciplined minds would be tempted to join and connect fields that simply didn't belong together. "America is a great incubator of synthetic cultures," he wrote, and he named "the Dianetics of Hubbard" as an example of "these cults."[15]

Walter then added a warning that would resonate for an entire generation. He phrased his warning against the cultish in almost poetic language.

> This is something to be aware of, for what we need is to preserve and cultivate just these growing-points of science, not to arrange in arbitrary style, like cut flowers, their sterile and exotic efflorescence.[16]

But Wiener's and Walter's warnings were futile. The universal theory of machines that was cybernetics was too powerful and too appealing for too many creative minds. Indeed, it was so seductive that it proved impossible to keep it in the narrow confines of proper science—enter *Psycho-Cybernetics*, a self-help book published in 1960 by Maxwell Maltz, a well-known plastic surgeon. The cover design was tabloid-style, set in black capital letters against red background. The book boasted that "this famous plastic surgeon's remarkable discovery" would help readers "escape life's dull, monotonous routine" and "get more living out of life." That wasn't everything. No, reading Maltz's magical book would even "make you look younger, feel healthier, be more successful!"[17]

The formula must have worked, if sales figures are an indicator. The book became a longtime *New York Times* best seller, up there on the coveted list next to *Heloise's Housekeeping Hints* and the *I Hate to Cook Book*. By the turn of the twenty-first century, the book had sold more than thirty million copies.[18] Maltz's work became an all-time classic in the expansive genre of self-help books. If somebody truly popularized cybernetic theory, it was the doctor working with breasts, not the one with the numbers.

Maltz's breathtaking success illustrates the appeal of cybernetics. He had an epiphany when he read Wiener's *Cybernetics*. Any good plastic surgeon, Maltz reasoned, must also be a psychologist, whether or not he or she wants to be. Cosmetic surgery changes not only a man's face or a woman's tummy. Surgery can change a person's future, behavior, personality, sometimes even basic abilities and talents. Changing the shape of somebody's nose inevitably affects that person's "inner self," as Maltz saw it. The doctor realized that his job came with an "awesome responsibility." Meeting this responsibility meant understanding the self, and how the body interacts with a person's inner self. In his quest to explore this mind-body problem, the cosmetic surgeon traveled widely and researched across disciplines. Finally, he recounted, "I found most of my answers in the new science of Cybernetics."[19]

Thus inspired by the new science of feedback loops and automation, Maltz saw the body as a machine that houses the human mind. By changing the machine through surgery, he would also change the mind. The doctor's newfound insights took him even further. The new science of cybernetics, Maltz realized, had provided ample proof that no such thing as a subconscious mind existed. Maltz didn't see the human soul as a complex and incomprehensible biological system, messed up by traumatic childhood experiences and deep archetypical fears, as psychoanalysts did. Freud and Jung were wrong; missile engineers were right.

"Your brain," as Maltz addressed his readers throughout the three-hundred-page book, is a goal-striving mechanism. That mechanism operates automatically to achieve a certain goal, "very much as a self-aiming torpedo or missile seeks out its target and steers its way to it," the plastic surgeon wrote, relating his concept back to Wiener's original inspiration with the antiaircraft predictor and automatic missile guidance.[20] Nuclear missiles didn't just intimidate; they also liberated—and in rather unexpected ways. The doctor returned to the "awesomeness" of the interceptor missile again and again to illustrate how the human mind works. He saw a goal-striving mechanism that consisted of the brain and the nervous system, all used by and directed by the mind. The consciousness operates the body, which Maltz saw as an automatic and purposeful machine:

> This automatic, goal-striving machine functions very similarly to the way that electronic servo-mechanisms function, as far as basic principles are concerned, but it is much more marvelous, much more complex, than any electronic brain or guided missile ever conceived by man.[21]

Comparing humans to machines was a risky move. Few people identify with pistons and crankshafts, let alone with ballistic missiles. Yet most people want to control their fate as if it had a steering wheel. Maltz sensed this tension. "You are not a machine," the surgeon clarified, talking to his readers directly. But at the same time, body and mind functioned like a machine, "like an electronic computer," a mechanical device preprogrammed to work toward achieving a goal. Maltz then suggested that his readers could reprogram their "built-in success mechanism" in order "to automatically steer you in the right direction to achieve certain goals."

This human-machine analogy was powerful. There was no subconscious beyond the control of the individual. No, in Maltz's world everybody could control his or her own "machine." Even making mistakes was okay. The unerring logic of negative feedback would allow for mistakes, ready to correct the course. The most crucial skills in life were learned by trial and error, "mentally correcting aim after an error," until the successful motion or reaction or performance was programmed into the servomechanism that was the human being. Once that had happened, more learning and continued success was accomplished by *forgetting past errors* while *remembering the successful response*, Maltz insisted.

The trick was trusting one's own mechanism to do its preprogrammed work, not to "jam it" by being too nervous and anxious, or by attempting to force something in too much of a conscious effort. "You must 'let it' work, rather than 'make it' work," Maltz wrote.[22] The brain was no gray, gooey mess; it was a whirring machine, ready to be put to work toward a better life. It just made logical sense. Like the guided missile. Maltz convinced tens of millions of readers.

The 1960s oozed optimism and an unshakable belief in technical progress. So Maltz's argument fell on fertile ground. The New York Yankees passed around worn copies of *Psycho-Cybernetics* when it came out in paperback in 1968. Tom Tresh, a Yankees infielder, raved about the book: "There's a passage that even helps me play shortstop." Instead of standing in the field nervously, "trying to outthink the ball and wondering which side of the field it'll be hit on," he would just relax and tell himself that wherever it would be, he had done it before and would do it again this time.[23]

In the foreword to his extraordinary longtime best seller, Maltz added a reflection. It was "rather ironic," he wrote, that an idea that began as a study of machines and mechanical principles "goes far to restore the dignity of man as a unique, creative being."[24] Even the creative Dr. Maltz could not have imagined how far cybernetics had yet to go.

By 1970, cybernetics had already peaked as a serious scholarly undertaking, and it soon began to fade. Its scientific legacy is hard to evaluate. On the one hand, cybernetic ideas and terms were spectacularly successful and shaped other fields: control engineering, artificial intelligence, even game theory. On the other hand, cybernetics as a science entered a creeping demise, with therapists and sociologists increasingly filling the rolls at the American Society for Cybernetics. Kevin Kelly, the *Wired* magazine editor, later observed that "by the late 1970s, cybernetics had died of dry rot."[25]

Yet, to the surprise of the remaining founders, cybernetics lived on—not in Boston's scientific research labs, but in California's counterculture communes. The rising New Age movement found the new discipline's mystic side appealing. The most eccentric expression of this remarkable shift is an ode to cybernetics written during the Summer of Love in 1967 San Francisco by Richard Brautigan, a long-haired hippie poet, "All Watched Over by Machines of Loving Grace":[26]

I like to think
(and the sooner the better!)
of a cybernetic meadow
where mammals and computers
live together in mutually
programming harmony
like pure water
touching clear sky.

I like to think
(right now please!)
of a cybernetic forest
filled with pines and electronics
where deer stroll peacefully
past computers
as if they were flowers
with spinning blossoms.

I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,
and all watched over
by machines of loving grace.[27]

The idea's journey from the East Coast to the West Coast is extraordinary—the ideology emerged and evolved in a range of military-funded and space-related projects, and then found its way into San Francisco's drug-fueled counterculture, in the short space of two decades. One person played a particularly important role in this metamorphosis: Stewart Brand.

II

Stewart Brand isn't easily described in one sentence: he has been an influential editor, writer, entrepreneur, socialite, intellectual, community organizer, and futurist.

The Cold War shaped Brand. A nuclear nightmare back from his teenage years in the early 1950s was one of his most vivid memories. His hometown, Rockford, in northern Illinois, was a well-known hub for the production of heavy machinery and tools. The Soviets, young Brand knew, had placed the town high on a list of likely targets for nuclear attack. The dream about the day after the strike was harsh: "There was chaos, and then I looked around and I was the only person left alive in Rockford, Ill., a knee-high creature."[28] He wanted out, to escape the specter of nuclear annihilation. Brand is best known for founding the famous *Whole Earth Catalog*, a publication that itself became an emblem and icon of California's late 1960s counterculture and back-to-the-land movement.

One afternoon, probably in March 1966 in the hills of San Francisco, Brand dropped a bit of LSD and went up on a roof overlooking the city. It was a form of escape. He sat in a blanket, shivering in the cold spring air, overlooking the hills, lost in enhanced thought:

> And so I'm watching the buildings, looking out at San Francisco, thinking of Buckminster Fuller's notion that people think of the earth's resources as unlimited because they think of the earth as flat. I'm looking at San Francisco from 300 feet and 200 micrograms up and thinking that I can see from here that the earth is curved. I had the idea that the higher you go the more you can see earth as round.[29]

Yet no photograph of the whole Earth was publicly available at the time, Brand thought, despite nearly ten years of US space exploration in a Cold War arms race that extended even beyond the planet. Then a skinny twenty-seven-year-old, 6 feet tall, with a big grin, he found this unacceptable. As he stared at the city’s high-rises, it seemed to him they were not really parallel, but diverged slightly toward the top—because of Earth’s curvature. Brand’s mind was racing: “I started scheming within the trip,” he remembered. “How can I make this photograph happen?” He had persuaded himself that it would “change everything” if only the people could see this photograph looking at Earth from space.[30] “Why haven’t we seen a photograph of the whole Earth yet?” That was the question.

The next morning he started printing buttons and posters asking exactly that question. He got himself a large Day-Glo sandwich board with a little sales shelf at the front, donned a white jumpsuit, strapped on boots and a top hat with a crystal heart, and went off to UC Berkeley. Each button retailed at 25 cents. The dean threw Brand off campus, which earned him an article in the *San Francisco Chronicle* and other papers. He soon branched out to Stanford, then Columbia, Harvard, and MIT. Maybe, just maybe, the picture he sought would change some minds and make people realize how small and precious and fragile Earth was.[31]

Finally, in November 1967, NASA beamed the picture down to Earth from an ATS-3 satellite. Brand was elated and slapped it on the cover of his new publication: the *Whole Earth Catalog*. The first issue came out in the fall of 1968. It had an all-black cover. In the middle was a round and clear image of the whole Earth. Above the pristine globe, the cover said simply, “Whole Earth Catalog: access to tools.” Tools, for Brand, had an almost mythical meaning. Anything could be a tool: a hacksaw, a monocular, a pair of Levi’s 501 jeans, or the ideas in a book. “Here are the tools to make your life go better. And to make the world go better,” he wrote in one of the catalog’s introductions. “That they’re the same tools is our theory of civilization.”[32] The sturdier and the more robust, the better. The catalog was modeled on Sears and L. L. Bean mail-order catalogs. But it was different.

Brand’s thinking was simple: if commune dwellers wanted to go back to the basics of self-sustained living and farming, they needed to know the basics first, and find those basics first. That’s where his catalog came in. It listed and recommended the basics, or what its maker considered to be the basics: guides on shelter and land use, industry and craft, communications, community, nomadics, and—first and foremost—“understanding whole systems,” the first item that the table of contents boasted. It was “purveying the stuff,” and it became “a node of a network of people purveying it to each other,” Brand recalled later. “And it was designed as a system. I knew about systems. I had studied cybernetics.”[33]

Brand had not just studied cybernetics; he oozed it. Naturally, perhaps, the first issue of the *Whole Earth Catalog* offered readers access to that multipurpose tool: cybernetics. Brand didn't review just one cybernetic book in the first and rather slim sixty-two-page catalog; he reviewed seven, in detail, including several classics that had defined the field.

First, of course, was Norbert Wiener's 1948 *Cybernetics*: "Society, from organism to community to civilization to universe, is the domain of cybernetics," Brand wrote, introducing the book to the hippies in bold holistic terms.[34] Wiener had died four years earlier and couldn't object anymore. Brand also reviewed Ross Ashby's 1952 classic, *Design for a Brain*. "This is the learning mechanism," he wrote.[35] Third, he reviewed the MIT professor's second book, from 1954, *The Human Use of Human Beings*, proclaiming it "social, untechnical, ultimate." The fourth classic was more popularly accessible: Maxwell Maltz's self-help bible *Psycho-Cybernetics*. In Brand's words, "This is not a book to read. This is a kit of tools to use in gaining control of your nature for whatever ends you desire." Then there were less well-known tomes—notably, *General Systems Yearbook*, *Industrial Design*, and *Human Biocomputer*—by other authors. On top of all that, Brand's first version of the cult catalog included Brautigan's famous poem "All Watched Over by Machines of Loving Grace," next to a picture of a nude couple with libertarian amounts of pubic hair on display.

The concept worked, and the *Whole Earth Catalog* became a runaway success. Brand and his wife, Lois, had started off selling a print run of a thousand copies out of their Menlo Park home. Version one retailed for $5. They hired staff as their readership, and the subscriptions to the catalog and its supplements, grew exponentially. Brand produced six different editions of the catalog, published every half year, and nine quarterly supplements in total that were much shorter. In 1971 he announced the final issue, which sprawled over 449 pages, listing well more than a thousand items. Two and a half million copies were sold in total. That last issue of the catalog won the National Book Award for Contemporary Affairs in 1972.

But the catalog didn't just proselytize. It would not have been so successful if it didn't have more to offer. Brand practiced what he preached; the opening pages of every single issue reminded its far-flung but growing readership of the catalog's function and purpose: "The WHOLE EARTH CATALOG functions as an evaluation and access device," it said. This device was about access to inspiration, to personal power, to better ways of shaping one's own environment, and to a community for sharing this ongoing adventure.

The ingenious Brand invited his readers to submit suggestions, ideas, and reviews. The supplements played a crucial role in this functional vision, and every supplement made this point as clear as possible: the function of the supplements was to correct and update information with the help of reader reviews, reader comments, and other input from the community. The supplements included new suggestions of items to add or remove. A section called "Other People's Mail" contained letters from "nameless to nameless." Each supplement also carried various announcements. The supplement was, in short, a community forum, complete with spam, trolls, and discussions that must have seemed pointless to many readers.

Each iteration of the full catalog carried forward the most popular and most recommended items, steadily growing in volume. The final issue was almost seven times as thick as the first. New issues of the catalog also included a selection of reader comments, printed alongside the items they recommended for inclusion. In the final issue, for example, one reader, Ron Nigh from Palo Alto, defended the listing of Ross Ashby's work and also strongly recommended including *An Introduction to Cybernetics*, the second book from the former doctor in Barnwood, Gloucestershire, published fifteen years earlier. "An excellent place to start," Nigh recommended, signing off with "Love."[36]

Brand had a vision, a purpose. He stated his vision on the first page of every Whole Earth publication, where he explained the "function" and then the "purpose" of this widely popular publication. According to Brand, the catalog's function was to serve as an evaluation and access device. With it, the "user" could find out what was worth getting and where to get it. The purpose was to promote tools for education, inspiration, and shaping the environment—because, Brand wrote, "We *are* as gods and might as well get good at it."[37]

Brand's vision was to turn the catalog itself into a tool. The CATALOG—he usually spelled it in capital letters—was to form a feedback loop. He wanted it to be a communication device that connected the far-flung community he cared so much about. He wanted the catalog to be part of something that would create an equilibrium. The catalog was part of a whole system, a dynamic and self-regulating system. Brand would collect the crucial negative feedback in the supplement every few months and loop it back to the land by mail, to the readers-turned-cogs of this machine of loving grace. His publications, as he saw it, were part of an adaptive machine, not unlike the magnetic forces that governed the adaptive behavior of Ashby's homeostat. The catalog itself, with its supplements and its community, *was the learning mechanism*.

Learning was a crucial part of counterculture. Learning was perhaps the only way to expand the mind to see the way into a better, more peaceful, and more just future. To those hungry for mind expansion and knowledge, both psychedelic drugs and computers had instant and intuitive appeal. But that appeal, and the connection between the two, was hard to articulate, at least at first.

Michael Rossman was a prominent community organizer, an advocate of open education, and an activist for the Free Speech Movement at UC Berkeley. He was also an avid proponent of the use of psychedelics. By 1969, then in his late twenties and dashingly handsome, Rossman was living the good life in California, praising the educational virtues of the sweet smell of grass in a book on learning and social change. “Psychedelics,” he held forth, “are a colorless, tasteless spice that heightens the flavor of whatever is cooking in the personal or social stewpot.”[38] To him, taking LSD or smoking pot was strikingly similar to participating in the free learning groups or impromptu therapy sessions that were then popular. Primitive cultures used these substances for collective mythical insights and religious experiences for a good reason, he thought.

Rossman had been an avid reader of the *Whole Earth Catalog*, and he was familiar with Brand’s take on tools and thoughts on control and communication, explained in the masthead of every issue and embodied by the catalog itself.[39] Rossman understood that LSD had become a favored chemical “tool” of painters, musicians, and writers. It was under the influence, he wrote, that “neglected or repressed sensory and emotional experiences and memories reassert themselves, often abruptly.” Psychedelics would facilitate the connection of diverse elements, so that new patterns could be formed. The effect of psychedelic drugs on society, to Rossman, could just as well be expressed in the language of engineering: “In the cybernetic description of process,” he wrote, “the corresponding passage is to a higher order of control—one that makes possible heterarchical rather than hierarchical control systems.”[40] What he meant was simple: counterculture was changing established power structures. Top down was the past; bottom up was the future. That’s where technology came in.

Rossman understood already in 1969 that computers had a key role to play in the future. As the free-speech activist was considering writing a book, the inventor Douglas Engelbart gave what became known as “the mother of all demos,” a now legendary ninety-minute presentation at the Fall Joint Computer Conference in San Francisco. Engelbart introduced the prototype of the first mouse and the vision of a personal computer, a computer that could be owned and operated by everybody, not only IBM and the Pentagon.

To Rossman, that meant technology wasn’t on the side of authority any longer. The future was brightening up: the “free use of computer technology” would mean that fifteen years into the future, flat structures would trump centralized power. “By 1984, America could govern itself by a system of totally decentralized authority,” Rossman wrote in 1971. By the year 2000, the young idealist predicted, “cybernated” societies would be in even better shape, “They will view the machine as their extension—not vice versa, as is the custom now.”[41]

Computer technology would free human labor, the Berkeley activist was sure, and make centralized decisions obsolete, thanks to the advance of cybernetics. “Every other industrial technology is now becoming capable of such re-engineering toward cyber-integrated production and full shared control,” young Rossman predicted.[42] Such ideas were becoming common countercultural currency at that time. But to articulate the Zeitgeist in best-seller form required a much more experienced and eloquent thinker.

Nobody was better placed to discover that missing cybernetic thinker than the restless Stewart Brand. Initially he came to cybernetics from biology, from “world saving,” as he called it, and from trying to understand mysticism. But he wasn’t entirely happy with the philosophy that he found and presented so forcefully in the *Whole Earth Catalog*. Three years of scanning innumerable new books as the catalog’s editor did not turn up what he was looking for. “What I found missing was any clear conceptual bonding of cybernetic whole-systems thinking with religious whole-systems thinking,” he recalled.

Brand was searching for the meaning of consciousness, for the right for life, for what’s sacred. “Tall order,” he admitted in *Harper’s* magazine. But then something remarkable happened. As Brand put it, “In the summer of ’72, a book began to fill it in for me: *Steps to an Ecology of Mind*, by Gregory Bateson.”[43]

Bateson was a British-born anthropologist and social scientist. His father had been a leading geneticist who hoped his son would follow in his footsteps. But the younger Bateson resisted the family pressure: he went from English public-school boy and fellow at Cambridge University’s St. John’s College to doing anthropological fieldwork in New Guinea and Bali. After an interlude during World War II in Burma working for the US Office of Strategic Services, Bateson became a countercultural icon in the wild San Francisco of the 1960s and ’70s. He developed a theory of schizophrenia but never lost his English accent. True to form, Bateson spent the final years of his life at the famous Esalen Institute, a mecca for hippies and dropouts 45 miles south of Monterey at Big Sur.[44]

Bateson had been at the first Macy conference in 1942, at the age of thirty-eight. The discussions in New York inspired him. He helped organize some of the early meetings. Throughout his life, Bateson felt privileged to have been part of the Macy conferences. "My debt," he recalled in the early seventies, "is evident in everything that I have written since World War II."[45]

Bateson put the finishing touches on his most influential book, *Steps to an Ecology of Mind*, when he was at the Oceanic Institute in Hawaii in 1971, working with dolphins. *Steps*, as Bateson and his fans affectionately called his book, was an instant success among the countercultural intelligentsia. As the then sixty-seven-year-old Bateson looked back, two historical events stood out. One was the Treaty of Versailles, which in his reading culminated in Hiroshima and Nagasaki. The other was the discovery of a new idea: "Now I want to talk about the other significant historical event which has happened in my lifetime, approximately in 1946–1947," Bateson wrote. It was the discovery of cybernetics. "I think that cybernetics is the biggest bite out of the fruit of the Tree of Knowledge that mankind has taken in the last 2,000 years."[46]

Overstating the profoundness of Bateson's cybernetic ideas is hard. In the previous twenty-five years, Bateson believed, extraordinary advances had been made "in our knowledge of what sort of thing the environment is, what sort of thing an organism is, and, especially, what sort of thing a *mind* is."[47]

About twenty years before Bateson wrote these lines, he met Ross Ashby in New York. He had been intrigued by Ashby's ideas and how Ashby used the homeostat as an inspiration and illustration, as well as how he insisted that the weird contraption was alive, that it had mental characteristics. Bateson later read Ashby's books and was fascinated by them. Ashby had used the examples of a man with an artificial arm trying to fix an engine, or a sculptor with a chisel shaping a slab of marble. Bateson took the latter example a big step further. To do that, he needed a stronger illustration with more symbolism. A chisel wasn't forceful enough.

"Consider a man felling a tree with an axe," Bateson suggested. When a lumberjack fells a tree, he does so iteratively. The man wielding the axe strikes the trunk, again and again. Each time, the man will modify the next stroke, correcting the angle of the blade, adjusting the force of the axe. The man will do so in response to the cut face in the tree left behind by the previous stroke. The tree is part of the process, not external to it. The lumberjack's mental corrective process is possible only because of the tree. For Bateson, the situation had to be understood in cybernetic terms: "This self-corrective (i.e., mental) process is brought about by a total system: tree-eyes-brain-muscles-axe-stroke-tree."

Already in the early 1950s, Ashby and Wiener had suggested that the line between humans and their tools is arbitrary. The chisel is functionally part of the sculptor. The bomber pilot acts like a servomechanism. Man and machine were forming one system. This was Cybernetics 101, the very basics. Ashby had then pointed out that the line between system and environment is arbitrary.

Bateson simply took this idea to its logical conclusion: if the axe was an extension of the man's self, so was the tree, for the man could hardly use the axe without the tree. So it was tree-eyes-brain-muscles-axe-stroke-tree—"and it is this total system that has the characteristics of immanent mind," Bateson wrote in *Steps*. One mind resided not in one person's skull; it resided in the whole system: "Mind is immanent in the larger system—man plus environment."[48]

Bateson knew that this would sound wild to most of his American and European readers, who were so used to understanding the world in individualistic terms, not in such a radically holistic way: "This is *not* how the average Occidental sees the event sequence of tree felling," Bateson hastened to add.[49] This was an understatement that, if anything, betrayed the philosopher's British origins.

But to Bateson, the loop of tree-eyes-brain-muscles-axe-stroke-tree was an elementary cybernetic thought. Any sensible behavior had to represent a "total circuit," a completed feedback loop. Therefore, any unit that displayed trial and error could be called a mental system, he believed. And the tree was the part of that unit that enabled the lumberjack to display trial and error in modifying his strokes. Naturally, the tree was part of the same mental system.

"*Any* ensemble" of objects that had the necessary complexity of causal circuits "will surely show mental characteristics," Bateson generalized.[50] Any such system will be self-corrective and automatically strive "toward homeostatic optima," just as Ashby had predicted. The system itself was a transducer, a sense organ.

The word "governor" was a misnomer, Bateson believed, in both engineering and politics. Talking about a governor assumed that the governor was in charge, governing and controlling the rest of the machine or the rest of a political community. But that wasn't just simplistic; it was wrong. The governor was itself part of a larger entity, part of a larger circuit. "The behavior of the governor is determined," Bateson argued, "by the behavior of the other parts of the system," by the environment itself.[51]

Bateson wrote a cybernetic book, and he had met and known all the founding cyberneticists at the Macy conferences. He was a sounding board for their ideas. He mentioned them in the foreword to his most influential book. Yet he never quoted Wiener. He never quoted Bigelow. He never quoted von Neumann. Instead, he was influenced most by the doctor from Gloucestershire. Perhaps

Bateson respected Ashby so much because, like Ashby, he worked in a hospital with mentally troubled patients during his formative cybernetic years, at the Veterans Administration hospital in Palo Alto, from 1949 to 1962.

Bateson referred to Ross Ashby in a curious way. He often harked back to the fellow British cybernetic mind without explicitly referencing Ashby's work, as would be customary in academic writing:

> Following Ross Ashby, I assume that any biological system (e.g., the ecological environment, the human civilization, and the system which is to be the combination of these two) is describable in terms of interlinked variables such that for any given variable there is an upper and a lower threshold of tolerance beyond which discomfort, pathology, and ultimately death must occur.[52]

Bateson had heard and discussed these ideas long before, when he had quizzed Ashby on his homeostat at the 1952 conference on Park Avenue in New York sponsored by the Macy Foundation, cocktails included. But he had not immediately grasped the fundamental, even spiritual, implications of Ashby's experiment.

Now Bateson understood: society was a homeostat. All of Ashby's ingredients were there; the dynamic was that of an "ultrastable system," Bateson explained. The system was "self-corrective." The distinction between organism and environment became blurred. The variables could move only within limits. They were interlinked, like the magnets and troughs in the primitive machine from the English west country. Adaptation happened in response to stress. The objective was conservative: to find a new equilibrium. "Again following Ashby," Bateson observed, the distribution of flexibility among a system's different variables mattered most to achieve that equilibrium. Bateson always recommended the fellow Englishman to his students on a legendary reading list that was posted on the door of his corner office at Kresge College in Santa Cruz.[53]

Bateson took Ashby's idea to its logical conclusion: saying that a computer, or a machine, could be "a mental process" was incorrect, he was sure.

> The computer is only an arc of a larger circuit which always includes a man and an environment from which information is received and upon which efferent messages from the computer have effect.[54]

The notion of a circuit was important to Bateson. A circuit, to him, was a circular connection or movement. It was something larger than just a loop of information; it implied a hardwired and system-wide connection among various parts. The circuit was the bridge between the feedback loop and the network. It was this larger system, or ensemble, that showed mental characteristics.

> The cybernetic epistemology which I have offered you would suggest a new approach. The individual mind is immanent but not only in the body. It is immanent also in pathways and messages outside the body; and there is a larger Mind of which the individual mind is only a sub-system. This larger Mind is comparable to God and is perhaps what some people mean by "God," but it is still immanent in the total interconnected social system and planetary ecology.[55]

To Bateson and to his many disciples, established views were tilted and biased toward the individual. So deeply entrenched were these established views that even he, Bateson, succumbed to them: "If I am cutting down a tree, I still think 'Gregory Bateson' is cutting down the tree." The self, his own mind, was still an "excessively concrete object to him."[56] That was different from the cybernetic epistemology. It was different from the true, correct view of the mind that cybernetics enabled. But there was a huge difference between glimpsing a new way of thinking in exceptional moments, and making that new way of thinking *habitual*.

Bateson needed to get into the habit. So he explored experiences that could help him imagine what it would be like "to have this habit of correct thought," as he called it. He experimented with psychedelic drugs. "Under LSD, I have experienced, as have many others, the disappearance of the division between self and the music to which I was listening," he said at a lecture in early 1970 in New York City. "The perceiver and the thing perceived become strangely united into a single entity."[57] Psychedelics were not an escape into a chemically created artificial reality. The drugs didn't pull down the curtain on the user; they pulled it up. The chemical substance revealed a more accurate, a more correct, and a more wholesome perspective on the world. Psychedelics *liberated* the viewer from an otherwise artificial reality.

Stewart Brand read *Steps* when it came out in 1972. Brand had just stopped editing the *Whole Earth Catalog* and had shifted his attention to similar publications with a different format. Brand was still looking for the book that would explain it all, the whole system. After reading *Steps*, Brand was intrigued. The book, he recalled, provided "the conceptual bonding of cybernetic whole-systems thinking with religious whole-systems thinking."[58] He decided to meet the author who commanded such spiritual persuasion. Brand arranged for an extended interview with Gregory Bateson himself.

Brand spent several days at the anthropologist's home in Big Sur, overlooking the Pacific shimmering in blue and green and gray and reflecting the unique, bright, yet mild light of northern California. He was intrigued by the way Bateson spoke of "circuits." The term appeared more accurate than "feedback loop," more open-system. The network itself began to shimmer like the sea. What kind of networks, Brand wasn't sure. Certainly not just cold computer networks.

Brand’s mind was more wholesome, his eyes hovering along the bright surface of the Pacific. Brand imagined a watched porpoise bedeviling its observer, a chilled body shivering until warm, flesh turning to ashes turning to flesh again, ice ages periodically shaping the ecosystem. He even dwelled on indigenous Iatmul culture in Bali, Indonesia, which Bateson had studied in the late 1930s, where all was “in beautiful cybernetic balance,” as Brand wrote in a long and winding story about his formative encounter with Bateson in *Harper’s* in 1973.[59]

This circuit was cosmic. “Without circuit, without continual self-corrective adjustment, is no life,” Brand wrote, reflecting on Bateson’s philosophy and the time he had spent with him at Big Sur.[60] The story turned out awkward, Brand thought when it came out. But the ideas it articulated were profound. “Every part of cybernetics research is jumping with fascinating activity,” he wrote a year later.[61]

III

For Brand, there were two “cybernetic frontiers,” and they were closely linked. The first was Bateson’s holistic philosophy. The second was *Spacewar*, the world’s first computer video game, released in 1962. The game was hugely influential among the first game developers, and it quickly spread in university campuses and research labs. *Rolling Stone* magazine commissioned Brand to write a long article, with many screenshots of *Spacewar* and extended sections of dialogue. It was 8:00 p.m. on a clear October night in 1972 when Brand came visiting the engineers-turned-gamers in the moonlit and remote foothills above Palo Alto, in Stanford’s Artificial Intelligence Laboratory.

The game involved two players, each in control of a spaceship attempting to destroy the other. The two ships were tiny symbols in the screen’s vast black space circling around a small sun in the center of the screen that had its own gravitational pull. The shots were lines of small white dots in the screen’s dark space. The exchanges among the gamers, chronicled over pages in *Rolling Stone*, went something like this:

“Where am I? Where am I? *click clickclickclickclick*

> "Agh!" *clickclickclick clickclick*
> "Glitch." *clickclick*
> "Awshit."[62]

The game was highly successful. Like so many other successful games, it was addictive. That addictiveness seemed familiar and appealed to Brand. The players in the AI lab used a PDP-10 mainframe, manufactured by the Digital Equipment Corporation, DEC. The machine, in a full configuration, with separate memory and disk and printer cabinets, could fill an entire room, weighed up to 6 tons, and cost about $200,000. The PDP-10 was the machine that popularized time-sharing, an innovative way of enabling multiple users to share the processing power of a large mainframe computer, each with his or her own "terminal."

When Brand saw the machine in action, he saw the future. Reliably with nightfall in North America, hundreds of computer technicians gathered to play. As soon as the action started, Brand observed, the technicians were

> effectively out of their bodies, computer-projected onto cathode ray tube display screens, locked in life-or-death space combat for hours at a time, ruining their eyes, numbing their fingers in frenzied mashing of control buttons, joyously slaying their friends and wasting their employers' valuable computer time. Something basic was going on.[63]

This ability to zone out reminded him of his own experiments with psychedelics in the 1960s, the oneness with the environment, and the perceptual intensity during the trip. The players were captivated, for hours, intense, frenzied—a spasmic grip on the keyboard and a trancelike gaze firmly fixed on the tiny, low-resolution screen, according to Brand "the most bzz-bzz-busy scene I've been around since the Merry Prankster Acid Tests"[64]—the legendary wild parties that took place at the end of 1965 and throughout 1966 in the San Francisco Bay Area, to experiment with psychedelic drugs. Ecstatic Merry Prankster partygoers were drenched in black lights against fluorescent paint, whipped up by stroboscopes, and entranced by the Grateful Dead's first performances.

The Whole Earth editor instantly saw the cultural appeal of this machine. "Ready or not, computers are coming to the people" was the first line in his *Rolling Stone* piece, "That's good news, maybe the best since psychedelics."[65]

For Brand, *Spacewar* was "a flawless crystal ball of things to come." Indeed, he saw what most engineers were unable to see. He had the bird's-eye view. The game represented a break with established principles of power and authority. It represented the coming revolution. It wasn't about top-down control, it wasn't about batch processing, it wasn't about sending data to a manufacturer to make production of something more efficient, it wasn’t about passive consumerism, and it wasn’t about the most efficient use of the machines. The game was the opposite of all that. “Spacewar was heresy,” Brand recognized, and the harbinger of more heresy to come.[66]

The game was intensely interactive in real time on a computer. It encouraged the users—who were programmers already—to be creative, to tinker, to make something new. It was about communication between humans. It served a deeply human interest, entertainment. And it “bonded human and machine” through graphical interfaces. The “hackers” enabled and created all this, not the managers and the planners. The game was about liberation, subversion, and expanding the mind. It was the electronic version of Bateson’s earthy axe-tree-unity—machine-eyes-brain-muscles-keystroke-machine.

Most members of Brand’s generation, he recalled, scorned computers as embodiments of centralized control, as tools of a militarized superpower in a senseless war in Vietnam, wielding computer-controlled nuclear weapons that could end all human civilization. Counterculture had tried and tried various ways to overcome war and capitalism and top-down control. Now, a small group of cultural entrepreneurs and hackers embraced computers as a tool of liberation. These machines, not psychedelic drugs or archetypal geodesic domes, “turned out to be the true royal road to the future,” Brand recalled later, in the mid-1990s.[67]

The editor of the *Whole Earth Catalog* knew well that a longer historical view was crucial to seeing the bigger picture. The hackers, in Brand’s reading of history, came in three waves. The first wave, in the 1960s and early 1970s, came from universities, and from newly minted computer science departments. He had portrayed these tinkerers in his *Rolling Stone* piece on *Spacewar*. They invented time-sharing, against the interest of large corporations, and gave more people access to SAGE-style supercomputers—in effect, turning mainframes into more widely accessible virtual personal computers.

The second wave of hackers, in the late 1970s, overturned mainframes entirely by bringing the personal computer to market. Many of them were hard-core counterculture types—for instance, Steve Jobs and Steve Wozniak, two cofounders of Apple. They had honed their skills by developing, and then selling, so-called blue boxes, illegal phone phreaking devices to make free calls.

Then came the third wave of “hackers,” the social hackers of the early 1980s. The personal computer and emerging network technology didn’t articulate an entire philosophy and aesthetic just by themselves. Of course, building software tools to connect and educate communities helped, and the then emerging free-software movement offered a promising platform. But writers, intellectuals, artists, and organizers needed to develop and carry these ideas and bring them to life hand in hand with the technology itself. This third wave of hackers was more social than technical, and it had a profound cultural impact—with counterculture as its stage-one boost phase. Technology on its own would have been too narrow, too geeky, too insular. But when combined with counterculture and paired with punk and added art, computers became cool.

High Frontiers was an alternative magazine that started up in 1984, with on-the-cheap layout, illustrated with clipped black-and-white pictures invoking the visual style of 1950s *Life* magazine, with an added dash of Dadaism. The tagline left no doubt about the irony of the publication's title, *High Frontiers*: "the space age newspaper of psychedelics, science, human potential, irreverence & modern art." R. U. Sirius and Somerset Mau-Mau started and edited the periodical, using these pseudonyms as well as their real names, Ken Goffman and Mark Frost. The first issue was so crude it was really more of a pamphlet than a magazine, retailing for $1 on counters in head shops on San Francisco's Haight Street and elsewhere. The hip magazine took advantage of the raw punk aesthetic then popular in the Bay Area underground scene. It declared itself the "official psychedelic magazine" of the 1984 Summer Olympics held in Los Angeles.

The countercultural psychedelic movement had a lot of respect for technology, especially computers. The first editorial of the very first issue of *High Frontiers* observed an "acceleration of our culture" by technology, such as "computers and robotics." This fast clip of change made new perspectives necessary. Cannabis, peyote, psilocybin mushrooms, ergot of rye, LSD—all these substances, Goffman suggested, would "accelerate our minds and cleanse our spirits" in order to be better equipped for fast technological and cultural change. "We are, after all, arriving at the technology which is indistinguishable from magick predicted by Arthur C. Clarke [*sic*]."[68]

Goffman was all too conscious of the paradox he was navigating toward: the same scientific and technical know-how that "can kill us all on any given afternoon" could also be used to create an age of abundance, leisure, personal growth, and space exploration. But to open the world's eyes to the peaceful use of science and technology, perceptual blinders that were shuttered needed to be removed. Goffman called for "flexibility, optimism, and generosity of spirit to choose planetary transformation over oblivion." And this is where peyote and LSD came in: "Psychedelic drugs, used in specific ways, are powerful tools in helping to remove our perceptional blinders."[69]

Counterculture celebrity Terence McKenna donated some money to lift the first issue off the ground, and his wife Kathleen helped with the artwork. McKenna was also one of the "psychedelic heroes" interviewed in the magazine. He was a prominent pioneer of shamanism, alchemy, and plant-based psychedelics at the time, and author of the best-selling *Psilocybin: Magic Mushroom Grower's Guide*. For McKenna, magic was a tool, triggered by plants or drugs or dance or exercise. He had encountered these "shamanic technologies" during his ethnobotanical expeditions to the Amazon basin, while looking for tribes using the hallucinogen aa-koo-he-hey. Shamanism, in McKenna's view, was just a self-consistent method of describing the world. Science was another such self-consistent method. "Voodoo is another one," McKenna was convinced.

Once the perceptual blinders were gone, the new and true technological state of affairs was revealed. Information technology was growing ever smaller and less obtrusive, McKenna emphasized. Nineteen eighty-four was the year Apple introduced the Macintosh, the first successful computer graphical user interface with a mouse. The new Domain Name System was about to be launched, enabling the .gov, .mil, .edu, .org, and .com domains. The system evolved out of ARPANET, originally to make sending e-mails technically easier. By then, about a hundred multiuser domains—often abbreviated as MUDs, or simply called dungeons—were active online.

The early internet was evolving fast. Yet McKenna was ahead of his time. To him, a new form of planetary connection was emerging: "Through electronic circuitry and the building of a global information-system, we are essentially exteriorizing our nervous system, so that it is becoming a patina or skin around the planet," he told *High Frontiers*. "And phenomena like group drug-taking and rock-and-roll concerts and this sort of thing," he said, "these are simply cultural anticipations of this coming age of electronic-pooling-of-identity."[70]

McKenna had been heavily influenced by Stewart Brand's philosophy, the *Whole Earth Catalog*'s infatuation with Wiener and Ashby, and later even edited one issue of the *Whole Earth Review*. McKenna pointed out that this global condition of "informational oneness" had become possible through the "advent of more advanced cybernetic systems and more advanced psychedelic drugs."[71]

To the Amazon-traveling ethnobotanist, the very technology that began its evolution in air defense research—and was then refined in the Cold War—didn't clash with the wholesome peace and oneness of the psychedelic subculture at all. On the contrary, technology and hallucinogens were two sides of the same coin: "I think every time you take a psychedelic drug you are anticipating and experiencing this future state of electronic and pharmacological connectedness," McKenna suspected in 1984. This was not an eccentric view. It represented an entire subculture. To those steeped in countercultural thought, *High Frontiers* was also about *access to tools*. Some thirty-five years earlier, Norbert Wiener and the early cyberneticists had tried to defend their new science against holism in all its forms, from Freud to Hubbard. Now, *High Frontiers* was taking the bogy of holism to a whole new level.

Timothy Leary, a countercultural guru, perhaps best captures this changed meaning of technology for counterculture. In 1959, Leary took an academic position at Harvard University as a lecturer in clinical psychology. The young tweed-donning professor was a straight arrow and narrow-minded person, by his own description. "I was very much against computers at the time," he said. In 1960, when the air force's SAGE network came online, powerful corporations and government agencies owned and used these expensive machines, not private individuals. "So I had this prejudice that computers were things that stapled you and punched you," Leary recalled.[72]

The military-run, prohibitively expensive, all-controlling IBM supercomputer was the epitome of both big business and big government. IBM was "Big Brother," as Leary saw it. This lingering image is what Apple mocked with such ingenuity in its famous one-minute 1984 Super Bowl ad, directed by Ridley Scott. An athletic blonde woman in T-shirt and shorts is seen charging past storm troopers, right into the heart of power, carrying that most iconic of tools, a sledgehammer. Then she throws the hammer, smashing the oppressor's larger-than-life image: "On January 24th, Apple Computer will introduce Macintosh," the video concludes, "and you'll see why 1984 won't be like '1984.'"[73] The personal computer had become the ultimate power tool of liberation.

Leary purchased his first personal computer in early 1983. "I've learned so much about drugs and the brain in the last six months from working with a personal computer," he told the audience at the Julia Morgan Theatre in Berkeley in July 1983. His nine-year-old son, and his grandchildren, ten and eleven, had tutored him. The most notable feature, for Leary, was that the computer needed to be "activated," as he saw it. "There is code," he said. It was just the same thing with the brain—the "human bio-computer"—and drugs. Drugs were the code that enabled you to boot up the biomachine in your head in novel ways: "You can activate it!"[74]

Several months later, early in 1984, Leary hosted a belated coming-out party for his computer, on Wonderland Park Avenue, at his home in Los Angeles. The gig was very 1980s: a flurry of guests in leather and silk, donning oversize glasses and neon-colored hair, sipped white wine and played with Leary's stretch limousine. His new IBM PC was sitting on a red lacquer picnic table, the guests hovering curiously around the magic machine, half-empty glasses in hand. IBM had launched the model two and a half years earlier, at an introductory price of $1,565. The box came from the future, in cream color.

“Tim, it’s *beautiful*,” one guest said, admiringly.

“The max, Tim, the max.”

“Make it talk.”[75]

Just days earlier, on January 24, Steve Jobs had introduced the Macintosh at De Anza College’s Flint Center near the company’s headquarters in Cupertino to an enthusiastic crowd. Jobs, in a baggy double-breasted suit, had made the “insanely great” Macintosh talk, to the roaring applause of the twenty-six-hundred-strong audience.

Leary knew that the young idealists, the early computer adopters, recognized the significance of freeing their perception from conformism and conservatism.[76] The vehicle for this subversion was merging man and machine. Not by implanting chips or “microsofts” into skull bones, as new science fiction proclaimed, although he wouldn’t exclude that as a possibility. Leary wasn’t a nerd who thrived in isolation; he was a socialite who thrived on flirtation. “Computers are the psychedelic drugs of the ’80s—oh, absolutely,” the then sixty-three-year-old told his mesmerized guests, “Like psychedelic drugs, they are mind-expanding.”

Leary was a gifted writer, speaker, and provocateur. His vision was both sensual and political. He had recognized the liberating power of the machine just after buying that IBM PC on the red lacquer table. “Personal computers and recreational computers, personal drugs and recreational drugs,” he was sure, “are simply two ways in which individuals have learned to take these powers back from the state.” To achieve this power grab, Leary teamed up with XOR, a Minnesota-based software company then known for its games. LSD, *PC Magazine* joked in an article about Leary’s wild party, would now stand for “Leary’s Software Development.”[77] But Leary wasn’t nearly as good at organizing and software engineering. His plans to develop what he then called artificial intelligence with XOR didn’t go anywhere.

But it was 1984—the year that wasn’t supposed to be like *1984*, as Apple had put it in its Orwell-evoking ad. The Macintosh was here. William Gibson published *Neuromancer*, and an era-defining subculture emerged. Yet something was missing.

IV

It was again Stewart Brand, of Whole Earth fame, who turned a cybernetic vision into reality. A little less than a year after Leary's party, on a day in the late fall of 1984, Brand had a fateful lunch with Larry Brilliant, in a restaurant in La Jolla. Both men were in town for a conference of the Western Behavioral Sciences Institute. Brilliant, a doctor, was a roly-poly man with a goatee and a lot of excess energy. He ran Network Technologies International, a company in Ann Arbor, Michigan, that offered newly designed conferencing software. And he needed a group of people who could bring his new product to life and help him showcase and market its potential. So he pitched an idea to Brand over lunch: take the *Whole Earth Catalog* online, along with its entire hippie community.

Brand was torn. He didn't want to take the old catalog online. He had moved on. He wanted something fresh. He wanted to reach a larger audience and bring in hackers, activists, intellectuals, and journalists. This new community could be really special; ARPANET had been closed off from the public, accessible only to researchers. The nascent internet was growing fast. By 1984, the number of servers connected to "the Net" had exceeded a thousand. The brand-new Domain Name System was introduced that October to simplify its setup. Yet so-called bulletin boards were still geeky hangouts for lone nerds and hacker types, not the online equivalent of a coffeehouse or a countercultural commune where it was fun to hang out and to meet new people. The time had come for something bigger, something more inclusive.

But Brilliant also had a point. The Whole Earth approach had already proved itself in paper form, in slow motion, with people writing in by mail and e-mail, and then waiting for the supplement to ship back to the land. Brand agreed to the deal. Brilliant's Ann Arbor company backed the agreement with what was then a significant investment: $150,000 for a VAX computer, a dishwasher-sized mainframe manufactured by DEC, a rack of half a dozen modems, and initially six telephone lines, plus another $100,000 for the primitive conferencing software, a Unix-based platform called PicoSpan.

Brand needed a name. Why not at least re-create the Whole Earth spirit in name, he thought. After some doodling, he found a quirky acronym so forced that it was also self-deprecating: WELL, which stood for Whole Earth 'Lectronic Link. In the spring of 1985, the WELL's hardware arrived in the ramshackle Sausalito offices of the Whole Earth, tucked between houseboats off the pier.

The community platform opened on April 1, 1985.

The WELL's newly hired director was Matthew McClure. McClure had worked as a typesetter for the *Whole Earth Catalog* until 1971. He then spent twelve years on the Farm, a large hippie commune in Lewis County, Tennessee. Brand hired McClure again in 1984 when he returned to the Bay Area. McClure was the ideal man for the WELL: a tech-savvy commune dweller of Whole Earth extraction. This time the two men wanted to make the online commune as accessible as possible to a large number of communards, practically to anyone with a computer and a modem. They pushed the monthly usage fee down to $8, plus $2 per hour. The lower the entry barrier, the better. The user dialed the number with an old-fashioned modem, machine-screaming a whining song of acoustic numbers into the phone. There were no videos, no pictures, no sound. Everything was text, and command based. Thus, denizens of the WELL had to learn to use a clunky system that often broke down. At first the WELL remained a curious and somewhat freakish phenomenon, experienced in low resolution, in rounded, thick glass, and visibly flickering.

Brand advertised the new platform a few times in the *Whole Earth Review*. His instinct was to offer free accounts to reporters, to spread the word faster. By 1986, the online community had grown to about five hundred.[78] Six years later, the number was about six thousand. The WELL was perhaps the first proper online social network with general appeal. It had all the upsides and downsides that come with social media: it was addictive, it was entertaining, it was riveting, and it could be a waste of time. There were great discussions, and there was spamming and trolling. A minority did the majority of the talking.

The social-media pioneers had enough experience to intuitively get the details right. Real names mattered. So, everyone's real name was available on the system, in "finger files." Any user could simply finger another user's screen name—say "hlr" or "rabar"—and pull up the user's real identity. It also mattered that users, not the WELL, took responsibility for what they said. So, Brand and McClure came up with "YOYOW": "You own your own words." The motto greeted every user on the log-in screen. Nobody could reproduce what somebody else had written.

These rules promoted civility and a high quality of discussion. And the initially small number of regionally clustered users meant that the WELL was indeed different from later and larger social networks in one critical aspect: there was an expectation that you would, sooner or later, meet the others in person, face-to-face, perhaps at one of the regular parties at the home of the WELL's mainframe and its administrators in Sausalito, a pleasant half-hour drive across the Golden Gate Bridge from downtown San Francisco. All this made for a real small-town community feel online.

The discussions were organized in so-called “conferences.” These threads covered a potpourri of topics: environment, future, books, drugs, sexuality, or “best and worst memories of the sixties.” The mideighties version of emoticons was typing “<smiles>” or “<hugs>” in pointy brackets, coding-style. All this appealed to baby boomers, who had come of age in the 1960s and were now in their late thirties and early forties—bright, libertarian, male, with postgraduate degrees. Their demographics and common interests alone made this online community a unique cultural phenomenon, in a “self-absorbed, cabalistic way,” observed journalist Katie Hafner in a *Wired* article about the WELL that has become a classic.[79]

One enthusiastic WELL member was Ramon Sender Barayón, a.k.a. “rabar,” a San Francisco artist and writer. With the Merry Pranksters, Sender had coproduced the now legendary 1966 Trips Festival, a formative event for the hippie movement. Initially, he had difficulty with PicoSpan, the clunky conferencing software, “but then I felt the energies on the WELL,” he recalled.

> It reminded me of the Open Land communes I’d been to in the 1960s. The tribal need is one our culture doesn’t recognize; capitalism wants each of us to live in our own little cubicle, consuming as much as possible. The WELL took that need and said, “Hey, let’s see what happens if we become a disembodied tribe.”[80]

Yet the tribe wasn’t completely disembodied. The earliest hippies, like Brand and Sender, understood that the online communication worked so well only because of the face-to-face contact between members of the community. That’s why the regular Sausalito meetings were so important, as some more distant members discovered. Jon Lebkowsky started dialing in from Austin, Texas, in 1990. In terms of interests, personality, and culture, he was an ideal fit, and he would later become a well-known activist. But he felt that his posts were ignored until he made the long trip to the Bay Area to attend a WELL party.

The very idea of separating online and offline didn’t square with the cybernetic minds of the Whole Earth pioneers. It was like isolating one of Ashby’s units of the homeostat, like cutting off Wiener’s negative feedback loops, like taking Bateson’s axe away from the man felling the tree—the antithesis of balance and whole systems. From the get-go, Brand wanted the Whole Earth network to be self-governing; he wanted the system to be a sociotechnical homeostat, a collective thinking machine and communal learning mechanism.

The experiment succeeded far beyond his expectations. The WELL brought Bateson’s metaphorical “circuit” in line with the technical circuits on the mainframe, one powering the other. The line between system and environment, or between offline and online, indeed became arbitrary. The WELL literally linked the “two cybernetic frontiers,” Brand had written about ten years earlier in *Rolling Stone* and *Harper’s*: the mind and the computer.

To the hippies at the congenial monthly Sausalito parties, the VAX mainframe was the long-awaited machine of loving grace (it had to be!).[81] Cliff Figallo, another former communard from the Farm in Tennessee, and the WELL’s nineteenth user, lovingly built the cabinet for the VAX. The WELL’s cybernetic origin in Norbert Wiener’s air defense research wasn’t just palpable in Brand’s philosophy, his approach to community organizing, and decades of Whole Earth work. The same type of dishwasher-sized DEC mainframe that powered the escapist hippie machine in Sausalito also powered the Minuteman ICBMs slumbering in the nation’s atomic missile silos, ready to wipe out the Soviet Union at the push of a button.[82]

So, it was not a coincidence that the idea of cybernetic space was first brought to life on the WELL’s Sausalito server.

6. SPACE

ON MARCH 27, 1984, *CBS EVENING NEWS* REPORTED ON A revolutionary new display technology invented by the US Air Force. An engineer in aviator glasses and a brown leather jacket stood in front of the camera and explained to mesmerized Americans how pilots could now fly in "virtual space," to video game–like images of jets racing along a grid-like electronic globe. Indeed, air force engineers were the first to articulate the idea of virtual space in the early 1970s, and then to realize it in a range of prototypes over an entire decade. This pathbreaking military research became public that March.

It was a potent cybernetic idea: a separate, virtual, computer-generated space distinct from real physical space—what later became known as "cyberspace." For decades, visual artists in advertising and film had articulated and imagined the space inside electronic apparatuses akin to outer space, portraying the atom as a solar system, with electrons orbiting like planets, the whole Earth encapsulated in a lightbulb, or tiny humans working inside giant vacuum tubes.[1] By the early 1980s, the idea had found its moment. The space inside the machine inspired and mesmerized the countercultural avant-garde, which already sensed that the technical ground was shifting. The 1980s became a decade of imagination, of "consensual hallucination," in the immortal words of William Gibson.

By the end of the decade, virtual-reality technologies were all the rage: data gloves, data goggles, and data suits triggered eccentric visions of how humans would interact through networked computers and wearable interfaces. The machines of the near future, many readers of the *Whole Earth Review* came to believe by the late eighties, would enable intense immersive experiences that would rival and surpass the most intense emotional experiences available to date: sex, music, and drugs. An entire subculture—cyberpunk—emerged at the curious intersection where technology and networked machines met mind expansion, psychedelics, music, and fashion. By 1988, entrepreneurs and intellectuals, inspired by cybernetics, control, man-machine interfaces, and whole systems, had dubbed this new place "cyberspace."

At first, this novel space was something that could be entered only with fancy hardware interfaces, with goggles and gloves and data suits. It was synonymous with virtual reality. Then, sometime in the spring of 1990, a curious flip happened. Cyberspace became almost synonymous with the entire internet. By the early 1990s, virtual space—discovered by the air force and coveted by hippies—became something that could be accessed with more affordable hardware by millions of legitimate operators; a personal computer and a modem were enough to begin the fantastic voyage to the new frontier. Cyberspace was on its gleaming path to becoming a mythical new realm of freedom and liberty—and of war.

I

The US Air Force was flying and fighting in cyberspace before Gibson had even coined the term. The same problem that had inspired Norbert Wiener during the Blitz in World War II had kept air force engineers busy throughout the fifties and sixties: human-machine interaction in the cockpit under stress. The result was the air force's invention of "virtual space" in the early 1970s.[2]

The trigger was Vietnam. The F-4 Phantom and the F-105 aircraft were used extensively in the war. But these ageing planes were at the end of their life cycles. They had limited cockpit space for updating and modernizing the displays.[3] This constraint prompted early innovative work on display technologies. By the early 1970s, McDonnell Douglas was developing the F-15 Eagle, and General Dynamics was working on the F-16.

But instead of improving the cockpit design, these fourth-generation fighter-bombers made the problem worse. An F-15 cockpit at night was a sea of lights and instruments: three hundred switches and seventy-five displays, including the so-called vertical situation display, the horizontal situation display, standby instruments, and radar. The control stick alone had eleven switches, and there were nine more on the throttle. All this was connected to about fifty computers providing stability augmentation, air data on speed and altitude and temperature, propulsion control, electronic warfare systems, various weapons, and so on. By interacting with these computers, an F-15 pilot effectively controlled an energy delivery system hurtling through space beyond the speed of sound.

The complexity was overwhelming. A state-of-the-art cockpit displayed more data to the pilot than a human was able to process, and it did so on tiny displays. Operators complained that their brains would “ooze out of their fingertips.”[4] Another problem was the high g-forces during ever-faster high-speed maneuvers. These forces made precise free arm movements difficult. As a result, tracing targets and aiming weapon systems became harder.

Human-machine interaction was ripe for revolution. The air force’s Harry G. Armstrong Aerospace Medical Research Laboratory decided to take the idea of the cockpit back to the drawing board, to design the “ideal cockpit,” as one of the lead engineers recalled. The question was straightforward, if daunting: “How could we input information to that crewmember”—the pilot—“so he could quickly make decisions?”[5] The air force engineers already had a guiding vision: “The key to solving these problems is to make the interfaces to the machine more ‘human-like’ rather than requiring the human to be more ‘machine-like,’” they understood.[6]

One of the key officers on the team at Wright-Patterson Air Force Base was a freshly commissioned second lieutenant, Thomas Furness. Furness was well qualified, with a degree in electrical engineering from Duke University. In the late 1960s, the lab started off working on helmet-mounted sights, to guide a plane’s weapon systems simply by pointing the head at the adversary. The next task was a workable night-flight display that was directly in front of the pilot’s face, not down in the crowded cockpit display area. Furness’s lab was entirely unaware of earlier, much more primitive work on three-dimensional displays.[7] Flying by a tiny 4-inch display down in the cockpit at arm’s length of the pilot’s face was clumsy; pilots don’t want to “go into the cockpit,” in aviator lingo. Head-coupled night vision would be a huge improvement, with an enhanced image projected into the transparent glass visor of a helmet.[8]

Over the next months and years, the air force lab made impressive progress with helmet-mounted sights. By 1976, Furness and his team had come up with the design plan for a “visually coupled airborne systems simulator,” or VCASS.

Their vision was “visually coupling” man and machine, as the project’s lead engineer told a DARPA conference on biocybernetic applications for military systems in Chicago in April 1978.[9]

Inspired by cybernetics, researchers in the Wright-Patterson lab had even more ambitious plans of “deeply coupling” pilot and plane. Their vision was to “input” information into the pilot’s brain through the VCASS display—visually, acoustically, and through touch—and then to “output” information from the pilot’s cortex back into the computer, by measuring neurologically evoked nerve potentials in the brain through magnetoencephalography. All that, the air force hoped, would work during high-stress air-to-air combat. Such direct “biofeedback” meant that flying machines “would be able to provide superhuman capability.”[10] The goal was winning in air-to-air dogfights by simply thinking about maneuvers and firing missiles.

A prototype of the lab’s complex helmet display became operational in 1981. The engineers later called it the super cockpit. The visually coupled VCASS helmet was the most sophisticated virtual-reality system ever built. Although it had “simulation” in the name, it was designed to become an in-flight system, to control an actual fighter plane against actual adversaries.

But it looked ugly and clunky. When the first test pilots from Edwards Air Force Base in California came over to the lab in Dayton, Ohio, they were shocked. “You got to be kidding me,” one said, incredulously. “Come on, Furness, what is this all about?”[11] One TV report later called the prototype helmet a “ridiculous contraption,” and journalists regularly made fun of the design.[12] The prototype was so unwieldy that it needed to be lowered over the pilot’s head from the ceiling above the test cockpit.

Thankfully, science fiction came to the rescue. In May 1977, George Lucas’s film *Star Wars* was released. Not only did the final showdown feature the hero Luke Skywalker using a targeting computer with helmet-mounted sights attacking the Death Star, but the helmet of the villain, Darth Vader, eerily resembled the air force’s own design—so much so that the engineers themselves immediately made the connection: “The VCASS looked like a Darth Vader helmet,” Furness recalled.[13]

Other officers, and later the media, loved making the comparison. Oversize helmets with eerie eyes suddenly became cool. But the air force helmet didn’t just look like science fiction. The engineers had crammed the system with cutting-edge technologies that were far ahead of anything the private sector had to offer at the time—even Luke Skywalker’s computer-controlled sight looked outdated in comparison to the air force’s system; the young hero had to pull the clunky thing up from behind his seat as he was trying to obliterate the Death Star.

The lab at Wright-Patterson had spent about $40 million developing the system over the years, with a team of more than a hundred people working on the helmet and its accessories.[14] The display had a high-resolution, high-luminance image source that would paint a panoramic picture in whichever direction the pilot looked, independent of the aircraft's boresight, even when obstructed by the plane's fuselage.[15]

The helmet provided a stereographic view, with one display for the left eye and one for the right, spanning a range of 120 degrees by 60 degrees. It had a partially silvered mirror, took advantage of holographic lenses, and filtered ambient light. The lab had even manufactured 3-D earprints, small models of digital human ears. The engineers had understood that the shape of the ear itself enabled the location of the sound in space. And they needed ears to design truly 3-D sound systems, not just simply stereophonic sound. The system tracked hand movement and even provided tactile touch feedback to the operators. Tiny pneumatic cushions sewn into the gloves meant the pilots could feel that a virtual switch had actually been pushed.[16] The machine was powered by eight room-sized VAX computers and water-cooled electronics.

Once geared up in the oversize prototype helmet, the pilot was able to interact with the aircraft in four different ways: by simply turning the head to look at a target, prompting the plane to aim its weapons accordingly; by voice control, speaking commands into a microphone (such as "Select," "Lock on," "Zoom"); by a touch-sensitive panel, calling up virtual switch panels; and by moving gloved hands, with a magnetic tracker that sensed hand position and orientation.[17]

A fifth control interface was possible but not yet installed in the simulator: control by eye movement, with an eye position tracking system incorporated into the headgear, measuring the orientation of the eye relative to the helmet. Humans usually turn their eyes to orient themselves, not the entire head, so eye tracking was a logical next step. The idea was that the pilot would be able to simply look at switches to toggle them on or off.

Once the helmet was lowered over a pilot's head, Furness and his team would switch on the imaging processor and a crisp, wide virtual image would appear in front of the pilot. The air force didn't want to present a highly complex picture to its aircrews. Complexity had been the problem in the first place. The idea was the opposite: to avoid a highly complex picture. "We fused the information from all these sensors into a cartoon," said Furness.[18]

The simplified map was in one-to-one registration with the real world. The pilot was able to tell how high he was above the ground, which was shown as a rough grid, just by seeing the virtual picture flow by, at low altitude and high speed. A pathway in the sky was automatically computed to avoid danger zones and displayed in the same panorama. Radiating surface-to-air missile batteries were shown as red cones of lethality, like vast and dangerous virtual cathedrals reaching into the sky; nonradiating batteries were shown as simple yellow boxes on the ground. The system displayed friendly airplanes in the sky as white planes, and any potential enemy as a small red plane in a yellow cube. The pilot could see everything at once, in one glance.

The skeptical experimental pilots, with proud "X" badges on the chests of their jumpsuits, were mesmerized. The system was "painting radar into the sky" for them, along with energy management information. They didn't have to go into the cockpit, but could keep their eyes on the adversary instead—eyes, and ears: "They'd be flying along; the test-pilots would hear the enemy coming in from the back," Furness said, because the system was programmed to use sound to indicate the enemy's position to the pilot. Being under the helmet was close enough to the real thing: "You'd hear a few swear words coming out," Furness recalled. After flying and fighting in early 1980s virtual space, the test pilots stepped outside the cockpit with sweat rolling down their faces. They were impressed. "This is fantastic," they would say. "When can we have it? It is the only way to go!"[19]

"The super cockpit was a cockpit that you wear," the program's chief engineer explained later. "You put on a magic flight suit, you put on a magic helmet, you put on magic gloves. You plug into the computer, and you create this panorama of three-dimensional information that you see, hear, touch."[20]

The Darth Vader helmet was a revolution—not just practically, but conceptually. Air force designers slowly came to understand the significance of computer-generated space. "The notion of virtual space really evolved in the early seventies for us, in my lab," recalled Furness, the lead engineer.[21] The air force already understood that to surround operators with three-dimensional information was not sufficient. Just watching wasn't good enough. Pilots needed to be able to interact with the displayed information and manipulate it—say, by flicking a virtual switch. This interaction is what created the perception of being in a separate space.

The engineers had long anticipated virtual space. On May 17 and 18, 1977, one week before *Star Wars* opened in theaters, Dean Kocian, one of the Wright-Patterson lab's lead engineers, had gone down to Phoenix, Arizona, to a conference at Williams Air Force Base. Kocian predicted that their project would enable his team to create "virtual space." State-of-the-art computer images could create synthesized hemispherical visual spaces. This approach was cost-effective and flexible. Once the hardware was created, the software designers would have full creative freedom: "Visual display configurations in virtual space can be developed and altered by simply changing the related software," Kocian told an audience of engineers and air force personnel in Arizona.[22]

Developing the display presented many problems. Some of them were unexpected. Already in 1978, the Wright-Patterson team reported discovering what it called "display fascination" to a DARPA conference on biocybernetics. Extensive testing and a body of anecdotal evidence showed that "crew members often become enthralled or 'drawn into' their display," so that it becomes difficult for them to interrupt or change the focus of their attention.[23] The lure of the display could potentially present problems during operations. The air force was worried that it took test pilots consistently longer to redirect their attention from the display to the real world than from the real world back to the display. It was as if the operators would default into the machine.

Despite these early clues, the air force engineers initially didn't realize the full power of what they were developing. That conception changed dramatically in 1981, when the full prototype system with all components was ready for testing in the lab—by the engineers themselves, not yet by test pilots. "When we turned the lights on the first time, it was like somebody reached out of that computer and pulled us inside. Now, we were not looking at a picture anymore, we were in a place, a place that was generated by that machine,"[24] said Furness, recalling the reaction in the lab at Wright-Patterson. "It was like you left your seat and went to another place."[25]

The air force leadership began to recognize the technology's potential, including its public affairs potential. Sometime in early 1984, Furness got a call from the Pentagon. A high-ranking officer asked whether the lab at Wright-Patterson could put together a news release. *CBS Evening News* with Dan Rather called first to schedule a slot. David Martin, a CBS reporter, spent an entire day on the base for filming. On the evening of March 27, 1984, Americans saw test pilots flying in virtual space in what the reporter called a "Darth Vader helmet."

Furness, now a civilian but still in aviator leather jacket, told CBS how the pilots were flying "in what we call virtual space." Lieutenant Colonel Arthur Bianco, an F-16 pilot and program manager, had an even better description: "The simplest way to think about it, conceptually, is *Star Wars* and R2-D2," Bianco said, against CBS's background displaying the final battle scenes of George

Lucas's science fiction film, with Luke Skywalker flying his four-winged attack glider against the Death Star, the iconic R2-D2 robot as his copilot, and the Empire's attack gliders screaming by. "We're taking the first steps on a very long path of getting a real R2-D2 in our fighters," the F-16 pilot said.[26]

McDonnell Douglas and Kaiser Electronics had already started developing an operational prototype, in cooperation with Furness's lab in Ohio. The helmet was called the "Agile Eye." And to improve the clumsy original VCASS design, the air force engineers turned to Lucasfilm, among others. "We actually used the same industrial designers that had designed Darth Vader's helmet to design the Agile Eye," Furness said.[27]

The group had nearly a hundred designs. To select the best helmet, they took the designs to a wind tunnel. Aerodynamic properties were critical. During an emergency ejection at a speed of about 560 miles per hour, the lift forces on the pilot's neck can be as high as 500 pounds, enough to kill him. The shape that the Lucasfilm designers came up with, by accident, acted like a spoiler with superb aerodynamic properties, reducing the lift in case of an emergency ejection by half. "Uh, this is really cool," the engineers said. By early 1987, the Agile Eye was ready for testing and soon thereafter for operations. It doubled the kill ratio of pilots during air-to-air combat training.[28]

Meanwhile, the CBS story triggered an avalanche of news coverage, and the coverage, in turn, sparked general interest in virtual-display technology. For a few more years, the lab at Wright-Patterson Air Force Base was the sole pioneer pushing out this technical frontier. But the huge public interest from journalists, from academics in other fields, and from the general public led to a change of mind-set.

Two of the engineers from Wright-Patterson took part in an aerospace conference on simulation in January 1986 in San Diego. It was a civilian conference, not held at a military base. Furness and Kocian gave a talk titled "Putting Humans into Virtual Space." They summarized their research and presented the virtual cockpit. They explained how the display could be stabilized against different features of the environment to give the pilot a steady focus: against the pilot's head for selecting virtual switches without shaking; against the cockpit to render instruments; against Earth to navigate way points; or against another plane for aiming fire.

But soon the air force team had applications in mind that went beyond dogfights and bombing runs. "Using this system," two of the military engineers told the audience in San Diego, "the operator becomes part of a 'designer's world' created in virtual space."[29] They began to understand that there was no reason why this should be limited to an F-15 Eagle. The operator could be a welder, with the mask displaying temperature and gas mixture in real time; or a shopper trying on virtual clothes; or a surgeon traveling into the virtual space that is the patient. Furness spelled out this vision for *Popular Mechanics* in 1986:

> As he [the surgeon] makes his incredible journey inside this human being, he sees a whole new world from inside the blood vessel. He "pilots" the catheter probe, navigating toward the heart, while hearing the gurgle of blood around a defective heart valve. As he approaches the heart valve, he reaches out with his hand to remotely control a miniature suturing machine which corrects that valve malfunction.[30]

The story was illustrated with an image of a doctor in a white lab coat, sticking a green-glowing catheter into a patient's chest while wearing the Darth Vader helmet.

By now, Furness foresaw that developing the hardware would be straightforward. "We know what to do," he said. "But the same cannot be said of the mindware."[31] The air force engineers felt that humans and machines were getting so closely coupled that "software" wasn't an appropriate term anymore, so they suggested "mindware" instead. Either way, developing the correct code would be the real challenge: "It is the mindware which provides the virtual workstation or super cockpit environment for the pilot," Furness told a symposium in May 1988, in his thick southern accent.[32] A few months later he left the air force to focus on nonmilitary uses of what would soon be called "cyberspace" (although nobody had yet used the term outside of Gibson's science fiction stories).

II

While the air force's Wright-Patterson lab was busy playing with virtual space, the idea began to capture the imagination of science fiction writers. Perhaps the single most influential book on the imaginary space inside the machines isn't Gibson's first and famous novel, *Neuromancer*, but rather Vernor Vinge's novella *True Names*,[33] published in 1981, the same year the VCASS was switched on in secret. Vinge is often credited with being the first to articulate the then futuristic vision of computer-generated parallel worlds as new domains of human interaction.[34] The author was well placed to be a pioneer: he then worked as a professor in computer science and mathematics at San Diego State University.

True Names plays out in an imagined future. It tells the story of a group of computer hackers who lead a double life—one in the “real world” and one on the “Other Plane,” a virtual world inside computers, processors, and switches. Roger Pollack, Vinge’s main protagonist, would enter this “data space” through so-called Portals. These entry points were installed in the protagonists’ homes, hooked up to a network operated by familiar-sounding service providers such as Bell, Boeing, or Nippon Electric. Vinge’s description of Pollack’s delicate ascent to the processor-generated Other Plane has become an iconic image:

> Then [Pollack] sat down before his equipment and prepared to ascend to the Other Plane. . . . He powered up his processors, settled back in his favorite chair, and carefully attached the Portal’s five sucker electrodes to his scalp. . . . For long minutes nothing happened: a certain amount of self-denial—or at least self-hypnosis—was necessary to make the ascent. Some experts recommended drugs or sensory isolation to heighten the user’s sensitivity to the faint, ambiguous signals that could be read from the Portal.[35]

Vinge’s vision was not unlike that of the Wright-Patterson engineers: man and machine were deeply coupled, through the brain’s electrical signals, linked by sucker electrodes. While their real bodies were left sitting in the real world, in their favorite chair, “users” made the mental ascent, their representations finding themselves in a bizarre, *Alice in Wonderland*–style world of talking frogs, magma moats, and icy mountains. Vinge’s protagonists would wear asbestos T-shirts and use fantasy pseudonyms, like Erythrina or Don.Mac, not their true names. Those true names remained secret on the Other Plane. Pollack’s nickname was Mr. Slippery.

Vinge’s story played with the relationship between the real world and the virtual:

> Its moats and walls were part of that logical structure, and though they had no physical reality outside of the varying potentials in whatever processors were running the program, they were proof against the movement of the equally “unreal” perceptions of the inhabitants of the plane. Erythrina and Mr. Slippery could have escaped the deep room simply by falling back into the real world, but in doing so, they would have left a chain of unclosed processor links.[36]

In Vinge’s story, the various landscapes and features of the Other Plane depicted real-world phenomena in a dreamlike way. A swamp, for instance, “represented commercial and government data space,” while a 2,000-ton satellite in static orbit over the Indian Ocean, which created a 900-millisecond time delay in communication, was “represented as a five-meter wide ledge” near the top of a mountain rising from those swamps. That ledge was a safe meeting space to conspire against an all-controlling government. *True Names* articulated one of cyberpunk's dominant themes: escaping into computer networks. "Some experts" in Vinge's story even "recommended drugs" to smooth the entry into the portal. Yet cyberpunk's postapocalyptic aesthetic was largely absent.

In the heady days of the early 1980s, writers did not have to look hard for inspiration. Counterculture was ripe with excitement about the rise of computers, yet cowed by the omnipresent and very real possibility of nuclear annihilation. In November 1983, a NATO crisis simulation exercise dubbed "Able Archer" was nearly misread by the Soviet Union as an impending nuclear attack, marking perhaps the single most dangerous moment of the Cold War.[37]

The tension between hippie utopia and nuclear dystopia was palpable.[38] It expressed itself in an escapist counterculture characterized by an intoxicating blend of punk, futurism, surreal collages, psychedelic visual art, a virtual-reality technology fetish, industrial and electronic music, and drugs. Cyberpunk had its own distinct fashion, with ponytails on men, tattoos on women, all-black leather jackets with mirrored shades on everybody, and hats brimmed with irony. The subgenre's symbolic father figure was William Gibson, an American-Canadian novelist with more links to counterculture than to computer science.

Gibson explained his muse in an interview with the *Whole Earth Review*. He wanted to write a novel, so he was looking for a place to set the story. The science fiction of Gibson's own childhood was space travel. The vehicle was the rocket ship. But outer space didn't resonate with Gibson. Inspiration came to him one day as he walked past the windows of a video arcade. Gibson recounted watching the kids play with the primitive purpose-built gaming machines, in rows, emitting bleeping sounds and flashing lights, like slot machines in Vegas:

> I could see the physical intensity of their postures, how rapt these kids were. . . . You had this feedback loop, with photons coming off the screen into the kids' eyes, the neurons moving through their bodies, electrons moving through the computer. And these kids clearly believed in the space these games projected.[39]

In Gibson's mind, a new level of human-machine interaction had been reached. "The body language of just like intense longing and concentration," he thought. "It felt to me like they wanted to, like, go right through the glass at the back of the machine. They wanted to be inside there with—the pong or whatever."[40]

Now he had a space: inside the machines. Gibson just needed a name. He tried different ones. "Dataspace" didn't work. "Infospace" didn't work. "But cyberspace!" Gibson wrote the word down on a notepad. It sounded like it meant something, or as if it might mean something, he thought. But then maybe not. "As I stared at it in red Sharpie on a yellow legal pad," the author recalled, "my whole delight was that it meant absolutely nothing."[41]

It was exactly what a science fiction author wanted, a hot but meaningless idea. Gibson was able to charge it with meaning, to specify the rules for the arena. He had derived it from cybernetics—another word that to him sounded evocative, spiritual, computer-related, deep and dangerous. Gibson first used the word "cyberspace" in passing in his 1982 science fiction story "Burning Chrome," published in one of the hottest literary and cultural magazines of its day, *Omni*. In the story there is a "chic bar for computer cowboys, rustlers, cybernetic second-story men," and Gibson mentions "cybernetic virus analogs, self-replicating and voracious."[42]

Two years later, in *Neuromancer*, Gibson introduced the new space inside the machines in the trademark language that made his work so popular. The segment describes the fictional thoughts of Henry Dorsett Case, a low-level drug dealer in the dystopian underworld of Chiba City, Japan:

> A year here and he [Case] still dreamed of cyberspace, hope fading nightly. All the speed he took, all the turns he'd taken and the corners he'd cut in Night City, and still he'd see the matrix in his sleep, bright lattices of logic unfolding across the colorless void. . . . The Sprawl was a long strange way home over the Pacific now, and he was no console man, no cyberspace cowboy. Just another hustler, trying to make it through.[43]

"Cyberspace," for Gibson, was meant to evoke a virtual, disembodied world of computer networks that users would be able to "jack into" through consoles and portals. By far the most quoted paragraph comes later in the book. These few lines of science fiction have become the canonical description of cyberspace, to be repeated many times in countless scholarly and military publications to come:

> Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts. . . . A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding.[44]

Gibson's novels had their own aesthetic. People lived in sprawling cityscapes, crammed and gritty and dark. Washed-up computer cowboys and hustlers with alien tattoos, shades, and neural implants that were blurring the line between human body and machine part. The stories had an apocalyptic feel, like Ridley

Scott’s 1982 cult film *Blade Runner* or *The Matrix*, a 1999 film directed by the Wachowskis.

Gibson romanticized the technology. When he shaped the language and the aesthetic of cyberpunk, he didn’t even know that hard drives had spinning disks. “Fortunately I knew absolutely nothing about computers,” he recalled.[45] Until late in 1985, the fêted science fiction author and creator of cyberspace didn’t even own a personal computer. And people talking about computers bored him. For Christmas that year, Gibson finally bought an Apple II at a discount. The machine’s successor model, the Macintosh, had been launched so effectively nearly one year earlier with the legendary cyberpunk ad “1984,” but the older Apple II was still a best-selling device.

When Gibson booted up the machine at home and got ready to use it, he was shocked by the computer’s mundane mechanical makeup. “Here I’d been expecting some exotic crystalline thing, a cyberspace deck or something, and what I’d gotten was something with this tiny piece of a Victorian engine in it, like an old record player.”[46] The science fiction writer called up the store to complain. What was making this noise? The operator told him it was normal; the hard drive was simply spinning in the box that was the Apple II. Gibson’s ignorance about computers, he recounted, had allowed him to romanticize technology. And romanticize he did:

> She slid the trodes on over the orange silk headscarf and smoothed the contacts against her forehead.
>
> “Let’s go,” she said.
>
> Now and ever was, fast forward, Jammer’s deck jacked up so high above the neon hotcores, a topography of data he didn’t know. Big stuff, mountain-high, sharp and corporate in the nonplace that was cyberspace.[47]

Those two science fiction visions of computer-generated spaces would appeal to different yet overlapping communities: Gibson’s *Neuromancer* appealed to a wider and, in the short term, more influential community passionate about counterculture, aesthetics, virtual reality, and drugs. Vinge’s *True Names* appealed to a narrower group that became influential only in the long term: those passionate about engineering, gaming, encryption, and privacy.

But for now there was a problem. The air force had developed the hardware in secret. Vinge and Gibson had developed the vision in novels without even knowing of the air force’s first steps in virtual space. Vision and prototype needed to be connected.

Jaron Lanier embodied what the *Whole Earth Catalog* stood for: offbeat, dreadlocked, bohemian, raised under a geodesic dome in Mesilla, New Mexico. Lanier went from performing on the streets of Santa Cruz to writing software for

Atari, an arcade game company. At Atari, Lanier had created *Moondust*, a primitive art-music game. The game confused many players because it was so different, not a first-person shooter but peaceful, "trippy," as one called it.[48] In 1984, the year *Neuromancer* was published, Atari's business started to sour and Lanier lost his job.

But Lanier had already started working on a "postsymbolic" visual programming language. Programming by coding seemed archaic and unnecessarily complicated and exclusive to young Lanier. His vision was manipulating objects in three-dimensional space. He had been working on a visual programming language that he called Mandala. Then the popular magazine *Scientific American* devoted its entire September 1984 issue to software. The editors had heard of Lanier's project and chose one of his visual programming experiments as a cover illustration. It showed a kangaroo, an ice cube, a score, colored swallows, and a trumpet. One day in August, Lanier received a panicked call from an editor. "Sir," the editor told Lanier on the phone, "at *Scientific American* we have a strict rule that states that an affiliation must be indicated after a contributor's name." But Lanier didn't have one at the time, so he made something up on the spot. "VPL Research," he blurted out, for "visual programming language." After the issue came out in September, investors started calling, and he founded the company for real.[49]

Soon Lanier discovered that having the traditional combination of screen and keyboard and mouse was a limiting factor for visual programming. The right interface was missing. There was no hardware to move things around. One possibility, Lanier thought, was that data gloves would do away with the mouse. Elegant hands-on screens would replace clunky arrow pointers and old-fashioned cursors. That way, even unskilled users could simply grab an object in a screen, twist it and turn it and reposition it, and interact with the machine. It was a bit like playing the drums or like conducting. Lanier wanted to be able to wave his hands and arms and make electronic music through motions.

In a stroke of good fortune, Lanier met Thomas Zimmerman at an electronic music concert in Stanford. They had both worked at Atari but never met there. Coincidentally, several years earlier Zimmerman had started developing a "data glove." In 1982 he had even filed for a patent on the glove.[50] Zimmerman's invention mounted optical flex sensors on the hand's individual fingers to measure how the fingers bent; not even the US Air Force engineers at Wright-Patterson Air Force Base came up with that idea. Zimmerman's passion for developing the glove came from a long-frustrated desire to play air guitar and create actual sounds by touching strings that weren't there.[51] Like Lanier, Zimmerman had envisioned conducting an entire orchestra playing electronic music by hand waving. He had also studied ballet at MIT, so he immediately thought his input device could extend over the entire body.[52] Zimmerman joined VPL in 1985.

The idea of a virtual concert was especially appealing. “Why not have it in a space that you’re actually in?” the founders reasoned. They had an input device with the glove. But to create the perception of virtual space, they needed an output device—some sort of head-mounted display to show the machine’s output to the human. So VPL started working on what the young company called the “eye phone,” little screens that sat on the eyes like the speakers of an ear phone sat on the ears. The key feature of the new device was a pair of color LCD displays that looked like two small TV monitors that had seen better days.[53]

Unfortunately, the prototype helmet was rather uncomfortable. The screens were heavy, so the contraption had lead weights to keep what looked like a black cyclist’s helmet balanced on Lanier’s or Zimmerman’s head. Just like the air force, VPL was discovering that the device’s center of gravity mattered a great deal. Putting the eye phone on wasn’t easy: two helpers were needed to strap the machine onto the wearer, with one person pulling apart the headphones and another one lowering the bulky front end. A finger-thick tube wound around the neck to feed input data to the screens. The goggles were heavy and left indented red lines on the forehead.

The glove was less of a problem. It was made of thin Lycra fiber, with optical sensors out of fiberglass. When the wearer flexed a finger, or turned a wrist, the fibers would be bent, thus transmitting less light. The computer would measure the loss of light and translate these values into commands. Over time, VPL improved the finger-bending measurements, by scratching and scraping the fibers at the right joints, so that the glove would ignore overstretched open palms but precisely measure a finger pulling a trigger.[54] Another sensor located that hand’s position in three-dimensional space. A computer collated the data from the sensors, drawing an image of a moving hand on a screen. A tangle of wires dangling from the wearer’s wrist and neck connected to an expensive state-of-the-art computer, which at that time was a custom Macintosh IIx design/control workstation, a machine with up to 128 MB of memory and a 16-MHz processor.

The logical next step was computerized clothing, the full-body data suit. The suit would make a foray into cyberspace a truly immersive experience. It looked like a diver’s outfit. When the wearer lifted an arm, a crude animated figure on a small screen lifted an arm. If the diver stepped forward, the avatar stepped forward, in real time. It was primitive, but exciting. VPL hired more Bay Area engineers, and soon sixteen people were developing hardware and software on "Virtual Reality," as the trend quickly became known, usually capitalized.

The machines were custom-made and labor-intensive, and production runs for the eye sets remained small. A full set of equipment cost an unaffordable quarter million dollars. Still, many potential clients and reporters came to VPL's offices to try out the machine. Again the glove was different. The company sold 1.3 million data gloves to Mattel as a gaming device and joystick replacement, and a smaller number of more sophisticated and more expensive versions to IBM and NASA. "It really sold itself 'cause it was so cool," one engineer recalled.[55]

Naturally, other entrepreneurs jumped on the bandwagon. Their companies had fancy names: Autodesk, Inc., Sense8 Corporation, Virtual Research Systems, Pop-Optix Labs, and TiNi Alloy Company for tactile feedback systems; Polhemus, Inc., for a widely used head tracker.[56] Even Apple considered joining NASA's Ames Research Center and Autodesk to further refine the gloves-and-goggle gadgets. Yet the two dozen VR companies that sprouted up like mushrooms lacked four things that the air force had benefited from during the previous decade: a significant budget, skilled engineers, time, and—perhaps most important—a clear purpose.

The Bay Area pioneers had a vague idea for a product, but not a clear problem to solve—no defining purpose, such as improving the kill ratio of an air force pilot under stress in an ill-designed F-15 cockpit. Pilot-plane interaction had occupied some of the world's brightest engineers for two generations, but in the San Francisco of the electrifying 1980s, counterculture trumped airpower. VPL even abandoned its original purpose: "The programming language fell by the wayside," one of Lanier's engineers recalled.[57] The developers were driven by a hazy vision of virtual worlds. They took Gibson's phrase "consensual hallucination" quite literally, it soon turned out.

"The idea is that by wearing computerized clothing right over your sense organs, you transport your sensory system into a reality that could be of any description," Lanier told one interviewer, sitting on the grass in front of a houseboat. He found the research "deliriously exciting."[58]

One evening in the spring of 1989, Adam Heilbrun drove down from Sausalito to Lanier's home in Redwood City to report a story for the *Whole Earth Review*. He arrived at 8:30. Lanier was busy fine-tuning a virtual Pacific Bell logo for an upcoming gig, but he immediately started creating a more impressive virtual world for the visiting journalist. Three hours later, by 11:30, they were ready for action.

Heilbrun recounted in awe how the blue figure of Lanier's girlfriend, wearing a fully-body data suit, twisted strangely on the floor of Lanier's apartment, slowly trying to find the "right place," as if her movements were controlled by a "distant, internal logic." Lying next to her was Lanier, his Rastafarian dreadlocks spread out on the floor, twirling along. Then came Heilbrun's turn. The entire setup seemed eerily familiar: "The room had the leftover aura of psychedelics," Heilbrun thought of this dreamland. "Well, I'm addicted," he suggested to Lanier. "Please don't use that word with this," Lanier interrupted softly. "Look what happened to mushrooms."

Lanier was referring to the ban on psychoactive drugs. Several of his friends had seen their academic careers coming to a screeching halt in response to psilocybin becoming illegal. Lanier mentioned Terence McKenna. "I'm really worried that virtual realities may become illegal," the twenty-eight-year-old entrepreneur sighed.[59]

In this pioneer's vision at least, virtual-reality gear was indeed a psychoactive substance. He envisioned that the user of his wearable technology could choose to be anything in virtual reality. A user could choose to be a cat, for instance: when the user smiled in the real world, the gear would read the facial expression, so that the cat in virtual reality also smiled. The movement and gestures and facial expressions of the real body, however subtle, would control the virtual body. That virtual body might as well be a mountain range or a pebble on the beach or a galaxy or a piano. "I've considered being a piano," Lanier told his guest. "I'm interested in being musical instruments quite a lot." This wouldn't even be that remarkable, he suggested:

> You could become a comet in the sky one moment and then gradually unfold into a spider that's bigger than the planet that looks down on all your friends from high above.[60]

Clarke's 1961 vision of becoming a spaceship or a TV network didn't seem too far off any longer, and the psychedelic scenes in *2001* suddenly made complete sense.

Again and again, Lanier emphasized the social aspect of his new technology. Strapping on goggles and gloves was more like using the telephone than watching TV; it was a two-way street, a shared experience, a way to socialize. Only far more intense. Switching on the virtual-reality engine would be, he imagined, like having a collaborative lucid dream. "It's like having shared hallucinations, except that you can compose them like works of art," Lanier told his guest.[61]

VR was even better than LSD because it was, by definition, a social experience, not chemically induced isolation. The effect would be wholly positive. Lanier believed his new technology would "bring back a sense of the shared mythical altered sense of reality that is so important in basically every other civilization and culture prior to big patriarchal power." The goggles-and-gloves technology had originally been developed to make F-16 bomber pilots more lethal. But now Lanier was convinced that it "has a tendency to bring up empathy and reduce violence."[62]

Indeed, the psychoactive trope came to dominate the debate on virtual reality. Ken Goffman, a.k.a. R. U. Sirius, the psychedelic editor and enfant terrible of San Francisco's publishing scene, was also friends with Lanier. Sirius published the very first nonscholarly article on the countercultural version of virtual space, which came out in the summer of 1988 in the psychedelics-and-tech underground magazine *High Frontiers,* which had been renamed *Reality Hackers*.

The influence of Stewart Brand's access-to-tools philosophy was palpable: the hipster magazine was all about psychedelics, mind machines, and "artificial reality technology." If that link to mind expansion wasn't clear enough, then the person reporting about the new technology left no room for doubt: the infamous Timothy Leary, illustrated with a psychedelic image of a man sitting at a personal computer, with the machine as the access portal to a trippy spiritual world, a Buddha looking down on the "cybernaut," as Leary referred to the user.[63]

The technology was brand-new and had never been covered in any magazine or newspaper before. Leary introduced the readers of *Reality Hackers* to helmet-mounted liquid crystal displays, head tracking, three-dimensional sound equipment, speech and gesture input, and VPL's prototype glove. Humankind, the psychedelic guru pointed out, had already entered a "post-industrial cyber-era." The real world was losing relevance, the magazine reported. A few months later, the *New York Times* was the first big national paper to cover the trend. "You and your lover trade eyes so that you're responsible for each other's point of view," Lanier told the nation's newspaper of record. "It's an amazingly profound thing."[64]

But so far, nobody had spelled out how cyberpunk, Gibson's stories, and virtual space were connected. This changed in September 1988 at Autodesk, then a six-year-old Sausalito-based company specializing in computer-aided design, a technology for displaying 3-D objects on screens. John Walker was Autodesk's founder and still one of the company's leading minds. The programmer was frustrated by people who referred to computers as "electronic brains." In Walker's view, this expression imputed characteristics to machines that they didn't have. "When you're interacting with a computer, you are not conversing with another person," he wrote in an internal memo. "You are exploring another world."[65]

But the user interface was the problem; how the user interacted with the machine was far more important than the computer itself. And the history of man-machine interfaces was ripe for revolution, in Walker's mind: yes, there was progress through the years from plugboards to punch cards, from time-sharing to menus, and eventually to graphical controls and windows. But a mouse couldn't "transport the user through the screen into the computer," Walker lamented. Just two weeks earlier he had read about the air force's brand-new helmet-mounted display, the *Star Wars*–inspired Agile Eye, and was impressed by it.[66]

Like Gibson, Walker now needed a name for that synthetic place. He dismissed virtual reality as an oxymoron and then suggested "cyberspace." Gibson misused the root "cyber," Walker pointed out, by talking about computers rather than control. So he suggested bringing the word back to its Greek origin, even using the Greek spelling in the Autodesk white paper. "Since I'm talking about means of man/machine interaction," wrote Walker, "I can make the case that 'cyberspace' means a three dimensional domain in which cybernetic feedback and control occur."[67] Autodesk tried unsuccessfully to register the term as a trademark. William Gibson was nonplussed and jokingly threatened to retaliate by filing a trademark application to register the name "Eric Gullichsen," then the lead programmer on the Autodesk project.[68]

By the spring of 1989, science fiction, drugs, and emerging computer technologies were all the rage in the Bay Area. So Stewart Brand, cybernetic pioneer and Gregory Bateson devotee, decided to get ahead of the game by lifting this shrewd phrase from science fiction and obscure start-up memos: "Cyberspace" was how he titled a lead story in the summer issue of the *Whole Earth Review*. To report the story, Brand took a few friends who worked at Autodesk down to NASA's famous Ames Research Center in Mountain View, a good half-hour drive south of San Francisco. The Ames press officers took the hippie researchers into the lab. There they strapped on the most advanced publicly visible virtual-reality gear (the air force's work, far ahead of NASA's, was still mostly classified then). And Brand was simply amazed:

> The first thing most of us did when we arrived in virtual reality was study our own hand, looking for all the world like stoned kids: "Have you ever really, REALLY looked at your hand!!?"[69]

It was spectacular. Wearable devices, and the virtual reality they would simulate so perfectly, would enable human operators to break free of desks, screens, mice, and entangling wires. The new technology promised new ways to move inside a human body, in atoms, or inside buildings that existed only as design plans. Virtual reality would revolutionize industrial design, medicine, architecture, space exploration, entertainment, education, games—even sex and drugs. “I have seen the future, and flew in it!” Brand reported in his own magazine. “I lost my body almost instantly, except as a command device (ultimate mouse), and thoroughly enjoyed life as an angel. Oh wings of desire,” he raved.[70]

But all that was theory. All those bold claims about social interaction in virtual reality were vision alone. It had never been done. The actual technology wasn’t there yet. In practice, Lanier’s cyberspace remained a solitary experience. Limitations in computing power and bandwidth did not allow for a truly interactive experience through glove and eye phone (at least not for another quarter century). That practical limitation, of course, didn’t hold back the enthusiasts. Even the *Wall Street Journal* was enamored of the idea and breathlessly repeated Lanier’s claim to its reporter that his gear and goggles were as good as “electronic LSD.”[71] The young entrepreneur, it seemed, wasn’t afraid any longer that the new psychoactive gear could be outlawed. The possibility of escaping, of escaping into a synthetic realm of the mind, was too appealing to resist.

Lanier met Timothy Leary in a getaway car. The VPL founder’s girlfriend at the time knew Leary. One day Leary was running an all-week workshop down at the Esalen Institute. But for some reason Leary wanted to get out, and fast. He called Lanier’s girlfriend to ask if they could come get him. He had a Tim Leary impostor on standby and wanted to smuggle the fake Leary in while they smuggled the real Leary out. Lanier and his girlfriend drove down from the Bay Area with two cars to make the exchange less suspicious. Lanier, then in his twenties, drove the flight car and ended up smuggling Leary out. Back at Esalen, nobody noticed. “They were all way too stoned,” recalled Lanier.[72]

Leary had famously pioneered the use and study of psychedelic drugs. Yet in hindsight, until the late 1970s he found that he had no language to express how the brain actually worked. But the psychologist had an epiphany when he got his first computer. He suddenly understood that cybernetic terminology was ideal to describe the workings of the mind and the brain, that “human biocomputer” he had spoken about already in Berkeley in 1983, covered in the drugs-and-technology magazine *High Frontiers*. Comparing the body to manufactured artifacts had been common for a long time: hydraulic engineering helped us understand the heart as a pump with valves and pipes and the blood as a circulation system, Leary believed. Now cybernetics enabled the understanding of the brain's piping. Networked computers, for Leary, were the operating system of the mind itself. Millions of young Americans understood that "the best model for understanding and operating the mind came from the mix of the psychedelic and cybernetic cultures."[73]

Leary's lectures at universities were packed. For one event at Sonoma State University, the flyer was an actual LSD packet, a plastic bag with an ominous sugar cube to swallow.[74] It was a PR stunt. By now the LSD guru was turned on by wearable technology. He gave talks like "From LSD to Virtual Reality." "Can this computer screen create altered states?" he would ask the students. "Is there a digitally induced 'high'?"[75] These were rhetorical questions; of course the answer was yes—or would be in the near future.

The main function of a computer was not merely to be a personal computer, but to be networked: to offer *interpersonal* communication, Leary was convinced. Computer networks were liberation: "individuals and small groups that go off to start learning how to program, reprogram, boot up, activate, and format their own brains."[76] Leary's prose captivated droves of students: "We are creatures crawling to the center of the cybernetic world," he told them, "But cybernetics are the stuff of which the world is made. Matter is simply frozen information."[77]

Leary's language resonated with an emerging subculture. The Grateful Dead's songwriter John Perry Barlow once described him as a reverse canary in the coal mine, meaning that whatever Tim Leary was interested in, mass culture would discover a few years later.[78] Several of the Bay Area firms saw marketing potential in Leary. Autodesk asked him whether he would be willing to pitch their cyberspace vision in a promotional video. "We believe that this is inevitable technology," said Eric Lyons,[79] technology director at the Sausalito-based company. Leary knew this already. He agreed.

"The concept of cyberspace, creating realities on the other side of computer screens, opens up a new and very thrilling chapter in the human adventure," Leary said in his typically soft-spoken narrator voice, sitting stylishly in front of a gray wall in a gray suit. He was hypnotic. Somewhere within our brains, he said, there was a universe of wonder and novelty that needed to be "accessed, booted up, turned on, activated." He sounded like a prophet, and even looked like one. For thousands of years, he argued, such activation was done through yogis, meditation, music, dance, drugs, or other mystical experiences. Men and women used to come back from the experience unable to express what they had just witnessed. People came back from exploring their brains saying simply, "WOW—," searching for words. Leary's "wow" sounded very convincing. Sometimes brilliant artists could capture the experience in a picture, he added, or a still frame.[80]

Now technology was changing all that. Leary understood two things: that the brain *is* a computer. The brain can't just be compared to a computer. It doesn't just work like a computer. It is a computer. And he understood that the brain, because it is a computer, can be connected through computers: "Now in the late 20th century, here at Autodesk, a band of explorers has assembled, given us the hardware and software, to move around in the cybernetic universe." Previously, all that computer users could do was put their noses up against the computer screen, looking into another universe, like looking into an aquarium. But now, with new equipment and software, users could actually go to the other side of the glass and swim around, he said, and meet other people. "It's cyberspace," he concluded, "and it's a nice place to be."[81]

For Leary, the possibilities were boundless. "There are no limits on virtual reality," he told one interviewer in 1990. Data glove and data suits were the future. "The donning of computer clothing will be as significant in human history as the donning of outer clothing was in the Paleolithic."[82] Leary knew of Wiener and Bateson but probably found their writings too impenetrable. Leary was a man of action, a sensual man. The numerous speeches and articles of the psychedelics guru are playful and inspiring, but undisciplined and rambling. Perhaps without knowing it, Leary had fully absorbed the cybernetic myths of the previous decades:

> Telephone, telegraph, teletype, cars, jet planes. . . . Today, at the end of the industrial age, at the dawning of the cybernetic age, most digital engineers and most managers of the computer industry are not aware that we live in a cyber-culture surrounded by limitless deposits of information which can be digitized and tapped by the individual equipped with cybergear.[83]

Leary even deployed the same image that Clynes had used in his landmark 1960 paper that presented the cyborg. "Cyberwear," for Leary and early 1990s counterculture, was a "mutational technology." Individual brains could now have out-of-body experiences, just as "landware" like legs and lungs had permitted fish to escape the water and have out-of-water experiences.

Intrigued by the hype, and an admirer of Leary, Grateful Dead lyricist John Perry Barlow wanted to see for himself. The problem, he understood, had long been the interface. During the twenty years leading up to 1990, human relations with "these magic boxes" had become ever more intimate, at a fast clip. First came austere batch-processing punch cards as input devices—with simple printers as output devices, of the kind Wiener had used when he first interacted with a computer. Then came the light gun in the air force's SAGE system, the keyboard, the mouse, and Lanier's gloves to get information into the machine—and graphical operating systems, screens in ever-higher resolution, and even the air force's helmet-mounted displays to get information back out.

But the link between user and computer was still slow and far too clumsy. The interface, to Barlow, was "the mind-machine information barrier." The solution seemed simple enough: that barrier needed to be eliminated.

> The thin alphanumeric stream which drips from our fingertips and into the computer is a pale reflection of the thoughts which produce it, arriving before the CPU at a pace absurdly mis-matched to its chewing/spitting capacities.[84]

The human CPU has always been fast, and the machine's CPU was getting faster—but the connection between the two was still only at trickle speed. To make matters worse, the speed of human-machine interaction wasn't the only issue. Another problem was that the interaction was only two-dimensional. No actual space was involved. Yet humans remember stuff in three dimensions, Barlow was sure. Something needed to be done.

So Barlow went to Autodesk to find out. There, John Walker took him "through the looking glass," as he had written in his 1988 internal Autodesk memo. "If cyberspace truly represents the next generation of human interaction with computers," Walker told Barlow that day, "it will represent the most profound change since the development of the personal computer."[85]

Walker had Barlow wired up with state-of-the-art equipment. The machine that generated the illusions was a Compaq 386, running Microsoft Windows 2.1, with a pair of Matrox graphic processors. The output device was a pair of VPL eye phones, with two video screens that were parallax-corrected, for the right viewing angles. When Barlow moved his head to look down from hovering hundreds of feet up, a Polhemus magnetic sensor tracked and measured this movement. The graphics engine then used the movement data to adjust the image that Barlow was seeing, with as little lag as possible. For input, he was wearing a VPL DataGlove on his right hand, also linked to a Polhemus positioning sensor.

The two tracking sensors forwarded the position of Barlow's head and the position of his right hand in real time to the Compaq processor. If the software worked properly, Barlow could then see the position of his right hand. When he made a fist or pointed his index finger, the fiber-optic cables sewn into each of the glove's fingers would bend (or not bend), letting light escape at the knuckles and joints, thus relaying the position of the single fingers to the CPU. The computer could then both use the hand's position data as input commands and display the gesture back to Barlow.

"Suddenly I don't have a body anymore," the former Wyoming cowboy reported from his first trek into the new frontier of cyberspace.

> All that remains of the aging shambles which usually constitutes my corporeal self is a glowing, golden hand floating before me like Macbeth's dagger. I point my finger and drift down its length to the bookshelf on the office wall.[86]

Barlow tries to grab a book, but his hand passes through it as if it doesn't exist. "Make a fist inside the book and you'll have it," a female voice says, seemingly coming out of nowhere. It is one of Autodesk's employees. Barlow does as he's told, making a fist in the real glove and moving his virtual hand again, and the book remains embedded in it. "I open my hand and withdraw it." Magically, the book remains suspended above the shelf, hovering in the emptiness of cyberspace.

Barlow is still standing in a small room, equipped with goggles and gloves. But in his virtual reality, he is exploring an office. He points up with his virtual hand. He ascends as if flying, passing right through an overhead beam as he zooms up. Several hundred feet up, he turns and looks down. It's a confusing situation, hovering up there in some undefined space. He feels a wave of loneliness and decides to head back down to the office building. He points down with his glove, but he's falling too fast. "I plunge right through an office floor and into the bottomless indigo below." In a panic, he tries to recall how to stop the fall. But he can't point his body. "I flip into brain fugue."[87]

It was nothing if not exciting. Barlow needed to see how others reacted, people he knew already. He called Jerry Garcia, singer, songwriter, and lead guitarist for the Grateful Dead. Was he game for a cyberspace demo? "When?" responded Garcia. Barlow had him try the goggles and the glove and delve right into virtual space. When Garcia was back in the reality he was used to, Barlow wanted to know how it was. "Well," Garcia said, "they outlawed LSD. It'll be interesting to see what they do with this."[88]

This tech-drug comparison at the time kept an entire subculture busy, complete with its own journals. "The closest analogue to Virtual Reality in my experience is psychedelic," Barlow wrote in *Mondo 2000* that summer. The hot new cyberpunk magazine, successor of *High Frontiers* and *Reality Hackers*, was still managed by the same crew from a villa in the lush Berkeley Hills.

"Cyberspace is already crawling with delighted acid heads," Barlow reported.[89]

In fact, the comparison was so common that it had its own term, the "cyberdelic." "It's a Disneyland for epistemologists," Barlow wrote. The experience was so surreal that he might as well have described an acid trip. He had read Bateson's *Steps* when it came out in the early 1970s. Barlow began to see "an underlying grammar of nature," he wrote obliquely.[90] When he was strapped into the VR gear, the British cybernetic philosopher again came to mind: "Gregory Bateson would have loved this," Barlow thought.

It wasn't just dazzling. It was revolutionary. The "colonization of cyberspace was beginning," the would-be frontiersman wrote in *Mondo 2000*.[91]

III

Ironically, the actual colonization of cyberspace began on a rather more primitive device: a Commodore 64. It wasn't real people in virtual space that did the colonizing. It was avatars. In fact, the creators of the early game *Habitat*—Chip Morningstar and Randall Farmer—came up with the idea and with the word "avatar" for the game.

The first version of *Habitat* was built for the C-64, a common home computer in the mid-1980s that already appeared "ludicrous" to the developers themselves.[92] The game was ambitious. Lucasfilm Games, the company that designed the virtual world, envisioned a population of twenty thousand users, with plans to expand to as many as fifty thousand. All these people, the equivalent of a small city, would meet "in a single shared cyberspace," as two of the lead developers outlined in 1990. Interaction would happen in real time. Users could "play games, go on adventures, fall in love, get married, get divorced, start businesses, found religions, wage wars, protest against them, and experiment with self-government," Morningstar and Farmer wrote in a famous paper on the lessons of their pioneering game.[93]

Morningstar and Farmer found much of the work that was done on cyberspace technology in these heady days exciting and promising, but also misplaced. They didn't appreciate the "almost mystical euphoria" about data gloves and head-mounted displays. Hardware, in the view of the game developers, was a distraction. Cyberspace was not about experiencing hardware;

it was about experiencing people. This is also the reason why Vinge was so popular with engineers. He was one of the few science fiction authors who understood that the input-output devices would remain slow and bulky. “The IO devices were very low bit rate,” Vinge said later, explaining how he had constructed *True Names*. “They depended on the viewer’s imagination to fill the gaps, which is exactly what happens when you read a book.”[94] The *Habitat* engineers had the same approach: the game depended on the player’s imagination to fill the gaps.

Habitat was meant to represent the real world—at least to a degree. The game designers liberally added childhood memories of games of make-believe, “a dash of silliness, a touch of cyberpunk,” and of course, their remarkable technical skills in what was then called “object-oriented programming.” The objects were the furniture of the *Habitat* world: houses, trees, gardens, mailboxes, books, doors, compasses, but also more controversial objects like clubs, knives, and guns. The game’s little cartoon characters, controlled by the gamer, could buy and sell these items with in-game money that they had in their in-game bank accounts. Tokens were the currency in the land of *Habitat*, commonly abbreviated simply as T. For each new player joining *Habitat*, an avatar was created, or “hatched,” and a starting amount of 2,000T was placed in the player’s personal account. Each day the player logged in to the game, the money grew by 100T.

The game was inspired by science fiction, “notably Vernor Vinge’s novel, *True Names*,” the game designers explained.[95] ATMs, which in *Habitat* stood for “automatic token machines,” gave avatars access to their money. One token was a twenty-three-sided plastic coin, slightly larger than a US quarter. Remarkably, the game coins had a portrait of Vinge on their face, adorned with the motto “Fiat Lucre” and the line “Good for one fare” on the back. But this was the 1980s. Such details could only be explained in the handbook and were lost on the bulky, curved, low-resolution screens of C-64s that started up with a painfully high-pitched beeping sound and never really stopped flickering.

The idea for the avatars came to Morningstar and Farmer out of cybernetic disappointment, out of a lost hope, or perhaps a lost fear: “Nobody knows how to produce an automaton that even approaches the complexity of a real human being, let alone a society,” the two wrote at the time. So they decided they shouldn’t even try. “Our approach, then, is not even to attempt this, but instead to use the computational medium to augment the communications channels between real people.”[96] The way to do this was to have small cartoon figures represent the players in the virtual world.

Morningstar and Farmer often walked around the offices of Lucasfilm Games, chatting and discussing how to name things—for instance, the "ATM," the token machine. Morningstar, who had been a bookish kid, had read about the Hindu concept of *avatāra*, which stood for the descent, or the appearance, of a deity on Earth. When the cord to the heavenly world snapped in the myth, as he recalled it, the avatar was pulled back.

The image worked very well for the developers at Lucasfilm Games: "There's this sense of being attached to the divine," Morningstar recalled. "I was in love with that."[97] The deity was the gamer in front of the Commodore 64, the avatar represented the user, and the mystical silver cord that connected the two was the telephone line hooked up to the computer's modem. "You were reaching out into this game quite literally through a silver strand," added Farmer. "The avatar was the incarnation of a deity, the player, in the online world."[98]

The computer game became a classic. The approach that Lucasfilm's developers took with cyberspace and representation was very different from that of VPL and the virtual space pioneers: they prioritized low bandwidth over high bandwidth. *Habitat*'s avatars coupled human and machine loosely, not tightly. Morningstar and Farmer wanted to move complicated hardware and software out of the way, thus allowing for a richer social interaction. That, they thought, was what cyberspace was all about: "The defining characteristic of cyberspace is the sharedness of the virtual environment and not the display technology used to transport users into that environment," they believed.[99]

The promise of cyberspace was palpable. And virtual worlds needed to be built; the cyberspace environment, after all, was a man-made environment. Naturally, architects became interested in building these new worlds. Michael Benedikt was a professor of architecture at the University of Texas at Austin who had been inspired by William Gibson's work. "Cyberspace was an idea that was only just beginning to flower," he thought then.[100]

It was time for a large academic conference to explore the possibilities. So Benedikt reached out to Gibson and asked him to join the four-person conference committee. The science fiction author accepted. Over the summer of 1989, Benedikt started pulling together the first large meeting of minds. His e-mail announcement emphasized that this conference was "not about the enabling technology of 3-D interfaces." Instead, Benedikt wrote, "It is about the nature of cyberspace conceived of as an independent realm."[101]

The subject came natural to Benedikt; he was an architect. "The design of cyberspace is, after all, the design of *a new world*," he wrote.[102] And Benedikt understood that cyberspace was not something that is just discovered; it needed to be built, entity by entity. “That was a huge opportunity for architecture of an amazing kind; there’d be no weather, there’d be no rain, there’d be no gravity,” he recalled. Even the laws of physics were adjustable. There were no building regulations. The possibilities were limited only by psychology, by how much disorientation users were able to handle.

Benedikt’s First Steps conference was historic. In hindsight, it marked a symbolic shift: cyberspace transcended virtual reality in Austin, Texas, on May 4–5, 1990.

It took the better part of a year to organize the meeting. Eventually, in the first week of May 1990, the university’s School of Architecture and Department of Computer Science jointly sponsored the conference; the fee was $115. One of Benedikt’s students had suggested advertising the meeting only by e-mail, which had never been done before. The stunned organizers received sixty abstracts from artists, technologists, computer scientists, entrepreneurs, architects, and sociologists, many of them WELL members, some from as far as Sweden and Italy. And the organizers were amazed again when these people actually arrived in Austin by plane, fresh out of cyberspace. Several of the fifty attendees would go on and shape the emerging debate, including the colorful author Howard Rheingold and science fiction legend Bruce Sterling, best known for *Mirrorshades*, an anthology that defined the cyberpunk genre.

John Perry Barlow was one of the first to respond. He mailed in an abstract titled “Music in Cyberspace.” The cattle rancher and Grateful Dead lyricist pointed out that his band had long been trying to blur the line between audience and performer. Jaron Lanier’s data glove, Barlow remarked, had been developed as a means for the guitar player wannabe to fulfill that desire, and then he asked, “Could we develop a system of shared cyberspace in which the band and members of the audience could get together and ‘jam’ in real time?” When Benedikt and the conference committee read Barlow’s abstract, they were confused. Benedikt didn’t know the rancher, and Barlow’s only academic credential was being a songwriter. “We very nearly didn’t invite him because he seemed crazy,” Benedikt recalled—but crazy in a good way. They quickly agreed: “This guy’s a live-wire; we have to have him.”[103]

At nine in the morning on the fourth of May, a beautiful Friday, the audience had coffee and then gathered in the Flawn Academic Center, a vast modernist white cube with ornamented windows, hovering over the landscape on pillars, itself a symbol of the 1960s space age. The architectural setup was inspiring: “It seems that the political arena of the sixties is slowly drifting to the existential arena of computers in the nineties,” one speaker noted after the conference.[104]

One of the first presentations was “Mind Is a Leaking Rainbow,” by Nicole Stenger, a French-born American artist and MIT-based virtual-reality pioneer. Stenger was a glamorous woman with intense eyes, eccentric earrings, and long curly blond hair. Stenger visibly stands out in the group photo of thirty-six. “The exploration of Cyberspace will become the first massive trip of humanity into hallucination,” she said in a thick French accent, striking a chord with many of the WELL members in the audience. “Without exaggeration, cyberspace can be seen as the new bomb, a pacific blaze that will project the imprint of our disembodied selves on the walls of eternity,” Stenger told the audience.[105] Her talk was more performance art than scholarship. It was very well crafted, and later very widely read and very frequently cited.

“On the other side of our data gloves,” she said, “we become creatures of colored light in motion, pulsing with golden particles.” By now, some of the technologists had incredulous expressions on their faces. Stenger was unfazed. “We will all become angels, and for eternity! Highly unstable, hermaphrodite angels, unforgettable in terms of computer memory. In this cubic fortress of pixels that is cyberspace, we will be, as in dreams, everything: the Dragon, the Princess, and the Sword.”[106]

Stenger compared the rise of cyberspace with the first days of creation:

> In this primeval garden where a synthetic sun will rise, inner voices will whisper, immaterial kisses hover in the air, you will lie in the reconstructed sense of fur. For blind bards as for nearsighted whiz kids, cyberspace will feel like Paradise![107]

Her artful performance contrasted sharply with some of the drier scholarly presentations: “Borne of Disneyland like luscious candy cotton. Atoll of grace between the West and the Orient. Soufflé of desires revolving in the light, whispering the names of the world’s fiancés: Laure, Beatrice, Peter Pan, John Lennon,” she explained. “Cyberspace the dessert of humanity!”[108]

Many of the computer scientists and the practically minded engineers could not believe what they were hearing. This blond French artist wasn’t even sure sex would survive in its natural form. “How will your boyfriend know that you’ve been in your pajamas for weeks if you only meet in a cyberspace exchange?” she wondered. “You won’t need condoms any more. Cyberspace will be the condom.”[109]

This idea resonated with many in the audience. Allucquère Rosanne Stone, an early transgender performance artist and media scholar, later organized the second conference of cyberspace, “2Cyberconf.” The paper she presented at the 1990 conference in Austin would become one of the most read and most cited.

“To become a cyborg, to put on the seductive and dangerous cybernetic space like a garment, is to put on the *female*,” Stone said. Cyberspace both disembodied, she argued, and it reembodied.

> As the charged, multigendered, hallucinatory space collapses onto the personal physicality of the console cowboy, the intense tactility associated with such a reconceived and refigured body constitutes the seductive quality of what one might call the *cybernetic act*.[110]

Morningstar and Farmer, the engineers of the first virtual world that was actually used, were also in the audience. To the two game developers it seemed as if these people were tripping. They could not understand a word. “Holy crap,” Morningstar said to Farmer. “I could not keep up.”[111]

Morningstar and Farmer presented in the afternoon. They explained the difficulties of building a virtual environment on limited processing power and low bandwidth. Their talk was hands-on in the way early settlers talked about the practicalities of homesteading the frontier. The audience was thrilled. “They clapped and stood up,” Farmer recalled later in Palo Alto. “They loved it,” Morningstar added.

These were the days when connecting through a computer was done by phone. So Barlow, who didn’t present, interjected from the floor that cyberspace is “where you are when you are on the telephone.”[112] The line got great laughs in Austin, and people started using it in the conference. The participants agreed that “how you plug yourself in” was secondary; helmet and goggles or keyboard and mouse—it didn’t really matter. In Austin the entire idea became a more abstract concept, a metaphor. Henceforth, Barlow and Rheingold and others would talk about “cyberspace” in metaphoric terms, just as the scholars at the conference had done. The conference volume was one of MIT’s best sellers for several years.

Tightly coupling man and machine, of course, retained a nearly irresistible appeal. The most bizarre articulation of cyberspace must be Howard Rheingold’s vision of teledildonics. After hearing Stenger’s wild presentation in Austin, Rheingold articulated his own vision of future sex in the summer of 1990 in *Mondo 2000*. The first fully functional teledildonics system, Rheingold clarified at the outset, would *not* be “a fucking machine.” Users did not want to have intercourse with a cold piece of technology; they wanted to make love to *other people*. But “at a distance,” hooked up to each other via modem or other data links, and “in combinations and configurations undreamt of by precybernetic voluptuaries.”[113]

Rheingold’s vision went something like this: a night out in the virtual village meant getting dressed first, of course. But getting dressed now was somewhat different: it involved entering a suitably padded chamber loaded with sensors, putting on a head-mounted display with high-resolution goggles, and then slipping into the second skin of a lightweight body suit, hopefully diaphanous by then, he added. The electronic stocking would fit tightly, “with all the intimate snugness of a condom.” The machine magic was embedded inside the suit, on the inside of its surface; tiny actuators and smart effectors would replicate the feeling of touch, and of course also the feeling of being touched. The miniature actuators would be ultrathin vibrators, hundreds of vibrators per square inch.

Once dressed, a user could pick up virtual objects, run fingers over a virtual surface, and feel texture and edges through the gloves and the body suit, Rheingold explained. There, alone in the virtual chamber, it was suddenly possible to feel virtual satin at the cheek, or to encounter virtual human flesh. Rheingold was intrigued by the possibilities: “You can gently squeeze something soft and pliable and feel it stiffen and rigidify under your touch.”

Once set up and ready to go, punters dialed a phone number to meet their partners (in the 1990s, modems required dialing a phone number to get online). “Your partner(s) can move independently in the cyberspace,” Rheingold outlined, matter-of-factly. The avatars are able to touch each other, “even though your physical bodies might be continents apart.”

Nineteen ninety technology wasn’t quite ready for action yet. Rheingold acknowledged this limiting detail. Every nook, every protuberance, every knob or plane or valley of a body’s surface would require its own processor. Computers weren’t powerful enough yet to control hundreds of thousands of sensors and actuators. But bandwidth wasn’t a problem any longer; fiber-optic networks would already be able to handle the flood of dildonic data, Rheingold believed. Actuators were getting better fast. “Today’s vibrators are in the ENIAC era,” he was sure, referring to a famous computing machine initially designed during World War II to calculate artillery firing tables for the US Army. Nevertheless, the future was slowly coming into glorious shape. “Part of the infrastructure for a dildonic system exists already,” the enthusiastic WELL member wrote.

To Rheingold, such a web would enable entirely new forms of human interaction—rather stimulating forms of interaction. “There is no reason to believe you won’t be able to marry your genital effectors to your manual sensors and have direct genital contact by shaking hands,” he predicted. A handshake was no longer just a handshake. The applications were titillating, the possibilities of gadgetry limitless. There was no room for doubt; his pioneering decade was merely foreplay. “Teledildonics is inevitable,” Rheingold wrote. Twenty years from 1990, remote sex will be “ubiquitous.”

IV

The emerging internet had a dark and ugly side. A few months before the conference in Austin, in December 1989, *Harper's* magazine hosted an online conference on the WELL. The editors invited forty participants to discuss privacy, hacking, and the computer underground. The group was a mix of the who's who of tech-hippies and hackers, including Stewart Brand and Kevin Kelly of Whole Earth fame, and Lee Felsenstein, who had founded the Homebrew Computer Club. John Draper (a.k.a. Cap'n Crunch) was there, along with two actual hackers from a shady group called Masters of Deception who did not reveal their names at the time: Mark Abene (a.k.a. Phiber Optik) and Eli Ladopoulos, who hacked as Acid Phreak. John Perry Barlow, one of the more prolific WELL members, was included as well.

At one point in the discussion about hacking, Barlow became agitated. The hackers implied that open systems deserved to be exploited. “You seem to argue that if a system is dumb enough to be open, it is your moral duty to violate it,” Barlow interjected. “Does the fact that I've never locked my house—even when I was away for months at a time—mean that somebody should come in and teach me a lesson?”[114] A heated exchange ensued.

“Barlow, you leave the door open to your house? Where do you live?” Acid Phreak wrote. The debaters were at home, in their familiar environment. Barlow felt emboldened: “Acid, My house is at 372 North Franklin Street in Pinedale, Wyoming. Heading north on Franklin, go about two blocks off the main drag before you run into a hay meadow on the left. I'm the last house before the field. The computer is always on.” It was late in the evening, and Barlow had had enough. “But do you really mean to imply what you did with that question? Are you merely a sneak that goes around looking for easy places to violate? You disappoint me, pal. For all your James Dean-On-Silicon rhetoric, you're not a cyberpunk. You're just a punk.”

Forty-eight hours later the hackers took revenge. Barlow had implied that Acid Phreak and Phiber Optik were simply alienated kids who were playing with modems instead of skateboards. The two didn't appreciate that comparison. “You have some pair of balls comparing my talent with that of a skateboarder,” Optik shot back, and he proceeded to post a full copy of Barlow's credit history right there on the WELL, open for everybody to see. He had hacked TRW, a company that logged credit histories. (Many years later, pranks involving public revelations of private details would become known as "doxing.") "I'm not showing off," Optik added. "I just find your high-and-mighty attitude annoying and, yes, infantile."[115]

Barlow was shocked. "I've been in redneck bars wearing shoulder-length curls, police custody while on acid, and Harlem after midnight, but no one has ever put the spook in me quite as Phiber Optik did at that moment."[116]

Barlow wasn't the only one spooked by computer hackers. By coincidence, the federal government was about to launch a massive crackdown on illegal hacking that had been nearly two years in the making. Operation Sundevil responded to complaints by businesses and organizations to federal law enforcement agencies. Hackers allegedly abused long-distance telephone services and voice-mail systems, and stole credit card numbers. On May 8, 1990, the US Secret Service deployed more than 150 special agents in fourteen cities across the United States, swooping down on the homes of twenty-eight hackers with search warrants. The raids hauled in forty-two computers, more than twenty-three thousand floppy disks, telephone testing equipment, and documents. The Feds arrested two suspects for crimes related to the investigation: one nineteen-year-old woman from Pittsburgh and a twenty-year-old man from Tucson, Arizona.[117]

Around that time, the *Harper's* magazine editor took Barlow and the two hackers who had spooked him so badly to dinner at a Chinese restaurant in Manhattan. The former farmer was surprised to find the "cyberpunks," as he called them, to be harmless, spotless, and fashionable—"dangerous as ducks." Barlow asked Acid Phreak why they had chosen such a threatening name for themselves, *Legion of Doom*. "You wouldn't want a fairy kind of thing like Legion of Flower Pickers or something," Acid replied. "The media ate it up."[118]

Over dinner, Ladopoulos told Barlow what had happened on January 24, 1990, a few weeks after their heated encounter on the WELL: a platoon of Secret Service agents, guns drawn, had burst through the doors of Ladopoulos's apartment. The only person at home at the time was his terrified twelve-year-old sister. The agents packed up Acid's computer, notes, books, answering machine, ghetto blaster, and entire collection of audiotapes. The place was a mess when his mother returned from work.

The raid wasn't part of Operation Sundevil, but to Barlow that made no difference. He saw injustice at work. Worse, he saw the federal government trying to encroach on the free and wide-open spaces of the virtual world. Barlow sat down in Pinedale, Wyoming, and wrote a call to action.

In the fall of 1990, Stewart Brand published the text as “Crime and Puzzlement: In Advance of the Law on the Electronic Frontier.”[119] The story recounted the episode of the *Harper’s* discussion on the WELL, of Barlow getting doxed by Acid, of a clueless FBI agent visiting Barlow in Pinedale, and of the subsequent government crackdown that was Operation Sundevil.

The story was liberally illustrated with Wild West imagery. There was a faceless silhouette of six desperado hackers in cowboy hats, just after sunset on a dirt road that stretched out into the horizon, throwing long shadows, all looking at a computer screen. There were cactuses and shot-out screens, still smoking, and a fence with a “No Trespassing” sign nailed against the planks. The clueless FBI agent was portrayed as the hapless sheriff, star pinned to his chest, with a clown’s hat. The WELL was a “frontier village” and “like open range,” Barlow wrote, with boundaries “hard to stake and harder still to defend.” Lines that used to be clear in the brick-and-mortar world were gone: between free speech and data, between land ringed by barbed wire and property infinitely reproducible, between trespassing and simple access.

“Cyberspace, in its present condition, has a lot in common with the 19th Century West,” Barlow wrote. He squeezed every last drop out of the corny Wild West comparison: “It is vast, unmapped, culturally and legally ambiguous, verbally terse . . . , hard to get around in, and up for grabs.”[120]

And it was time for action. In May 1990, just after returning from the rousing Austin conference, Barlow decided to establish the Electronic Frontier Foundation. He got crucial support from Mitch Kapor, a wealthy Silicon Valley entrepreneur. Their goal: “the extension of the Constitution into Cyberspace.”[121]

In the heady days of 1990, the frontier spirit was strong. A cyber gold rush was on. With Woodstock on their minds, Kelly and Brand from the Whole Earth Institute decided it was time for a similar type of mythical event.[122] They called it Cyberthon.

Cyberthon was a twenty-four-hour marathon conference, fair, and exposition on virtual-reality culture, held the first weekend of October 1990. The venue was a vast warehouse studio of Colossal Pictures, at the edge of San Francisco’s Bayview District near Hunters Point, next to a junkyard. The organizers built a disorienting wooden maze of 10-foot-high corridors, hung with black curtains to hide snake dens of cables, “with calculated irreverence toward day, night, right, left, and the entire history of empiricist philosophy,” in the words of Peggy Orenstein, a reporter for *Mother Jones* at the time. (Orenstein was making an inside joke about the then popular postmodernist critique of empiricism, not unlike the views that had surfaced at Benedikt's Austin conference several months earlier.)[123]

The technology was presented in the small spaces between the plywood dividers. The maze was hot from the machines and the bodies of the excited guests. There wasn't enough virtual-reality hardware for the four hundred visitors, so the organizers held hourly VR lotteries whose winners got to enter the promised land. Wavy Gravy, veteran political activist and hippie clown, announced the winners with a megaphone. About three hundred managed to catch a glimpse.

Three companies provided the main gear: Sense8, Autodesk, and Lanier's VPL. There was a lot to see: Tahiti, Mars, or the human brain in 3-D. At the Autodesk stand, visitors could strap on tightly fitting goggles and gloves. The picture they saw was grainy, as if they were sitting too close to an old-fashioned television set. By tilting back their heads and looking up inside the warehouse, they could see a virtual bland sky, with a fish swimming by in the air. TiNi, the company providing the tactile feedback, attached electrodes to the fingers of curious visitors, sending tiny pulses into their fingertips at the push of a button. There was a game room, to play handheld versions of British arcade video games. *Habitat* designers Farmer and Morningstar presented their social game.

When Farmer explained the game to Orenstein, two figures appeared on the live screen, with real people playing in real time. A "man" with a standard-issue nondescript body said he was from Nebraska. The "woman" was from North Carolina, with equally standard-issue big breasts and a slim waist. The man extended his arms and grabbed the woman's breasts. "Nice boobs," he said.

Orenstein didn't like the game's built-in sexism. Farmer told Orenstein that the gesture was bad form. But he pointed out that the woman was walking around headless.

"I'm a man, you idiot," she said.

"What's with the boobs, then?" typed the man from Nebraska, confused.

"They're muscles. Now get off 'em."[124]

The entire event seemed strange. Comedian and actor Robin Williams was there, muttering to himself as he tried to fly his avatar through cyberspace in a Sense8 machine. "What was it like?" asked Orenstein when he was done. "Try it," Williams said; then, lowering his voice to a whisper, "Don't be scared."

"Was it fun?"

"Yeah, in a vertigo kind of way," Williams said.

"Cyberthon's flavor was pure Woodstock," the science fiction author Gregg

Keizer reported from the VR gig. “I haven’t seen so many tie-dyed shirts since high school 20 years ago.” Everything was new and exciting. Keizer found the enthusiasm, the idealism, and the naïveté “infectious.”[125] Everybody was there. “Cyberthon brought together Berkeley acid-heads, techie nerds, art damage punks, and the people who are actually building cyberspace,” the *Whole Earth Review* reported.[126]

Science fiction legends William Gibson and Bruce Sterling were there. “It was supposed to be ironic,” Gibson said of *Neuromancer*. “I didn’t expect anyone to actually go out and build one of these things.”[127] Barlow was there, and Rheingold of teledildonics fame, and of course the crew from *Mondo 2000*. Mind expansion gurus Terence McKenna and Timothy Leary were there, telling guests at three in the morning that all reality is virtual.

“It was that whole San Francisco mixture of psychedelia and computer technology,” remembered Erik Davis, who attended as the *Village Voice* rock critic.[128] Davis said he’d gone because he had always been fascinated by psychedelics, the occult, and weird religious ideas. Some started calling the event the “Acid Test of the Nineties,” in reference to the Merry Pranksters of the sixties.

VR was powerful. Seeing the new technology with their own goggles convinced many skeptics. “Maybe all the mystical talk about the technology and how it will change communication, play, and work isn’t so mystical after all,” Keizer mused.[129] Orenstein also recalled arriving at the Cyberthon maze “curious, but terribly smug,” indeed with what she called a neo-Luddite feeling of superiority. But by daybreak she had changed her mind. Helmet-mounted displays and glove control weren’t just a fad for geeks with weird hair; this was real.

Stewart Brand, with his trademark combination of tech enthusiasm and skepticism, issued a warning to his guests at the nightly San Francisco cyber show: “We have to lower our expectations,” he said about virtual-reality technology. “It’ll take ten years to live up to the expectations of today.”[130] Even that prediction turned out to be far too optimistic.

The same year, not long after the Cyberthon, Jaron Lanier’s VPL, the virtual-reality pioneer, filed for bankruptcy. The company’s fall from grace was vertigo inducing. But this unexpected development turned out to be prophetic. In these years, every issue of *Mondo 2000* was sprinkled with ads from virtual-reality companies. “It’s a really remarkable institution,” said Leary, the technology prophet, about the magazine: “A beautiful merger of the psychedelic, the cybernetic, the cultural, the literary, and artistic. It shouldn’t last a long time.”[131]

The same was true for the short-lived virtual-reality craze of the early 1990s. It didn't last a long time. By 1993, the hype was in overdrive. "Enthusiasm for VR has reached a critical level such that an overabundance of media hype threatens further advances," observed the NSA in an internal and unpublished text in *Cryptologic Quarterly*. "Laymen are beginning to expect *science fiction* capabilities and not *scientific* capabilities," America's vast electronic agency concluded.[132] The subculture was subsiding. By 1996, all three iconic formative magazines of the cyberpunk era had fallen: the *Whole Earth Review*, *Omni* magazine, and *Mondo 2000* were no longer. The world everywhere was moving on.

Meanwhile, cyberspace was going mainstream. The internet was growing fast, with the dot-com boom taking off in 1995. The world's fewer than forty million internet users were able to view just over twenty thousand websites.[133] Netscape, builder of one of the first browsers, went public that year; Yahoo!, Amazon, and eBay opened their gates too. On February 8, Bill Clinton signed into law the Telecommunications Act of 1996. The day was historic. The United States would update its telecommunication law for the first time in more than sixty years.

The law included a highly controversial provision, the so-called Communications Decency Act. The law was notably restrictive. It went beyond prohibiting the distribution of pornography to children. For one, it attempted to limit the public debate on abortion, at least in the eyes of many activists. Most controversial, however, was criminalizing "indecent" expressions. The law defines indecency as "any comment, request, suggestion, proposal, image or other communication that, in context, depicts or describes, in terms patently offensive as measured by contemporary community standards, sexual or excretory activities or organs." Numerous websites on the still young internet protested by going dark for forty-eight hours. The American Civil Liberties Union argued that the law placed unconstitutional restrictions on free speech online.

Barlow was outraged. The law made it "punishable by $250,000 to say 'shit' online," as he saw it. He decided it was time to "dump some tea in the virtual harbor." With characteristic grandiosity and pomp, as Barlow himself said, he gave the world a "Declaration of the Independence of Cyberspace." The text's opening paragraph has become iconic:

> Governments of the Industrial World, you weary giants of flesh and steel, I come from Cyberspace, the new home of Mind. On behalf of the future, I ask you of the past to leave us alone. You are not welcome among us. You have no sovereignty where we gather.[134]

The wide and free global social space would be “naturally independent” of the tyrannies of government. “You have no moral right to rule us, nor do you possess any methods of enforcement we have true reason to fear,” Barlow wrote in his influential pamphlet, which he posted to the WELL. The lyricist laid out an oft-repeated yet deeply flawed and naïve vision of the future. As the NSA had observed, Barlow was one of the laymen who expected a reality based more in science fiction than in technical and political actualities. Nevertheless, his “Declaration of the Independence of Cyberspace,” addressed to the governments of the world’s industrial nations, became a landmark document in the history of the internet:

> Cyberspace does not lie within your borders. Do not think that you can build it, as though it were a public construction project. You cannot. . . .
>
> Cyberspace consists of transactions, relationships, and thought itself, arrayed like a standing wave in the web of our communications. Ours is a world that is both everywhere and nowhere, but it is not where bodies live.
>
> Your legal concepts of property, expression, identity, movement, and context do not apply to us. They are based on matter. There is no matter here.
>
> Our identities have no bodies, so, unlike you, we cannot obtain order by physical coercion.[135]

Two sharply different communities seized on the myth of cyberspace as the new frontier: West Coast privacy activists and the East Coast defense establishment. For the former, cyberspace was a space of freedom; for the latter, it was a space of war.