XANADU: A LITERARY DREAM FOR THE COMPUTER AGE

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Abstract

People try to pigeonhole Ted Nelson as a writer only, or group him with the computer counterculture that ushered in personal computers and the network age. Nelson's most lasting legacy may be his writings, which inspired a generation of counterculturists to try to improve society with technology, but Nelson's dream, pursued in his Project Xanadu, stands alone in the history of computing. This thesis argues that Nelson's Xanadu imagined a different way of relating to computers. It was a literary vision, based on the broadest conception of what literature is—by Nelson's account, a system of interconnected writings. Although Nelson led the charge as computers moved from the world of research into the hands of the masses, something slipped away in the process. Computers-for-the-people took on new meaning, Nelson's Xanadu never materialized, and the Web took the role Nelson had imagined for Xanadu. Yet Nelson's dream persists.

Keywords: hypertext, cybernetics, Memex, Xanadu

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Introduction

I first met Ted Nelson in October 2018. It was the fiftieth anniversary celebration for the *Whole Earth Catalog*. A sort of holy text for the hippie counterculture, the *Catalog* was filled with book reviews, mail-order tools, and tips for the would-be communalist. Fifty years after its publication, the anniversary brought together the contributors that had made the catalog and the community that had made it famous.

Nelson was seated at a table selling prints of his own work of the same era, *Computer Lib/Dream Machines*—for which *Whole Earth* had been no small source of inspiration. *Computer Lib/Dream Machines* is one of many works Nelson has written in his life, all directed toward a common goal. For the past sixty years, Nelson has fought to make the computer more than just a cold calculating machine, with unyielding perseverance as his efforts have been cut down again and again. His conviction remains as strong as ever, as he works largely and increasingly alone. He keeps telling everyone "I told you so," and insisting that the entire ecosystem we've built is terribly wrong. Over the years Nelson has coined a lot of words we use, like "hypertext" and "hypermedia," and many more words we don't, like "intertwingled" and "transclusion" and "teledildonics."[1] Central to all of this is Nelson's unrealized Project Xanadu. From the start, Xanadu has imagined how computers could usher in a new medium for the written word, based on a paradigm of interconnected texts that Nelson calls hypertext.

On that Saturday in October, Nelson was wearing coat and tie and a pair of gold-rimmed glasses. His business cards have an excerpt from the original proposal for the

[1] "Intertwingled" is a combination of intertwined and intermingled, "transclusion" is the inclusion of one document within another, and "teledildonics" is technology for remote sex in which feelings of touch are transmitted over a network.

World Wide Web printed on the back: “There are few products which take Ted Nelson’s idea of a wide ‘docuverse’ literally by allowing links between nodes in different databases.”[2] Nelson wants the world to know that the Web we all use daily was not independent of his ideas, nor by any means the inevitable winner. That the Web launched before Xanadu and carried forward only a limited form of Nelson’s hypertext concept is his greatest regret. How this happened, and what was at stake, is the topic of this thesis.

Nelson and I exchanged emails, and the following January I joined him at his archives in Richmond, California. Nelson has an office in the Internet Archive facilities there. The walls are lined with boxes holding papers and journals from his past. Down the hall is a shipping container filled with the rest of his life in papers. When Nelson and I discussed memories of his past, he would pull a box from a shelf and dig out the pamphlet he had distributed or the poem he had written or the notes he had taken. In such conversations, you get the sense that Nelson’s thoughts are distributed across the papers around him. And you begin to understand what was at stake in his lifelong project to build a new medium for the written word. All of these documents and the links that connect them were meant to reside in Xanadu. The computer software we have has not lived up to Nelson’s hopes. Despite all that has been done in the world of information technologies, and despite the obvious success of the “personal computer” industry, relatively few computer technologies have helped us to better understand ourselves.

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[2] Tim Berners-Lee, “Information Management: A Proposal,” March 1989, https://www.w3.org/History/1989/proposal.html (accessed October 1, 2019).

Ted Nelson encountered a computer for the first time in 1960, while attending graduate school at Harvard. This chance encounter was a turning point in Nelson's life. He was enthralled and inspired, and immediately began to rethink his plans for the future. At the time Nelson wanted to be a film director, but it now seemed clear to him that the media of the future would be on computer screens.

Six years passed before Nelson gave his project its name. Nelson chose to borrow a name from Samuel Taylor Coleridge's poem "Kubla Khan."[3] Coleridge's poem is a masterpiece: a vivid description of Kubla Khan's faraway palace, Xanadu, with its expansive grounds, its natural beauty, and a haunting darkness hidden just beneath the surface. Coleridge based the poem on a vision that came to him in a dream. When he awoke, he eagerly captured as much as he could in writing before he was interrupted by a visitor. By the time he returned to the poem, he had only a dim recollection of the dream.

Like Coleridge's dream palace, Nelson's Xanadu is stuck somewhere between dream and reality. As years turned into decades, Nelson continued to pursue his dream, trying relentlessly to turn a vision to reality. Nelson's Xanadu proved elusive.

In 1995, *Wired* magazine called it the "most radical computer dream of the hacker era."[4] In 1970, Ted Nelson stated his aims simply: "All I want to do," he said, "is put Renaissance humanism in a multidimensional responsive console."[5] The same *Wired* article, titled "The Curse of Xanadu," later concludes that Xanadu is "the longest-

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[3] Samuel Taylor Coleridge, "Kubla Khan," 1816, available at https://www.poetryfoundation.org/poems/43991/kubla-khan (accessed November 7, 2019).

[4] Gary Wolf, "The Curse of Xanadu," https://www.wired.com/1995/06/xanadu/ (accessed September 30, 2019).

[5] Theodor Holm Nelson, "Barnumtronics," *Swarthmore College Bulletin*, December 1970.

running vaporware story in the history of the computer industry."[6] It's surely one of the longest-held still-unrealized dreams of the computer age.

Beginning in 1960, Nelson began to consider what a future might look like in which the computer screen became home to all forms of media. Nelson did not pause to ask whether the day would come when everyone used computers. Rather, Nelson looked forward to that day and asked, "What will we do with them?"

Nelson believed that computerized media could better represent the creative process of writing and make possible a more exploratory experience of reading. Nelson's Xanadu aimed to do just this by representing the network of interconnected ideas across texts in software for early computers. By 1970, Nelson realized that new communications infrastructure would emerge that connected all the world's computers, so he extended his vision. The same medium that could represent the interconnection in one's own thinking could bring all the world's writing together in a global web. Xanadu took on a broader scope: no longer aiming simply to represent the structure of individual texts, Xanadu would represent the structure of a global, electronic literature. At this point, Xanadu was described as an operating system with two programs, server and client. "Of course," Nelson wrote in *Dream Machines*, "if hyper-media aren't the greatest thing since the printing press, this whole project falls flat on its face."[7] It was a dream Nelson held onto for a lifetime, and one that he nearly wrote into existence. Nelson spent decades spreading his vision, explaining it in numerous books and publications. A literary dream for the computer future, it's only fitting that it came to life in the written word. "The

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[6] Ibid.

[7] Theodor Holm Nelson, *Computer Lib/Dream Machines* (Self-Published, 1974), DM56.

cosmic joke," Nelson would later say, "is that everybody has a different reason for thinking the same thing—I'm the one who's perfectly qualified to design software."[8]

Nelson, first and foremost, was designing tools that he himself wished to use. As a sociologist and writer, this meant powerful tools that supported sophisticated thinking. As a film-maker, this meant simple tools that did not compromise on presentation. Nelson and digital computers are about the same age.[9] When Nelson was young, development of computers was driven by the military aims of the Cold War and a broad project of command and control.[10] However, many of these developments were gradually reclaimed by the counterculture as the tools for a new non-hierarchical way of organizing society.[11] Computers passed from the world of government-funded research to the world of industry and Nelson led the charge. However, in the process, something slipped away. Nelson combined the momentum behind the postwar pursuit to figure out how best to direct computer technology and the fruits of science and the countercultural effort to bring power to the people, but his dream was more specific than that—it was a comprehensive vision, an epiphany.

Andreas Kitzmann, in "Pioneer Spirits," suggests that Nelson's project is often mistaken as radical, when it was in fact conservative, and that most accounts of his work fail to situate it in its ideological and social context.[12] In one effort to contextualize

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[8] Byron Reese, "50 years ago today the word 'hypertext' was introduced," Gigaom, entry posted August 24, 2015, https://gigaom.com/2015/08/24/hypertext-50/ (accessed November 3, 2019).

[9] The first digital computer, the Atanasoff–Berry computer, was developed in 1939 and the more famous ENIAC was unveiled in 1946. At the time Nelson was two years old and nine years old respectively.

[10] Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA: The MIT Press, 1996).

[11] Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: The University of Chicago Press, 2006).

[12] Andreas Kitzmann, "Pioneer Spirits and the Lure of Technology: Vannevar Bush's Desk, Theodor Nelson's World," *Configurations* 9, no. 3 (2001): 441-442.

Nelson's work, Kitzmann suggests that Nelson's overinflated aims are in part a product of the countercultural climate. Nelson is portrayed as a countercultural hero by Jaron Lanier in *You Are Not a Gadget*.[13] John Markoff similarly links Nelson to the counterculture, with *Computer Lib/Dream Machines* serving as his rallying cry.[14] Thomas Streeter, in *The Net Effect*, suggests that Nelson's main contribution was as a writer and the main influence of the countercultural thread of computing was to make people rethink how they exist within institutions.[15] It may be that Nelson's success was as a writer, but he was not merely a writer and his dream was not at first tied to a counterculture. Nelson imagined a distinct relationship with computers, captured in designs as well as writing, that cannot be reduced to a broader movement. Belinda Barnet, in *Memory Machines*, concludes that "all we have of Xanadu is a tantalizing design, its ideals and its ideas."[16]

Many others have written on hypertext more broadly. I can only gesture at the expansive literature. Some were excited by an apparent resonance between hypertext and critical theory.[17] Paul Edwards observed this idea and identified a tension in how theorists were thinking about hypertext: they attempted to hold two views of the text at once, a personal and social understanding of the structure of ideas coexisting in one form.[18] N. Katherine Hayles, in *Electronic Literature,* responds to the same understanding of hypertext in relation to critical theory and concludes that its hopes for the medium were

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[13] Jaron Lanier, *You Are Not a Gadget* (New York: Vintage Books, 2010), 18.

[14] John Markoff, *What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry* (New York: Viking Penguin, 2005), 282.

[15] Thomas Streeter, *The Net Effect: Romanticism, Capitalism, and the Internet* (New York: NYU Press, 2011), 54-65.

[16] Belinda Barnet, *Memory Machines* (London: Anthem Press, 2013), 82.

[17] George Landow, *Hypertext: The Convergence of Contemporary Critical Theory and Technology* (Baltimore: Johns Hopkins University Press, 1992).

[18] Paul Edwards, "Hyper Text and Hypertension: Post-Structuralist Critical Theory, Social Studies of Science and Software," *Social Studies of Science* 24, no. 2 (1994): 229-278.

overblown. The tension between a social and a personal understanding of the text, identified by Edwards, can be understood through the history of Xanadu, in which the two developed one after the other.

In this thesis I will situate Nelson's dream in its context. I will develop his dream alongside others, like those of Vannevar Bush, Doug Engelbart, Gregory Bateson, and the pioneers at Apple and Xerox PARC. Nelson's dream resonated with these, but his distinct vision has gone mostly unappreciated. Nelson imagined a different way of relating to computers in which literature, in its broadest conception, was central.

* * *

The world that Nelson imagined can help us to understand our own. His Project Xanadu represents a path not taken in the world of computers. As Marco Polo says in Italo Calvino's *Invisible Cities*, "Elsewhere is a negative mirror. The traveler recognizes the little that is his, discovering the much he has not had and will never have."[19]

This is the story of Xanadu, and Ted Nelson's life-long effort to bring the age of digital networks into alignment with his dream. Nelson's dream, still unrealized, can be like a negative mirror for the current network age. At its broadest, this is the story of an alternative vision for the network age grounded not in the sort of network observed in corporate or military organization, nor in the sort of network that underpins commerce and communication. Rather, it is a vision for the network age in which literature—conceived broadly as a system of interconnected writings—is central.

This thesis traces Nelson's dream across his written works and system designs, situating them within an evolving technical ecosystem, and identifying their gradual

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[19] Italo Calvino, *Invisible Cities*, trans. William Weaver (New York: Harcourt, 1974), 29.

evolution. An unusually long-running vision, it's necessary to historicize the project. It is a story of dreams and hopes that evolved over the decades, revealed through a close reading of inspirational, speculative writing, that aims to understand what drove those involved in the rise of computers and retrieve some of the most powerful visions for the future.

The first chapter sketches the mood of postwar and Cold War-era science in America and the hopes of various thinkers, including Nelson, who believed that technology could be directed toward the betterment of society. The second chapter describes Nelson's presentation of his vision to the public and how it evolved alongside the broader ecosystem. The final chapter identifies Nelson's Xanadu in its final synthesis, some similar projects that were underway at this point, and the eventual victor of the hypertext saga: the World Wide Web. My hope is not to make Nelson's Xanadu clearer than he already has, nor to suggest a novel understanding of its influence on other projects. Rather, my intention is to draw out Nelson's hopes for Xanadu that make it unique.

Chapter I: WWII, Postwar Science and the Rise of the Computer

Computers have a dual nature, supporting top-down control on the one hand and individual empowerment on the other. Early computers, characterized by the former, were central to what Paul Edwards describes as a Closed World discourse in Cold War America. This Closed World was all-encompassing: the world was brought into total closure as rockets, meant to conquer the final frontier of outer space, put satellites into orbit about the planet. But the same computers that made this possible began to emerge with a different cultural valence in the decades that followed. We will trace the roots of computers to World War II—when Ted Nelson was still a child—and, in mapping the climate of science and the diverse hopes held for the future of science and technology in the decades that followed, situate Nelson's Xanadu in a broader social and political context.

Ted Nelson's Early Life

Theodor Holm Nelson was born of Emmy Award-winning director Ralph Nelson and Academy Award-winning actress Celeste Holm, in 1937. Nelson was raised by his mother's parents, Jean and Theodor Holm. Their home, Nelson says, was a home of culture. Growing up, Nelson loved films and he loved words—but he never liked school. In fact, Nelson recalls wanting to burn his school down at four or five.[20]

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[20] Theodor Holm Nelson, *Possiplex: Movies, Intellect, Creative Control, My Computer Life and the Fight for Civilization* (Self-Published, 2010), 25.

While World War II raged in Europe, Nelson was a child in Chicago. He recalls a memory, when he was four or five, seated on a rowboat with his grandparents. He trailed his hand in the water as his grandfather rowed their boat forward:

> The water was opening around my fingers, gently passing around them, then closing again behind.
>
> I considered the different places in the water and the connections between them, the places that at one instant were next to each other, then separated as my fingers passed. They rejoined, but no longer in the same way.
>
> How is it, I wondered, that every instant's arrangement, in the water and the world, can be so much the same as before and yet so different? How could even the best words express what systems of relationships were the same and different?[21]

If there's a common thread across all of Nelson's work, it is a view of the world as an interconnected whole. In his intellectual work and later his technical designs, Nelson always directed his focus toward the relationships between things. In 1955, Nelson began college at Swarthmore. On campus, he directed three plays, including the world's first rock musical, and a film in which a young man discovers the meaning of life; produced three issues of a magazine and two newsletters; and served on student council. One of Nelson's publications, titled "We Need a Sociology Department," demonstrated sociological topics at play on campus.

At Swarthmore, Nelson says, his mind was "a bird set free."[22] Nelson, unsurprisingly, sought out courses in sociology. "To me," Nelson would later write, "the social sciences were always breathingly close to everyday life, in an invisible dimension others somehow could not see."[23] The view of the world as deeply interrelated that had so captivated young Nelson now reappeared in the field of sociology. Nelson read the work

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[21] Theodor Holm Nelson, "World Enough: Sample pages advertising the manuscript edition," Ted Nelson's archives, private collection, 1.

[22] Nelson, *Possiplex*, 63.

[23] Nelson, "World Enough," 102.

of sociologists such as Claude Levi-Strauss and Talcott Parsons, and he learned to think about the contours of this other dimension of life.

His junior year, Nelson enrolled in a seminar taught by Michael Scriven that thrilled him. As he began to write a sprawling work of sociology, his mind "was on fire with its power and generality."[24] In Nelson's mind, his topic of investigation expanded from "the social sciences to all of description."[25] "Unfortunately," Nelson recalls, "this writing would sprawl too much for my room." Nelson was working with a rich structure of ideas that pushed the limits of normal composition. His ideas needed space, so he setup in the elevator across from his room:

> It became my office. I put in a chair, lowered the elevator a few feet and put my typewriter outside on the third floor itself, now a shelf. Then I taped all my notes to the walls of the elevator and sat day and night, writing and rewriting furiously … My paper was a huge cut-and-paste operation, in the real writer's sense. The walls were my manuscript; I moved and reaped the pieces of thought, moving them up and down, from side to side and to the back, and then typed from them, looking over my shoulder when necessary.[26]

Stitching thought together into a linear narrative, as Nelson struggled to do in his building's elevator, is a reductive process. It puts all the power in the hands of the author, and the true, sprawling structure of the ideas at play is never accessible to the reader. In the years that followed, Nelson would realize that this process of writing could be moved onto the computer screen, and ideas would no longer need to be reduced to a linear form. The interconnected structure of thought could be the new medium for the written word.

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[24] Nelson, "World Enough," 130.

[25] Ibid.

[26] Ibid.

Nelson says that his initial plan out of college was to first get his PhD and then go to Hollywood to make movies.[27] So, fresh out of Swarthmore, Nelson joined Harvard's Department of Social Relations. While in graduate school he had the epiphany that spawned Xanadu and he "made a new and much bigger plan." He would first found the personal computing industry and design his vision of hypertext, then return to his original plan.[28]

It was in a computer programming course at Harvard that Nelson had his epiphany. In 1960, computer media were basically uncharted territory, but for Nelson it was enough to know that computer screens could make patterns of dots. Look closely at a picture in a newspaper and you'll see the same. So, Nelson concluded, "There's no picture you couldn't put on the screen!"[29] Nelson devised a final project for the course in which he would build a writing system for Harvard's only computer. The system would store manuscripts, allow certain editorial operations, and print them out. Nelson called this "text handling," although it later came to be known as "word processing."[30] To Nelson, an important feature was the ability to compare two versions of a text side by side. However, Nelson did not finish the project on time and he got an incomplete for the course, and thus left Harvard with a Master's degree.[31] After graduate school, Nelson went to Dr. John C. Lilly's Communications Research Institute (CRI) to study communication and cognition in dolphins but he did not lose track of his vision. At this

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[27] Theodor Holm Nelson, "What Box?," in *Intertwingled*, eds. Douglas Dechow and Daniele Struppa (New York: Springer, 2015), 137.

[28] Ibid.

[29] Theodor Holm Nelson, "Virtual World Without End" (lecture, CyberArts International Conference, September 7, 1990), Ted Nelson's archives, private collection.

[30] Theodor Holm Nelson. *Literary Machines (*Sausalito, CA: Mindful Press, 1980), 1/25.

[31] Ibid.

point, Nelson was nearly unique for the humanistic hopes he had for the future of computers, a view that followed naturally from his background as a film-maker.

At the CRI, Nelson joined impressive ranks. Among Nelson's new colleagues was a man named Gregory Bateson. A fellow social scientist, Bateson too had been pulled into the world of computers in years past. That Bateson and Nelson shared an office for the brief period during which they were both at the lab is a striking coincidence. Bateson's career centered on new ways of explaining the social world. Like Nelson, Bateson was focused on the networks of relations that are at play in ideas and the world.

Social Sciences during the War

Bateson's relationship with the computer world is unusual, and traces back to the early days. While Nelson was still a young boy, Gregory Bateson was involved in the war effort. The great question of those times was how man should relate to technology and the fruits of science. Bateson was among the most sensitive to these concerns.

In 1940 Bateson volunteered to help steer American morale as part of Arthur Upham Pope's Committee for National Morale.[32] "As the United States geared up for war," Fred Turner explains, "its leaders faced a quandary: they wanted to use media to unite Americans against their enemies, but many also feared that using mass media to do it would transform Americans into just the kind of authoritarians they were trying to defeat."[33] In 1942, Bateson suggested something similar in his essay "Social planning and the concept of deutero-learning":

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[32] David Lipset, *Gregory Bateson: The Legacy of a Scientist (*New Jersey: Prentice-Hall, 1980), 166.

[33] Fred Turner, "Machine Politics: The Rise of the Internet and a New Age of Authoritarianism," *Harper's Magazine*, January, 2019, 26.

> It is hardly an exaggeration to say that this war is ideologically about just this—the role of the social sciences ... Now that we have the techniques, are we, in cold blood, going to treat people as things? ... The problem is one of great difficulty because we, as scientists, are deeply soaked in habits of instrumental thought[34]

Bateson was wary of the misuse of power as it pertained to science. Bateson's interest was in how science could be applied without being oppressive. In 1943, Bateson went to D.C. to join the Office of Strategic Services (OSS) as a "psychological planner."[35] He applied his models for thinking about interactive systems, feedback loops, and social systems to the problem of propaganda:

> The one activity which caught his interest, however, was operating a radio station aimed at undermining Japanese propaganda in Burma and Thailand … "We listened to the enemy's nonsense and we professed to be a Japanese official station. Everyday we simply *exaggerated* what the enemy was telling people."[36]

Bateson's work centered on the premise that the interactions within a system could be direction-determining. In the case of propaganda, Bateson demonstrated a clever use of this framework, undermining enemy messages by extending their lies even further from the truth. Bateson once said that as a student "teleology was the main zoological sin you could commit in a zoology lab."[37] With this in mind, he wrote his first book, *Naven*, assuming that he could not appeal to purpose as an explanatory device.[38] Rather, what he "stumbled on" was that interactive systems become direction determining. "This is related to Hegel," Bateson says, "it's related to Marx, it's related to common sense."[39] In

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[34] Lipset, *Gregory Bateson*, 166.

[35] Ibid., 174.

[36] Ibid.

[37] Gregory Bateson, "Ecology of Mind" (lecture, October 5, 1976), Gregory Bateson Papers, Special Collections and Archives, University of California, Santa Cruz.

[38] Gregory Bateson, *Naven: A Survey of the Problems suggested by a Composite Picture of the Culture of a New Guinea Tribe drawn from Three Points of View* (Cambridge: The University Press, 1936).

[39] Bateson, "Ecology of Mind."

this early work of Bateson's are the seeds of the sort of systems thinking that he applied in the war years. Similar methods would take center stage as America transitioned its technology programs to peacetime.

Postwar Science, Cybernetics and Digital Computers

Where Bateson avoided teleology, some of his contemporaries were less hesitant. Norbert Wiener, Arturo Rosenbluth and Julian Bigelow wrote "Behavior, Purpose and Teleology" in 1943.[40] Their work kickstarted an American effort to bring various disciplines of science together. A series of conferences held in New York shortly after the war ended brought two groups of scientists together for a common project. The first group were the engineers, physicists, and mathematicians who had been recruited to military programs during the war. The second group consisted of psychologists and anthropologists. Bateson was invited as part of the second group. Bateson's early work in understanding social systems anticipated many of the ideas of wartime engineers concerned with modeling a different type of system.

The conferences were hosted by the Josiah Macy Foundation, between 1946 and 1953, and aimed to bridge the work of wartime engineers with the social sciences. During the war, a mathematician named Norbert Wiener was recruited to work on antiaircraft systems.

By World War II, airplanes had evolved significantly since World War I. Faster and more nimble warplanes required more accurate antiaircraft guns.[41] Manual aiming of

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[40] Arturo Rosenblueth, Norbert Wiener, and Julian Bigelow, "Behavior, Purpose and Teleology," *Philosophy of Science* 10, no. 1 (1943): 18-24.

[41] Edwards, *Closed World*, 45.

guns, in which human operators need to decide how to aim the gun, became too difficult for most gunners. So Wiener and his colleagues devised a system in which a primitive computer would calculate the future position of a plane and then automatically direct the gun accordingly.[42]

Working on these systems, Wiener began to understand the man-machine systems of combat as networks of agents, interrelated by communication, message-passing, and feedback loops. Building off of this early use case, Wiener developed a language of command and control that could relate the behavior of men and machines. Cybernetics emerged as an independent field in the following years and in 1948, Wiener's *Cybernetics* introduced the field to the world, grounding it in his wartime experience and giving it a name derived from the Greek word for "steersman."[43] Wiener was a central figure at the Macy conferences which eventually adopted the banner of cybernetics.

Antiaircraft demanded that sophisticated calculation be done nearly instantly. The automation of the calculation involved in compiling ballistics tables for antiaircraft weapons was "the raison d'etre for the first electronic computer," wrote Herman Goldstine, co-director of the ENIAC project.[44] The differential analyzer developed by Vannevar Bush was a helpful aid, but could not alone replace the tedious calculations involved.

After the war, Bush, as head of the wartime Office of Scientific Research and Development, proposed the establishment of the National Science Foundation in his

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[42] Ibid.

[43] Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine* (Cambridge, MA: MIT Press, 2000).

[44] Edwards, *Closed World*, 49.

report *Science, The Endless Frontier*. "Government subsidy was essential," he said, "if research … was not to fall flat on its face" after the war.[45]

The Moonshot

Concerns about the direction of post-war science, techniques developed for the direction of ballistics missiles, and the rise of the digital computer all converged in the great effort of postwar research: the space race. As America entered into the Cold War, the space race emerged as a sort of Manhattan project that could demonstrate American supremacy.[46] The space race brought with it a new relationship between man and Earth. President Kennedy spoke of "a 'new frontier' in which high technology would unseal the closed globe to exploration of the limitless universe beyond."[47] Space was the final frontier, but here there was an irony.[48] "After all was said and done," Paul Edwards explains, "the space program's chief products were not outward- but inward-looking: spy cameras to pierce the Soviet Union's veil, pictures of the Earth drifting alone through space, pictures of the closed world."[49]

The irony of space as a frontier of possibility leveraged above all to bring the world into a new closure was stretched even further when a man named Stewart Brand looked to the image of Earth from space as an icon of a freer world. He recalls the acid trip that led eventually to his *Whole Earth Catalog*:

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[45] Vannevar Bush (remarks at the National Science Board Dinner honoring Alan T. Waterman, June 21, 1963), Vannevar Bush Papers, MC 78, Institute Archives and Special Collections, M.I.T. Libraries, Cambridge, MA.

[46] Edwards, *Closed World*, 134.

[47] Ibid., 135.

[48] Ibid.

[49] Ibid.

> There were no public photographs of the whole earth at that time, despite the fact that we were in the space program for about ten years. I started scheming within the trip. How can I make this photograph happen? Because I have now persuaded myself that it will change everything if we have this photograph looking at the earth from space.[50]

When Stewart Brand thought about the space program that day, he decided that what the world needed was for everyone to see the view of the astronauts. In a way, this is a distillation of the project that would follow: the effort to reclaim the fruits of science to be directed toward counterculture rather than hegemony.

Other Goals

Not everyone believed the moonshot was a worthwhile direction for postwar science. In 1960, Vannevar Bush wrote a foreword to John Heller's "Of Mice, Men and Molecules." Bush reflected on the renewed interest in research brought by World War II. "We in this country," Bush suggested, "are prone to follow fads."[51] Specifically, Bush looked to the space exploration program and questioned whether such a program was worthwhile given the many unspectacular but vital problems that could be addressed by basic research.[52]

Basic research and its support by technology and funding was Bush's hope for postwar science. When *The Atlantic* ran Bush's "As We May Think" in 1945, the editor explained:

> As Director of the Office of Scientific Research and Development, Dr. Vannevar Bush has coordinated the activities of some six thousand leading American scientists in the application of science to warfare. In this significant article he holds up an incentive for scientists when the fighting has ceased … Now, says Dr. Bush, instruments are at hand which, if properly developed, will give man access

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[50] Turner, *From Counterculture to Cyberculture*, 69.

[51] Vannevar Bush, "Foreword: Of Mice, Men & Molecules," Vannevar Bush Papers, MC 78, Institute Archives and Special Collections, M.I.T. Libraries, Cambridge, MA.

[52] Ibid.

> to and command over the inherited knowledge of the ages. The perfection of these pacific instruments should be the first objective of our scientists as they emerge from their war work. Like Emerson's famous address of 1837 on "The American Scholar," this paper by Dr. Bush calls for a new relationship between thinking man and the sum of our knowledge.[53]

At the time of writing, Bush was the director of the Office of Scientific Research and Development (OSRD). As World War II came to an end, Bush was tasked with prioritizing research projects that could carry forward the momentum of wartime research as the country transitioned to peacetime. Among other things, Bush put forward a vision for how technical knowledge might be better stored and retrieved. Bush believed that tools could be developed to make the deluge of inherited knowledge more accessible. Such tools, built on microfilm, could empower scientists at a time when scientific knowledge was accumulating to such an extent that no-one could make sense of it all and individuals were increasingly forced to specialize.

In "As We May Think," Bush describes a hypothetical device called the Memex that could help the thinking man to better navigate the sum of technical knowledge. The Memex is imagined as a futuristic desk, equipped with display screens and microfilm storage, that would make information accessible by a code typed into a keyboard. Crucial to the idea of the Memex was the concept of "trails." Trails would allow items to be gathered together "from widely separated sources and bound together to form a new book"[54]. Such trails would provide a new way of wrangling a vast library of texts. Bush's hypothetical device was a lasting legacy.

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[53] Vannevar Bush, "As We May Think," *The Atlantic*, July 1945.

[54] Ibid.

In 1944, a young man named Doug Engelbart was deployed to war. He came across Bush's "As We May Think" in the Fall of 1945 in a library in the Philippine Islands.[55] Rereading the article more than a decade later, Engelbart was "startled to realize how much I had aligned my sights along the vector you had described."[56] In 1961, when Engelbart was working at the Stanford Research Institute (SRI), he outlined a "Program on Human Effectiveness."[57] He sent a copy to Bush and attached a letter, acknowledging the fundamental influence of Bush's article on the aims of the program.

Engelbart's first break was based on work in shrinking computers. In 1959, Engelbart came across an article titled "Shrinking the Giant Brains for the Space Age" by Jack J. Staller of the Missile Guidance Department of the American Bosch ARMA Corporation.[58] Engelbart gave a similar presentation shortly after on his concept of "similitude:" the phenomenon of scaling electronics down in size while maintaining their behavior. Engelbart was among the first to comprehend the implications of shrinking electronics. For him, shrinking electronics was deeply related to a proliferation of computers. The technologist Alan Kay was startled when he came to a similar realization:

> The thought almost frightened him, for he realized instantly that computing as it was known in the 1960s would never survive. Suddenly, he was certain there would soon be not thousands but millions of computer users. He likened the feeling to the kind of queasiness that those who read Copernicus must have felt

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[55] Douglas C. Engelbart to Vannevar Bush, May 24, 1962, Vannevar Bush Papers, MC 78, Institute Archives and Special Collections, M.I.T. Libraries, Cambridge, MA.

[56] Ibid.

[57] Douglas C. Engelbart, "Program on Human Effectiveness," Stanford, http://web.stanford.edu/dept/SUL/library/extra4/sloan/mousesite/Archive/Post68/PrHumanEffectiveness.html (accessed November 1, 2019).

[58] John Markoff, *What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry* (New York: Viking Penguin, 2005), 17.

> when he looked up at the sky after he realized that the sun did not circle around the earth.[59]

Engelbart, like Bush, was concerned with the most worthwhile use of government funding for science. Engelbart suggested regarding his program in Human Effectiveness:

> It is felt that such a program competes in social significance with research toward harnessing thermonuclear power, exploring outer space, or conquering cancer, and that the potential payoffs warrant a concerted attack on the principal problem areas.[60]

The basis of Engelbart's proposal was that humanity faces increasingly complex and urgent problems, and so improved effectiveness in dealing with such problems was crucial to the continued stability and progress of society.[61]

Engelbart's vision was cybernetic in essence. "The possibilities we are pursuing," Engelbart explained, "involve an *integrated man-machine working relationship*, where close, continuous interaction with a computer avails the human of radically changed information-handling and portrayal skills, and where clever utilization of these skills provides radical changes in the way the human attacks problems."[62] Where cybernetics had often considered how man might be replaced by machine, Engelbart wondered how man's intelligence could be augmented by computer aid, keeping man in the loop.

Engelbart became director of the Augmentation Research Center (ARC) at SRI in 1959. At the same time, John McCarthy was leading the Stanford Artificial Intelligence Laboratory (SAIL) on the opposite side of campus.[63] Whereas Engelbart was working to

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[59] Ibid., 144.

[60] Engelbart, "Human Effectiveness."

[61] Ibid.

[62] Ibid.

[63] John Markoff, preface to *What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry*. New York: Viking Penguin, 2005.

augment the human mind, McCarthy's lab was working to replace it. These two programs represented a bifurcation of cybernetic research at Stanford. The thinking of the time was that artificial intelligence was imminent and Engelbart's aim to augment human intelligence with computers was considered irrelevant to the state of the art. Nonetheless, when a man named Bob Taylor met Doug Engelbart he committed NASA funding to the project at ARC.[64]

Back when Norbert Wiener wrote the founding text cybernetics, he was working in the after math of World War II. While he acknowledged that cybernetic developments had great possibilities for evil, he did not align himself with the optimists who hoped that cybernetics could be redirected toward a better world. With regard to hopes that the field could provide for a "better understanding of man and society" that could outweigh its contribution to the concentration of power, Norbert Wiener said it was "a very slight hope."[65]

Gregory Bateson, however, was undeterred. He resisted the imposition of cybernetic systems without first developing a better understanding of the social order on which one was intervening, and held out hope that the methods of cybernetics could support this better understanding:

> insofar as we let our cybernetic inventions—the computers—lead us into more and more rigid situations, we shall in fact be maltreating and abusing the first hopeful advance since 1918.
>
> And, of course, there are other dangers latent in cybernetics and many of these are still unidentified. We do not know, for example, what effects may follow from the computerization of all government dossiers.

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[64] David Bennahum, "Doug Engelbart: The Interview," http://memex.org/meme3-01.html (accessed November 7, 2019).

[65] Norbert Wiener, *Cybernetics*, (Cambridge, MIT Press, 2000), 29.

> But this much is sure, that there is also latent in cybernetics the means of achieving a new and perhaps more human outlook, a means of changing our philosophy of control and a means of seeing our own follies in wider perspective.[66]

In a 1976 interview, Bateson explains that the extension of cybernetics into new ways of understanding behavior never quite happened.[67] The reason, he suggests, is that the cyberneticians present at the conferences turned to a narrow model of "input-output." Circular causality and feedback were fundamental to cybernetics; however, its popular conception of these years resisted taking this principle too far. Cyberneticians of more "hard science" backgrounds maintained a preference for approaches in which the system one studies can be considered wholly separate from oneself, the studier. Bateson's extension of circularity out of the system being studied and into the realm of the scientist was less eagerly embraced. This formulation came to be known as "second-order cybernetics."

Bateson saw in cybernetics the potential for a new regime of science. During the war and in the years after, Bateson was focused on the ethical application of science to society. His concept of second-order cybernetics spoke to these concerns as it brought the scientist down into the system of study. In this way, it was impossible to look down on the whole of society. And, like Engelbart, this meant keeping the human, whether designer or user, in the loop of cybernetic systems. It is here that technological devices emerge with potential for individual empowerment.

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[66] Gregory Bateson, *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology* (Northvale, NJ: Aronson, 1972), 335-6.

[67] Stewart Brand, *For God's Sake, Margaret*, (CoEvolution Quarterly, 1976).

As Nelson was coming of age there was confusion as to the direction of science and technology. However, in a few distinct ways, Americans began to imagine how technology could be reclaimed for individual empowerment. Nelson built in this tradition and made one additional leap: Nelson combined freedom with humanism as he began to imagine systems that would bring man into a computer-mediated literary relationship with the world.

Bush's vision of the Memex was inspiring to many, and Ted Nelson was among the young technologists curious how something like the Memex might be made a reality with maturing computer technology. In 1965, Ted Nelson gave a talk at the Association for Computing Machinery (ACM) on the topic of "A File Structure for The Complex, The Changing and the Indeterminate."[68]

In this talk, Nelson demonstrated how computers could make possible new media and new ways of navigating texts. Nelson's talk was notable at the time for its incorporation of interactive computer use. At a time when computers were out of mind for all but the highly technical, Nelson imagined how computers could be directed toward the design of new media with writers, not engineers, in mind. "The original idea," Nelson said, "was to make a file for writers and scientists, much like the personal side of Bush's Memex."[69]

Reworking Bush's vision for the age of digital computers, Nelson concluded that "the only answer is a simple and generalized building-block structure, user-oriented and wholly general-purpose."[70] The generalized structure that Nelson introduced in this talk was named "hypertext." Nelson chose the prefix "hyper-" to connote "extension and generality; cf. 'hyperspace.'"[71] As Nelson described it at the time, hypertext was a structure for text more flexible and more responsive to change than anything seen before:

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[68] Theodor Holm Nelson, "A File Structure for The Complex, The Changing and the Indeterminate," *ACM Annual Conference/Annual Meeting: Proceedings of the 1965 20th National Conference* (1965): 84-100, available at https://archive.org/details/SelectedPapers1977 (accessed Septembere 30, 2019).

[69] Ibid., 33.

[70] Ibid.

[71] Ibid., 45.

> It is useful where relationships are unclear; where contingencies and tasks are undefined and unpredictable; where the structures or final outcome it must represent are not yet fully known; where we do not know the file's ultimate arrangement; where we do not know what parts of the file are most important; or where things are in permanent and unpredictable flux. Perhaps this includes more places than we think. And perhaps here, as in biology, the only ultimate structure is change itself.[72]

In his description of hypertext's usefulness, Nelson is getting at an important point. What Nelson hoped was that new sorts of computer media could help better convey ideas. Like Bush's Memex, Nelson's hypertext was first conceived as a personal system for reading and writing. However, Nelson's hypertext called for more granular interconnection, made possible by a move away from microfilm to the computer screen. Whereas Bush's trails would allow pages of text to be recombined to form new books, Nelson's hypertext interlinked quotes, revisions and commentary between texts. "The task of writing," Nelson points out, "is one of rearrangement and reprocessing, and the real outline develops slowly."[73]

Nelson conceived of writing as the reduction of a complex tapestry of related ideas into a linear structure. With the help of computers, the writer could finally interact with this complex structure directly. In the years that followed, Nelson would incorporate hypertext into the larger project he named Xanadu.

The Lesson of Film

Xanadu was a perfect synthesis of Nelson's background. Not only did it develop from a sociologist's view of the world in terms of its relationships—calling back to his experience of writing in the elevator—but it happened on the screen, Nelson's first love.

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[72] Ibid., 46.

[73] Ibid., 37.

Nelson considered how developers of computer media might learn from the development of film.

Nelson found in computers something better than film, which in his world was no small claim. Nelson always loved film. Both his parents were actors, and as a kid Nelson remembers appearing on television. Later, Nelson drafted an adoring letter to Stanley Kubrick in which he laid out his credentials for the review and put forward meaningful praise.[74] But Nelson thought the future of all media was on computer screens. Computers, in his mind, were part of a "social-mental revolution" as significant as the one that followed Gutenberg. Nelson hoped this revolution could "revitalize our mental life." The issue was pressing, because to Nelson, the age of television was "degrading to the intellect."[75]

Film nonetheless provided Nelson with a useful historical analogy for the project he foresaw. Nelson's hypertext, he suggested in a 1967 essay titled "Getting it Out of Our System," could be understood in relation to the motion picture.[76] "By considering the time and trouble it recently took to understand the nature of the motion picture—another prepared temporal and visual medium," suggests Nelson, "we may see better why things are difficult now."[77]

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[74] Theodor Holm Nelson to Stanley Kubrick, Ted Nelson's archives, private collection.
[75] Adele Freedman, "Computer apostle spreads The Word," *Toronto Globe and Mail*, January 10, 1979.
[76] Theodor Holm Nelson, "Getting it Out of Our System," 1967, Ted Nelson's archives, private collection.
[77] Nelson, "Getting it Out," 19.

His story of the motion picture centers on D. W. Griffith, who Nelson believes may have been the "greatest film director of all time."[78] "It was he," in 1915, "that consciously began constructing the film out of shots rather than 'scenes.'" And in "The Birth of a Nation," Griffith put together a "'total' film the way none had ever been. Uniting all the techniques that had come before, all his new effects of camera placement, cross-cutting, and tempo of movement and editing he wove history, battles and love story into a single, entire fabric. Audiences were stupefied."[79]

Such tactics were not obvious to early filmmakers and hearken back to the sophistication of Nelson's hypertext as a medium. Nelson takes a moment to reflect on theory, and whether such regime changes in media could be reduced to structural determinism. In this way, media like hypertext and film would follow inevitably from the intrinsic dynamics of the medium. However, Nelson believed this untrue for the case of hypertext.

> The medium has an internal dynamic, I think, immanent and intrinsic in the technology. This we must discover. But however compelling this internal dynamic may be, there will be play for some adjustments. We must strive to add the touches that suit it best to the way we want to do things.[80]

Writing in 1967, it was already clear to Nelson that computers would usher in media as novel as the film. And unlike the case of film, its dynamics were not tethered to the intrinsic properties of the technology. Furthermore, the new media could break from the medium of the written word left mostly untouched for hundreds of years:

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[78] Griffith's "The Birth of a Nation" was a controversial film even at the time of launch as it depicts the Ku Klux Klan as saviors in a post-Civil War South, cf. https://www.history.com/news/kkk-birth-of-a-nation-film.

[79] Ibid.

[80] Ibid., 27.

> The conventional 'document' is not God-given, and in fact is inappropriate for most purposes. Systems based on discrete and isolated documents relinquish the greatest power of the new technology. But at the other extreme we are wrong to suppose that an information machine can or should eliminate the human task of composition. We have not begun to explore the possibilities of natural language woven into more complex (but also natural) arrangements.[81]

"The problem of Getting It Out of Our System" that Nelson describes is not how to surface documents from a file store—a popular concern of Information Retrieval projects in those years. Rather, what Nelson believed technologists needed to get out of their system were "the fixities of thinking and procedure that hold us back."[82] Nelson was calling for something even better than the Memex.

The Mother of All Demos

When, in 1965, Ted Nelson gave his talk at the ACM on "A File Structure for The Complex, The Changing and the Indeterminate," he, like Engelbart, was working toward Bush's vision of the Memex. After the talk, Bob Taylor introduced himself to Nelson and suggested that he get in touch with Engelbart. In 1966 Nelson got an early demo of Engelbart's project and the two men became lifelong friends.

In 1968, Engelbart's work was revealed to the world in what is now known as "the Mother of All Demos." Engelbart demonstrated interactive computer programs controlled by a mouse—his most lasting legacy.[83] Shortly after the demo, however, Engelbart's world fell apart. When Bob Taylor put together a dream team at Xerox PARC neither Engelbart nor Nelson was invited to join.

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[81] Ibid., 29.

[82] Ibid.

[83] Engelbart is known for his invention of the mouse.

Nonetheless, Engelbart's "Mother of All Demos" introduced his oNLine System (NLS) to the world. For all who saw the system, it was a revelation. Most had never even seen a computer used interactively, let alone the computer as a communications and text management system:

> In one stunning ninety-minute session, he showed how it was possible to edit text on a display screen, to make hypertext links from one electronic document to another, and to mix text and graphics, and even video and graphics. He also sketched out a vision of an experimental computer network to be called ARPAnet and suggested that within a year he would be able to give the same demonstration remotely to locations across the country. In short, every significant aspect of today's computing world was revealed in a magnificent hour and a half.[84]

Engelbart gave the world its first demonstration of personal computing. For the first time, so many of Nelson's dreams for the future of computing were a reality. Engelbart's central mission was to develop computers to promote "Human Effectiveness." When the home computer industry began to take off, however, many of Engelbart's ideas would be left behind. Eager to possess their own computers, PC hobbyists would miss the most important piece: computers as communications devices.[85]

Humanism and Counterculture

Engelbart's program in human effectiveness aligned well with Nelson's goals. Nelson sought to revitalize literature and to develop for computers a more worthy medium of thought. As mentioned above, Nelson claimed in 1970 that all he wanted to do was "put Renaissance humanism in a multidimensional responsive console." This was the topic of an essay, titled "Barnumtronics," that Nelson contributed to Swarthmore College's

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[84] Markoff, *Dormouse*, 147.

[85] Markoff, *Dormouse*, 78.

alumni bulletin.[86] This issue of the bulletin showcased the achievements of some of Swarthmore's most accomplished alumni. Displayed on the front cover, alongside Stanford's new president and a major league baseball player, was a young Ted Nelson—peeking out from behind a computer. What was Nelson's claim to fame? He was the inventor of Xanadu, among other things.

The essay traces Nelson's first decade in the computer world, the obstacles he faced, and the ideals that motivated him. Nelson describes the turning point in his life, which had come in his computer programming course at Harvard. What Nelson realized at the time was that computer presentation of media would not be a matter of technicalities, but a matter of writing and showmanship. Hence, "Barnumtronics": the humanistic future of computers would not be unlocked by engineers, but by "Gutenbergs, D. W. Griffiths, and P. T. Barnums." Nelson ends his inspired essay with a closing message to the reader:

> Ladies and gentlemen, the age of prestidigitive presentation and publishing is about to begin. Palpitating presentations, screen-scribbled, will dance to your desire, making manifest the many mysteries of winding wisdom. But if we are to rehumanize an increasingly brutal and disagreeable world, we must step up our efforts. And we must hurry. Hurry. Step right up.

The age of personal computers had not yet begun. But like Engelbart, Nelson could at least hope to spread his vision of the exciting new era of computing that awaited. As Nelson explains in Barnumtronics, "So far my predictions have been generally right except for chronology. I originally thought the printed word might be eliminated by 1970 or 1972. Now, uh, I guess it will take a little longer."

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[86] Theodor Holm Nelson, "Barnumtronics," *Swarthmore College Bulletin*, December 1970.

In an essay from the same year, Nelson argued that the realm of new media for computers was liberated from technical determinism. “Until now, our media,” Nelson explains, “have been based on specific inventions and technical connections.” However, in this new age “information may be commuted to any form,” and furthermore, “networks may be built connecting any device to any other device.”[87]

The world had begun to agree that computer networks were on the horizon. Engelbart’s demonstration may have been the first time many in the field became aware of this. Then, in 1969, the Internet was born. Nelson began to incorporate this new potential into Xanadu. As for what form information should take in this network, Nelson’s belief was the same as ever: hypertext. Nelson further emphasized that the possible futures open to the world at this moment were not a matter of science, and the new age would not be “scientific.” “The technological imperative is a fake,” Nelson explains, and “computerization can take whatever form we wish it to.”[88]

Nelson stepped up to fill the role of visionary. In 1971, Ted Nelson gave a talk on Computopia and Cybercrud. At this point, Nelson had been pursuing his vision for more than ten years. He claimed to feel like Marco Polo in his later years, “no longer Italian and certainly not Chinese, trying to interest one in the other.”[89] Nelson was frustrated. “I am here to say,” he began, “what I always say, not so much to influence anybody now as to say ‘I told you so’ later.”[90]

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[87] Theodor Holm Nelson, “The crafting of media,” *SOFTWARE*, May 24, 1970, 17.

[88] Ibid.

[89] Theodor Holm Nelson, “Computopia and Cybercrud,” 1971, 185.

[90] Ibid.

Nelson presented a dichotomy targeted at young dreamers, a fork in the road of computer adoption. On the one hand, Nelson put forward his computer utopia ("computopia"): "a sort of Woodstock with terminals. With terminals on all sides, we can more easily go barefoot and pocketless. I propose to turn on people's minds with display screens rather than drugs."[91] Cybercrud, on the other hand, represented a future in which the individual was subjugated to the whims of the machine. Nelson's message was simple: Computers for the people!

Simplicity and Power

In 1972, Nelson wrote an essay on the issue of simplicity, power, and balancing the two in software. The paper sought to show that the two could be merged. "It is a matter of design, aesthetics and psychology," Nelson said.[92] In the case of text, Nelson suggested that the basic operations could be taken from Engelbart:

> The basic sorts of things a text system should do are very clear from the work of Engelbart… The user should, at a screen, be able to swiftly change something he is writing (or delegated to change), and do so without error or danger. In addition, he should be able to jump among linked portions of what he is reading.[93]

Nelson however believes that previous systems were well-suited for engineers, but not writers.[94] For the latter group, simplicity is essential. However, adherence to the paradigm of the traditional document structure seems inappropriate to Nelson—hypertext, as ever, seems to him the more fitting medium. And with the popularization of

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[91] Ibid., 187.

[92] Theodor Holm Nelson, "Simplicity versus Power in User Systems: The Text Case," February 1972, Ted Nelson's archives, private collection, 2.

[93] Ibid.

[94] Ibid., 3.

computer displays imminent, Nelson believes the time has come to design the writing tools of the future.

A central feature that Nelson proposes is the "parallel text face." The ability to display two documents side by side on a screen is crucial to the working writer. Nelson suggests its usefulness allowing commentaries, translations, sources of excerpts, outlines, and past revisions to be seen alongside the document of focus.[95] To maintain the links between corresponding parts of documents, Nelson proposes a convention reminiscent of cut and paste operations performed with paper. "Beginning with an old draft," Nelson explains, "successive parts are copied to a new draft, in any new order, and changed there as desired. The system memorizes the links during the copying operation, and shuffles them appropriately thereafter."[96]

The Workplace of the Future

Interactive computers moved into industry to support big business productivity. When Bob Taylor moved to Xerox's Palo Alto Research Center (PARC) in 1971, his background as director of funding gave him access to a unique network of talent.[97] He hired away Engelbart's engineers and led the development of interactive computers that compromised Engelbart's vision.[98]

At Xerox PARC, Bob Taylor led development of the first compelling personal computers. In 1973, Xerox launched their Alto, touting an 8.5" x 11" screen and a variety

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[95] Ibid., 8-10.

[96] Ibid., 14.

[97]Theodor Holm Nelson, *Geeks Bearing Gifts* (Sausalito, CA: Mindful Press, 2009), 120.

[98] Ibid., 126.

of fonts. Its text system, Bravo, sold the world on a new paradigm called WYSIWYG: What You See Is What You Get. This means that what you see on screen is what you get when you print. A company that had made its fortune selling printers began to market computers as paper simulators. Nelson hates the PARC UI paradigms and that the world largely settled for text handling in the form of paper simulators.[99]

Computer Lib/Dream Machines

Now, in 1974, Nelson wrote his cult classic—a rallying cry for computer hobbyists. In *Computer Lib*, Nelson identifies professionalism, Cybercrud, and the Myth of the Machine as forces antithetical to individual freedom that must be fought in defending computers for the common good. The Myth of the Machine, as Nelson explains it, is the myth that the machine is some dehumanizing force taking over our society. Instead, Nelson says, "machines per se are essentially neutral"—and the right way to develop the computing machines in question, Nelson suggests at the beginning of *Dream Machines*, "continues the Western traditions of literature, scholarship and freedom."[100] Cybercrud, as Nelson defines it, is "putting things over on people using computers."[101] Cybercrud is closely related to who controls computers—and at the time of writing, Nelson saw the guardianship of computers as "one example of the creeping evil of Professionalism."[102]

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[99] Ibid., 119-125.

[100] Nelson, *CL/DM*, DM2.

[101] Ibid., CL8.

[102] Ibid., CL2.

Then, Nelson extended his dream of Xanadu. To Nelson, "the computer and electronics people are like generals preparing for the last war."[103] Nelson believed it completely inappropriate to act as if there is a scientific basis to the use of computers. "The technicalities matter a lot," Nelson says, "but the unifying vision matters more."[104] A later section of *Dream Machines* is a reflection on Engelbart's system. "Engelbart's system," Nelson says, "is a prototype for the world of the future, I hope."[105] Of special significance to Nelson, it eliminated all handling of paper.

As presented in *Dream Machines*, Xanadu includes all the facilities proposed earlier in Nelson's "Simplicity versus Power." Xanadu, so far conceived, was not a universal literature but rather a medium for one's personal network of interconnected ideas. However, by the time of *Dream Machines*, it was clear that networked computers were coming. Nelson explains that the Xanadu dream has grown. At first, Xanadu was going to be "a super system for handling text by computer." In a 1973 essay titled "Man-Machine Everything," Nelson described Xanadu as the compression of "communication, retrieval and revision of big and fancy files, along with interactive animation, into a small stand-alone machine."[106] Since the machines could network with each other, it would be possible to communicate such files between Xanadu sets.[107]

Now, in 1974, Nelson gave the following more ambitious description of Xanadu's aims: "To give you a screen in your home from which you can see into the world's

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[103] Ibid., DM2.

[104] Ibid.

[105] Ibid., DM46.

[106] Theodor Holm Nelson, "A Conceptual Framework for Man-Machine Everything," 1973, 84.

[107] Ibid., 85.

hypertext libraries."[108] "The fact that the world doesn't have any hypertext libraries—yet," Nelson explains, "is a minor problem."

Concretely, Xanadu was billed as an operating system with two programs: a data management system and a generalized display system. The data management system, then, could provide servers for the network itself. Out of this a decentralized hypertext library could emerge. The Xanadu display system incorporates all the elaborate designs of text handling that Nelson had developed over the past fourteen years: storage of previous versions whose corresponding parts can be seen alongside the original, dynamically linked outlines, text commentary and recombination of documents.[109]

Home Computers

In 1975, the Homebrew Computer Club began. It was a community of professional and amateur technologists in the Bay Area interested in getting their hands on computers of their own. Among them was Steve Wozniak, cofounder of Apple. Steve Wozniak recalls the influence Ted had on the group:

> He had a very important part in my whole life and background going back to the homebrew computer club where the ideas of computers for people were really becoming important to me … We had a few great leaders of our club. And they usually came from a humanistic point of view. They weren't just technologists they said here are the social benefits that computers are gonna bring to society … At our computer club the Bible was Computer Lib and the people who spoke about it were Stanford professors of sociology, they weren't engineering people necessarily. And they were referring to this book of how we would have this glorious world and describing some of the links and micropayments. And I sat

[108] Nelson, *CL/DM*, DM56.

[109] Ibid., DM54.

> there quietly being influenced by this … I'm listening to them tell these stories and I'm thinking I've gotta be a part of this.[110]

Nelson's *Computer Lib* provided a generation of counterculturist technologists with a social understanding of computers and how they might be directed to a better world. However, computers quickly became big business. In 1976, others were thinking about the business model. At the same time that Apple was rolling out their Apple I, Bill Gates wrote an open letter to hobbyists. "To me," Gates wrote, "the most critical thing in the hobby market right now is the lack of good software courses, books and software itself." The issue, Gates said, was that "As the majority of hobbyists must be aware, most of you steal your software. Hardware must be paid for, but software is something to share. Who cares if the people who worked on it get paid?"[111]

The home computer industry was growing up, and the frontier of the technology moved from PARC to the platform wars between Apple and Microsoft. In 1979, Steve Jobs was given a tour of Xerox's projects at PARC. A few years later Apple launched the Lisa which incorporated many the things they had seen at PARC. But after the Lisa failed, Jobs began work on his next project. He finally struck gold relaunching the vision in the form of the Macintosh. Meanwhile, Bill Gates and Microsoft recruited a man named Charles Simonyi, who had led development of Bravo, the word processor at PARC. Simonyi would lead the development of Microsoft Word.[112]

In a presentation in 1997, Steve Jobs recalled his visit to PARC. "If I'd just stayed for another twenty minutes," Jobs complains, the Mac could have been a networked

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[110] Steve Wozniak, "Steve Wozniak's Surprise Tribute to Ted Nelson, 2014" (talk given at Intertwingled conference, April 2014), available at https://www.youtube.com/watch?v=gl0Wfs70rV4 (accessed November 9, 2017).

[111] William Henry Gates III, "An Open Letter to Hobbyists," *New York Times*, February 3, 1976.

[112] Nelson, *Geeks*, 127.

computer much earlier.[113] Jobs and his crew were so enthralled by the Graphical User Interface (GUI) that they failed to take note of either networking or object-oriented programming techniques. Jobs later said of his first encounter with the GUI, "It was like a veil being lifted from my eyes. I could see what the future of computing was destined to be."[114]

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[113] Steve Jobs, "NeXT, OpenStep and the return of Steve Jobs to Apple" (talk given at MACWORLD EXPO, San Francisco, January 7, 1997), available at https://www.youtube.com/watch?v=QhhFQ-3w5tE (accessed November 3, 2019).

[114] Walter Isaacson, *Steve Jobs* (New York: Simon & Schuster, 2011).

While the world was catching on to the graphical user interface between computer and user, there was growing opportunity in building networked systems. By 1980, Nelson's Xanadu had fully embraced the future of a global computer network. Nelson's hypertext, originally meant to capture one's own thought as a network of interconnection, would be extended across the computer networks of the future. Nelson's Dream Machines became Literary Machines and he published a book to mark the occasion. "A literature," Nelson explains, "is a system of interconnected writings. We do not offer this as our definition, but as a discovered fact. And almost all writing is part of some literature."[115] The design put forward in *Literary Machines* is a beautiful crystallization of the Xanadu vision. Xanadu is rethought as a medium for the network age and takes issues of ownership and monetization in stride.

Xanadu is conceived as a worthy representation of the true structure of literature. The interconnections of literature "do not exist on paper except in rudimentary form, and we have tended not to be aware of them," Nelson explains, "We see individual documents but not the literature, just as people see other individuals but tend not to see the society or culture that surround them."[116] The paradigm of literature seems to Nelson the only suitable structure for a global hypertext. "We believe there is something very right about the existing system of literature," Nelson says, "indeed we suspect that there are things right about it that we don't even know, as is true of Nature. And so we have tried to mirror, and replicate, and extend, existing literary structure as we have described it."[117]

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[115] Nelson, *Literary Machines*, 2/9.

[116] Ibid.

[117] Ibid., 2/12.

The vision that Nelson presents in *Literary Machines* is of an electronic publishing system. The storage and delivery of compound documents, Nelson suggests, "represents an extension of the true structure of text."[118] "Given the hyperfile with links that we have just expounded," Nelson asks, "Why can't we extend it into a full publishing system?"[119]

> Suppose that hyper-documents already stored could be reached and used by anyone. All that we need additionally is the ability for any user whatever to create links among them—to make bookmarks and marginal notes, to quote from them by direct excision. And why not, indeed, allow users to publish assemblies and collections of compound documents building on others?[120]

Such a publishing system seems a natural extension of the true structure of literature. Naturally, it should include provisions for privacy, copyright, and royalties. Toward this end, Nelson outlines a publishing system with both public and private documents. When a document is accessed on the system, royalties are divided between document owners in proportion to how much of their materials are transmitted or used.[121] Such a system allows for anything to be quoted without further permission, such that compound documents and modified versions can be contributed to the literature, with royalties being distributed appropriately.[122]

"It is our unusual hope and vision," Nelson said, "that this system, with its simplicity of approach and efficiency of implementation, will become the standard publishing and archival medium of the future"[123]

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[118] Ibid., 2/41.

[119] Ibid.

[120] Ibid.

[121] Ibid., 2/42.

[122] Ibid., 2/45.

[123] Ibid., 2/47.

User Empowerment by Other Means

Meanwhile, early adopters of computers recognized a shift taking place. In 1986, some of Nelson's dreams were coming true, but the central role of literature was lost. A "Hacker's Manifesto" was published that year:

> I am a hacker, enter my world...
> Mine is a world that begins with school... I'm smarter than most of the other kids, this crap they teach us bores me...
> I'm in junior high or high school. I've listened to teachers explain for the fifteenth time how to reduce a fraction. I understand it…
> I made a discovery today. I found a computer. Wait a second, this is cool. It does what I want it to. If it makes a mistake, it's because I screwed it up. Not because it doesn't like me...
> Or feels threatened by me...
> Or thinks I'm a smart ass...
> Or doesn't like teaching and shouldn't be here...
> And then it happened... a door opened to a world... rushing through the phone line like heroin through an addict's veins, an electronic pulse is sent out, a refuge from the day-to-day incompetencies is sought... a board is found.
> "This is it... this is where I belong…"[124]

The hacker ethos brought together so many of Nelson's premises: computers are for the people, they can be anything you want them to be, and they can provide a realm for your mind to roam freely. But in this way, it was like Xanadu without the literature. Code and computer networks were the mode of expression in this world.

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[124] The Mentor [pseud.], "Hacker's Manifesto," Phrack Magazine, entry posted January 8, 1986, http://phrack.org/issues/7/3.html (accessed November 7, 2019).

In 1987, Stewart Brand wrote a foreword to the revised edition of *Computer LIb*. Brand described Nelson as "the Tom Paine of the personal-computer revolution."[125] Nelson later said that he liked the comparison, but "the remark makes me just a writer, not a designer, which is where a lot of people want to pigeonhole me."[126]

The populist computer revolution had come to pass and the world was feeling its impact.[127] "The enemy" in this revolution had been "Central Processing, in all its commercial, philosophical, political, and socio-economic manifestations."[128] Brand concluded that to continue to get original ideas in the computer world would demand "a technology far more convivial, self-evident, affordable, powerful, and user-malleable than what we have so far."[129]

This brand of computer humanism was perhaps best captured by a project out of Apple called Hypercard. Bill Atkinson, who was working at Apple at the time, recalls the acid trip that inspired Hypercard.

> as I looked down at the street lamps I saw pools of light and another pool of light and a sort of dark area of the street, I thought about human knowledge and I thought about how the physicists know some things and the poets know some things and the musicians know some things and the chemists know some things and the biologists know some things and there's a lot of paraphrasing between them but they don't talk to each other so they don't see the bigger picture of how they connect … We have technology to change the future, but not the right wisdom to make the ethical and aesthetic choices between alternative futures … I thought, if you can at least facilitate this—the connection of the different bodies of knowledge talking to each other, then there's kinda a trickle up effect that you might develop some wisdom on the planet. I thought about how can we get the scientists to talk to the musicians and how can we facilitate that communication.

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[125] Stewart Brand, foreword to *Computer Lib/Dream Machines, Revised Edition*, by Theodor Holm Nelson (Redmond, Washington: Tempus Books/Microsoft Press, 1987).

[126] Nelson, *Possiplex*, 255.

[127] Brand, foreword.

[128] Ibid.

[129] Ibid.

> Now I'd just come from a world where we pasted a tennis shoe into a MacWord document and now the world dealt with words and pictures. And I thought really what you want is interaction. You want to express something in a way that someone can interact with what you've made—the interactive document. So I said let's make a stack of cards and each card can have graphics on it and text on it and buttons that you can touch and they'll do something—they'll go to another card … there needed to be some flexibility about what the cards did. And what I wanted to make is essentially a software construction kit that allowed non-programmers to put together pre-fab models … The web was, instead of a stack of cards, it was just pages. And pages had graphics on it and text on it and buttons that could take you to some place else[130]

Hypercard reclaimed some of Nelson's earliest ideas—with Atkinson grounding the vision in imagery as vivid as Nelson's childhood memory of his hand passing through water—and addressed some of the social concerns that had emerged in postwar science as discussed earlier. However, as among the hackers, user programmability and interactivity were prioritized at the expense of the literary.

Last Shot

The world was moving fast around them, but Nelson and his team stayed fixed on Xanadu. Despite Nelson's unrelenting pursuit of his dream, Xanadu was evasive. Nelson was not a programmer and the road to Xanadu was marked by turmoil for him and his coders. Running low on energy in the mid-'80s, Nelson updated *Literary Machines* with a farewell:

> We have held to ideals created long ago, in different times and places, the very best ideals we could find. We have carried these banners unstained to this new place, we now plant them and hope to see them floating in the wind. But it is dark and quiet and lonely here, and not yet dawn.[131]

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[130] Bill Atkinson, interview by Leo Laporte, April 25, 2016, available at https://www.youtube.com/watch?v=INdByDjhClU (accessed November 1, 2019).

[131] Wolf, "Curse."

But dawn came again. In 1988, the Xanadu project was acquired by Autodesk. John Walker, the CEO, recounted the story at the time: in 1964, Xanadu was a dream in one man's mind, in 1980 is was a shared goal of a small group of technologists—now, he claimed, it would be a product by 1989 and by 1995 it would change the world.[132] However, Walker later concluded that the Xanadu team had "hyper-warped into the techno-hubris zone." The project proved intractable for those working on it and Autodesk eventually dropped it, allowing Nelson and his coders to reclaim ownership.

Many additional false starts followed. By 1995 we find Gary Wolf interviewing one of Xanadu's most loyal programmers for *Wired* magazine. Gary Wolf asks Roger Gregory: after all these years of work, after the information age has already arrived and the other programmers have drifted away, why continue the pursuit? Gregory answered, "Total insanity."[133]

Caught in the Web

The Web was invented in 1989 at CERN, the physics lab in Geneva, Switzerland, by a software engineer named Tim Berners-Lee. In a document titled "Information Management: A Proposal," Berners-Lee describes a system intended to make it easier for CERN researchers to share information with the rest of the organization.[134] This proposal, meant to address problems specific to CERN, developed into the Web of today.

Berners-Lee believed there was a disconnect between the formal organization of CERN and its true working structure. Although researchers were nominally organized in

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[132] Ibid.

[133] Ibid.

[134] Tim Berners-Lee, "Information Management: A Proposal," https://www.w3.org/History/1989/proposal.html.

a hierarchy, researchers nonetheless tended to collaborate in various ad hoc arrangements. The actual working structure of the organization, Berners-Lee suggests, was not a hierarchy, but rather a "multiply connected 'web' whose interconnections evolve with time." Berners-Lee believed that information needed to be organized accordingly.

To address the problem, Berners-Lee proposes a distributed system for storage and retrieval of inter-linked documents. When Berners-Lee drafted his proposal, the system did not yet have its name. And at first, the proposal was rejected. "Vague but exciting," read the feedback from Berners-Lee's boss.[135] Nonetheless, Berners-Lee began work on the proposed system and in 1990, Berners-Lee gave the World Wide Web its name.

The Web, although inspired by Nelson's concept of hypertext, adopted a different design. The Web brought texts together in a network of interconnection, but links were one-way. Furthermore, links were not between parts but between whole texts. Texts maintained their linear narrative and remained atomic pieces that could not be broken down further. In this way, the Web was more in line with Bush's Memex than Nelson's hypertext. Whereas Nelson's hypertext was designed first and foremost for the personal organization of thought, Berners-Lee's Web aligned itself with the network structure of research within an organization.

The Web was designed for the collaborative network of CERN researchers. Researchers could now participate in a network of text production captured by the Web. However, the Web made no effort to change the medium of text more fundamentally. The

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[135] Elizabeth Nix, "The World's First Web Site," https://www.history.com/news/the-worlds-first-web-site.

issue of networks of thought that was so important to Nelson was neglected. The Web developed a different idea of the network that sought to capture the patterns of collaboration and communication within a research community.

Although quite different from Nelson's vision, the Web is by far the most successful implementation of hypertext. Tim Berners-Lee wrote and published the first web page.[136] It was an introduction to the World Wide Web that featured Nelson's earlier ideas on hypertext prominently. If you navigate to this web page—it's still live today—you will find a description of the Web as conceived in 1990. "The WorldWideWeb," it reads, "is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents." If you follow a link, you are taken to another page: "What is HyperText." The simple answer is that *this* is hypertext. Hypertext, as implemented in the Web, is a text with links pointing to other texts—no more, no less.

As Nelson first envisioned it, hypertext was about inter-linked documents and non-linear reading. The Web borrowed some of its concepts, and directed it toward the issue of non-hierarchical organization of work. In the 1960s, when Nelson dreamed of Xanadu, there was no dominant paradigm of software interface design and certainly no home computers. A distinct approach to interface design was a key component of Nelson's vision. However, in the '70s and '80s the computing world began to congregate around a paradigm of interface design whose roots can be traced not to Nelson, but to Xerox PARC. When Berners-Lee developed the Web and its first web page, he was working in this tradition of software design. Once the Web got out into the world, things

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[136] "World Wide Web," http://info.cern.ch/hypertext/WWW/TheProject.html.

moved far faster than anyone could have anticipated. The opportunity for a comprehensive design of our computer world passed away as the masses came online.

2020 Vision

In 1990, Nelson presented a lecture called "Virtual World Without End." In it, Nelson turns his attention to the future and sets out to share a vision for the year 2020. "Imagine the year 2020," he says, "Billions of people, including you, are at their computer screens around the planet. And each of you is able to draw to your screen, from a common document repository of humankind, any fragment of text, graphics, audio or video." This is the world we live in. But Nelson perceived two shortcomings of the moment that are likely as prominent now as then. First, Nelson suggests that document storage technologies of the time make it impossible to understand how texts relate to one another:

> What the typical office is now, in case you haven't noticed, is an accumulation of mysterious and unknown disks and files with mysterious names. We don't know where they came from or which ones quote from where. We all suffer from this problem because we don't have transclusions and we don't have linkage built into existing computer systems. What we need, I believe, is a complete revision of the way that things are stored so as to keep track of what comes from where, and what the origins, differences, and connections are.[137]

This is a problem Xanadu was meant to address since the early days. "What holds us back," Nelson concludes, are "sluggish ideas. Then it was fear of computers. Now, … we're going to use this magnificent piece of equipment, this incredible technological achievement, as a *paper simulator.*" The alternative, Nelson says, is to represent on computers the *real* structure of interconnection. As ever, Nelson believes that the computer world could be redeemed, if only the concept of literature were made central.

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[137] Nelson, "Virtual World Without End."

Conclusion

Nelson's dream of Xanadu was the last time that anyone could have put forward a comprehensive design for the computer age. As computers have become increasingly pervasive and the internet has connected the world, it has become impossible to imagine a technical ecosystem with a single comprehensive design.

When the Web first began to catch on, it seemed to many that a new democratization was underway. In 1995, John Perry Barlow observed that "Unlike previous frontiers, this one has no end."[138] Like space exploration before it, cyberspace represented an endless frontier. However, like the space program, it seems an irony emerged whereby we did not enter into a frontier, but rather brought the world into a more complete closure. This was not obvious at the time. On February 8, 1996, John Perry Barlow addressed Davos with a "Declaration of the Independence of Cyberspace."

> 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…
>
> We will create a civilization of the Mind in Cyberspace. May it be more humane and fair than the world your governments have made before.[139]

Such optimism now seems naive. Xanadu never materialized. The Web developed and popularized a half-baked hypertext developed initially for a specific organization, and Nelson's initial, literary dream for the computer age slipped away. The internet—once hailed as the new home of mind that would liberate men from the tyranny of government—has given way to global empires of surveillance capitalism. Computers, once promised

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[138] John Perry Barlow, "Is There a There in Cyberspace?" *Utne Reader*, March/April 1995, available at https://www.eff.org/pages/there-there-cyberspace (accessed November 7, 2019).

[139] John Perry Barlow, "A Declaration of the Independence of Cyberspace," February 8, 1996, available at https://www.eff.org/cyberspace-independence (accessed November 7, 2019).

to augment the human intellect, seem to be making us all dumber. Xanadu was meant to first make us clear thinkers and better writers, and then bring us all into one global library. Well, we have the global library. And without proper tools, we are all drowning in too much information. The hope once attached to personal computers and the Web has mostly slipped away, but Nelson's dream remains as vivid as ever.

"I believe I was right all along and that others have not figured it out yet," Nelson wrote on the final page of his autobiography, "but this gives me scant comfort."[140] Yet, in a final, typical note, Nelson declared he has no intention of giving up:

> I have no alternative but to go on. Like Shackleton of Antartica, I find myself enmeshed in a harsh duty that was not the original plan. But like Stockdale—the American prisoner in Vietnam who endured by his grim optimism for the long term—I am absolutely certain that my work will be proven right eventually, and empower the world at last. The question is whether it will be in time for my serious use, and/or in my lifetime, or in time to help in the darkening future. But I will fight for it to my last breath.[141]

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[140] Nelson, *Possiplex*, 339.

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