Code and critique: Ted Nelson's Project Xanadu and the politics of new media

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ABSTRACT

The history of hypertext has been dominated by the history of the World Wide Web. However, the inventor of hypertext, Theodor Nelson, has long viewed the Web as a deeply problematic implementation of his ideas and advocated for his own hypertext system known as Project Xanadu. This essay situates Xanadu against a background of changing ideas about media and text in the 1960s and 1970s. Based on close reading of Nelson's work, this essay shows how Xanadu was an instance of the kind of media structure that Nelson saw as most liberating and empowering.

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INTRODUCTION: AGAINST THE WEB

"Hypertext," at least in the popular imagination, is completely synonymous with its most popular implementation in code, the World Wide Web, and intimately linked to Tim Berners-Lee's productions: Hypertext Mark-up Language (HTML) and the Hypertext Transfer Protocol (HTTP). These were software tools developed during Berners-Lee's time at the

Franco-Swiss CERN laboratory during the 1980s and 1990s. The history of their emergence is well documented.[1]

But hypertext itself was not the creation of Berners-Lee. Its origins are older and tied to the singular personage of Theodor "Ted" Holm Nelson (1937 -). Although Nelson's 1960 invention of hypertext usually receives some attention in accounts of the Internet and the World Wide Web, he remains a marginalized figure.[2] This is in part because Nelson has remained a staunch critic of the most popular implementation of his invention: "The World Wide Web was precisely what we were trying to PREVENT," he reminds us.[3] For most of us, a world without the Web (and the other software and technologies built around and on top of it) has become almost unimaginable. Nelson's opposition to a technology that appears to be so fundamental to life in late modernity has marked him as a rather peculiar iconoclast.

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[1] Tim Berners-Lee, *Weaving the web: the original design and ultimate destiny of the World Wide Web*. (Harper Business, 2000); Paul Ceruzzi, *Computing: a concise history* (Cambridge, MA: MIT Press, 2012), 121-154.

[2] Many versions of Web history hardly mention Nelson. Ceruzzi's history mentions Nelson once (Ceruzzi, *Computing: a concise history* (cit. n. 1), 134). Ceruzzi's longer account gives more attention to Nelson but does not describe his ideas for Xanadu in any detail (Paul Ceruzzi, *A history of modern computing*. 2nd edition. (Cambridge, MA: MIT Press, 2003).

[3] Ted Nelson, "Ted Nelson's computer paradigm, expressed as one liners," 1999. https://xanadu.com.au/ted/TN/WRITINGS/TCOMPARADIGM/tedCompOneLiners.html. See Pam's more detailed account: Andrew Pam, "Where the World Wide Web Went Wrong," accessed 21 July 2022. https://www.xanadu.com.au/archive/6w-paper.html

This essay attempts to situate Nelson's objections to the Web and to understand the significance of the alternatives he offers. In place of the Web, Nelson has long championed own hypertext project, called "Project Xanadu." Nelson, along with various collaborators, has been working to realize a fully operational version of Xanadu since he initiated the project in the mid-1960s. Existing accounts of Nelson's life and work have emphasized the "visionary" nature of his work. Belinda Barnet's history of hypertext argues that despite Xanadu's chequered history, the "issue is not that Xanadu has failed as a vision,… but that the vision has failed to realize itself qua technical artefact."[4] In other words, Nelson succeeded as a "visionary" even while still failing to produce working code. Daniel Rosenberg has also focused on the significance Nelson's "vision," his prescience, and his role as a "forecaster of so much we take for granted in the electronic universe."[5] These accounts take as a starting point that Xanadu was a project oriented towards *producing code* and that the production of software was Nelson's primary aim.

Nelson did want to produce software, but his aims were also more ambitious. This essay aims to put Nelson's story, and Project Xanadu, in a different context. Rather than placing Xanadu directly within the history of software or computing, it situates it against a background of changing ideas about media and text in the 1960s and 1970s. Nelson's writing from the period reveal that in many ways he didn't care very much about code, at least in its technical details. In many ways, his work aimed to *decentre* code and programming. What Nelson did care about was developing a framework for how to use new media (including

[4] Belinda Barnet, *Memory Machines: The evolution of hypertext* (Anthem Press, 2013), 68.

[5] Daniel Rosenberg, "Hummingbird futures: Theodor Nelson the creation of hypertext," *Cabinet* 13 (Spring 2004).

computers) in ways that could maximize human creativity, freedom of expression, and communicative capacity. I argue that Nelson built a powerful *political critique* of computers as communication and world-structuring machines. Xanadu, as well as being a software project, was more importantly a model of the kind of media structure that Nelson saw as most liberating and empowering.

The developing field of critical code studies aims to make code and software the locus of study for understanding part of our contemporary world. It aims to read and understanding code not only in terms of its function, but also in terms of its literary, social, political, economic, and other qualities.[6] Despite the novelty and potential of this approach, critical code studies continues to privilege, even fetishize, code. But code, of course, cannot run itself. It needs to be packaged, copyrighted, marketed, sold, installed, maintained, and run. Without this work, code ceases to matter.

Rather than focusing on code, then, this essay takes its cue from the work Matthew Kirschenbaum's literary study of word processors, *Track Changes*. Kirschenbaum is hardly interested in the code of word processors or who built them or why. Rather, he is concerned with how word processors came to be adopted, who used them, how they were used, and what difference this made to writing.[7] Nelson was interested in building computer-powered writing tools (including text editors and word processors) not only to speed up or assist with writing, but also because he was interested in exploring the precise problem of how

[6] Mark C. Marino, *Critical code studies* (Cambridge, MA: MIT Press, 2020)

[7] Matthew Kirschenbaum, *Track Changes: a literary history of word processing.* (Cambridge, MA; Belknap Press, 2016).

information technologies influenced writing and communication. These investigations also have important implications for thinking about the relationship between pre-digital and digital media. As Jon Agar has shown, much of the conceptualization of what computers could do and what they would mean took place *prior* to the development of digital electronic machines.[8] nevertheless, much of Nelson's tinkering took place in non-digital forms, particularly on and with paper. For Nelson, realizing the potential of computing meant thinking *without* code. Attending to these questions is particularly important in our current moment in which much of our online activity is dominated by codes to which we have no access and over which we have no control. The implications of Nelson's ideas for these problems will be taken up in the conclusion.

This argument here is based on close attention to Nelson's biography as well as a close reading of several of his works from the period 1960-1981. Nelson's immersion in literature, film, and other media is critical for understanding his approach to computing. Although Nelson did not produce a lot of code, he certainly produced a great deal of writing (and talking) *about* Project Xanadu. Although Nelson's personal archives remain inaccessible, the volume of his published and unpublished works that are available is vast. This includes the collection of his papers at Stanford University Archives, papers and notes made available via the Internet Archive, a range of recorded videos, demonstrations, and speeches (many available on YouTube), as well material available elsewhere online (including Nelson's personal pages, the Project Xanadu website, and material archived by

[8] Jonathan Agar, *The government machine: a revolutionary history of the computer* (Cambridge, MA: MIT Press, 2003).

others).[9] A full account of Nelson's work would certainly need to utilize sources other than those produced by Nelson himself. However, my aim here is not to produce some sort objective assessment of Nelson's work, but rather to attempt to understand what Nelson was attempting to achieve on its own terms.

NEW MEDIA

The 1950s and 1960s saw the proliferation of new technologies for organizing and sharing information. Immediately after World War II, Vannevar Bush's described the "Memex" machine for linking together "trails" of texts.[10] Experiments in artificial intelligence led to the growing exploration of computers as tools for manipulating symbols and text. With cold war imperatives in the background, researchers from psychology, cybernetics, and other fields began to investigate the relationships between brains, computers, and communication. New institutions such as ARPA's Information Processing Technology Office supported this work. From this emerged novel visions of how to utilize computers for communication, cooperation, designing, and learning. Time-sharing computing, for example, allowed multiple users to work together simultaneously on the same machine. J.C.R. Licklider's visions of a "Galactic Network" and "Libraries of the Future" inspired attempts to link computers

[9] For a partial list of Nelson's work see Henry Lowood, "A critical (and critically incomplete) bibliography." In: D. Dechow and D. Struppa, eds. *Intertwingled: The work and influence of Ted Nelson* (Springer, 2015). The project Xanadu website is: http://www.xanadu.com/. Some of Nelson's websites are: http://ted.hyperland.net/ and http://www.xanadu.com.au/ted/.

[10] Vannevar Bush, "As we may think." *The Atlantic*. July 1945.

together with wires and radio waves.[11] In 1968, Doug Engelbart brought together many of these new forms of interacting with and through computers in his "oN-Line System" (NLS) that included hypertext, a mouse, teleconferencing, windows, and raster-scan video monitors.[12]

Simultaneously, countercultural figures like Stewart Brand were experimenting with new ways to organize videos, sounds, and text for communicating new ideas. In 1966, working with Ken Kesey, Ramon Sender, and the Merry Pranksters, Brand produced the Trips Festival, a three-day sound and light extravaganza. After working with Engelbart on his "mother of all demos" for the NLS, Brand published and distributed the multimedia "Whole Earth Catalog" to support the emergent US commune movement.[13] Nelson was not directly a part of these developments, but he was sufficiently nearby (in the San Francisco Bay area) to see them up close. He remained friends with Engelbart for many years.

Alongside these developments, a small number of researchers were beginning to think about the broader social and political impact that these new technologies might have. In 1962, the philosopher Marshall McLuhan published *Gutenberg Galaxy: The Making of Typographic Man*. In it, McLuhan famously argued that the medium of the printing press had

[11] M. Mitchell Waldrop, *The Dream Machine: J.C.R. Licklider and the revolution that made computing personal.* (New York: Penguin, 2002).

[12] Thierry Bardini, *Bootstrapping: Douglas Engelbart, coevolution, and the origins of personal computing*. (Palo Alto: Stanford University Press, 2000).

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

transformed European culture and thought, ultimately ushering in individualism, democracy, Protestantism, capitalism, and nationalism. McLuhan argued that communications technologies shape the way individuals perceive the world and as such have the power to shape and re-shape whole cultures. For McLuhan, the emergence of a "electronic media" would be cause a return to oral and aural cultures as well as more collective and "tribal" forms of existence.[14] McLuhan's subsequent work through the 1960s (particularly *Medium is the Massage* (1967) – which experimented with graphical and text collages) elaborated on the argument that the *media themselves*, rather than their specific content, shaped human perception and cognition.[15]

Although McLuhan's work has been said to "predict" the rise of the Internet, much of his description of "electronic media" was directed towards radio and television, rather than computing. Although McLuhan was certainly aware of computers, he was not immersed in their development through the 1960s and 70s.[16] In contrast to this, Nelson's proximity to developments in computing gave him a unique perspective on how he understood their potential impact on literacy, culture, and politics.

EARLY MEDIA

[14] Marshall McLuhan, *The Gutenberg Galaxy: the making of typographic man*. (Toronto: University of Toronto Press, 1962).

[15] Marshall McLuhan and Quentin Fiore, *The medium is the massage: an inventory of effects*. (New York: Penguin, 1967).

[16] Philip Marchand, *Marshall McLuhan: The medium and the messenger* (Cambridge, MA: MIT Press, 1998).

Ted Nelson grew up with his grandparents in Chicago and was deeply immersed in both scientific and humanistic subjects from a young age. "We had a home of wonderful words," Nelson recalls in his autobiography.[17] But Nelson recalled particularly books that contained not merely words but also images, diagrams, and maps: "The reader… unites these in the mind, learning to connect different aspects of sight and story."[18] With a happy and freewheeling education taking place at home, Nelson was less excited about the rigidities imposed by school. Even at the age of five, he claims, he wanted to burn it down.[19] Radio, phonograph records, and movies all had a profound effect on Nelson's perceptions of the world around him. Although Nelson's retrospective reconstructions of his childhood precocity should be taken with a grain of salt, there is no doubt that he grew up in a stimulating and media-rich environment.

Nelson's passion for broad learning and media experimentation continued through high school and into College. Matriculating at Swarthmore in the fall of 1955, he dove into a variety of subjects – from linguistics to anthropology. But he spent most of his time pursuing a range of extra-curricular activities including photography, stage direction, calligraphy, poetry, and publishing. In his junior year, Nelson wrote the college (rock) musical, calling it "Anything & Everything." Nelson wrote the play, recorded the music, and produced an

[17] Nelson, *Possiplex: Movies, intellect, creative control, my computer life and the fight for civilization.* (Mindful Press, 2011).

[18] Nelson, *Possiplex* (cit. n. 21), 26.

[19] Nelson, *Possiplex* (cit. n. 21), 5.

advertising poster that doubled as a program.[20] Finding himself unable to work with students organizing Swarthmore's literary magazine, Nelson invented his own.[21] *The Nothing*, as Nelson called it, became a tiny magazine, printed on two sides of a single sheet of legal-size paper and sold for five cents. Nelson designed a kite-shaped issue that had to be rotated, unfolded and re-folded to be read, linking together drawings and pieces of text in different configurations.

In his senior year, Nelson also wrote, produced, and directed a film. He had no time to write a script, so he had the actors mime speaking with the intention of filling in the dialogue later.[22] The process convinced Nelson that he had a natural talent for film-making and that he should pursue this as a career. Throughout his undergraduate degree, Nelson experimented with putting together ideas, texts, and images in novel ways, in print and on screen. As he wrote later, he explored the possibilities of writing with the tools of "card file, notebook, index tabs, edge-punching, file folders, scissors and paste, graphic boards, index-strip frames, Xerox machine and the roll-top desk."[23] The products were often idiosyncratic, but Nelson's immersion in media – especially textual media – primed him for thinking about new tools for linking the disparate parts of his knowledge and imagination.

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[20] Nelson, *Possiplex* (cit. n. 21), 73.

[21] Nelson, *Possiplex* (cit. n. 21), 71.

[22] Nelson, *Possiplex* (cit. n. 21), 76, 85-87. "Slocum Furlow Scene 7," Nelson, director. https://www.youtube.com/watch?v=QF4v3pUXofo

[23] Nelson, "A file structure for the complex, the changing, the indeterminate" ACM '65: Proceedings of the 1965, 20th national conference (August 1965), 85.

Nelson recalled that at Swarthmore, "my strength was in *not* narrowing down." Wanting to continue to pursue studies across various fields, as well as to analyze, design, and innovate, Nelson was unsure how to proceed with a career.[24] Eventually he made the decision to attend graduate school and in the fall of 1960 he enrolled in a graduate degree in philosophy at Harvard. There, Nelson continued to think about and experiment with texts and different forms of writing. But Nelson also took a computer course and had an immediate realization:

> The public had been told that computers were mathematical, that they were engineering tools. This misstated things completely. The computer was an all-purpose machine and could be whatever it was programmed to be.[25]

Especially important for Nelson was that computers could be made to manipulate text. Text could be stored, rearranged, and updated; paper could be dispensed with and interactive computers could put humans into a whole new set of relationships with words. "I foresaw," he later recalled, "a sweeping new genre of writing with many forms of connection… Writings like this would be far superior to ordinary writings on paper, and nobody would want the old forms of writing anymore."[26]

During the early 1960s, a handful of other individuals were beginning to think about computers as text-manipulation machines. In particular, mathematicians interested in

[24] Nelson, *Possiplex* (cit. n. 21), 55.

[25] Nelson, *Possiplex* (cit. n. 21), 100.

[26] Nelson, *Possiplex* (cit. n. 21), 111.

artificial intelligence began to think about the possibility of using computers for natural language processing and machine translation. John McCarthy's developments of the LISP programming language allowed computers to perform more sophisticated manipulations of text and symbolic expressions.[27] But the emerging field of computer science was mostly interested in how computers could autonomously manipulate and reason with language and text. Nelson, on the other hand, was interested in how humans could manipulate texts using the computer as a powerful tool. AI pioneers were interested in whether language manipulation could make computers think; Nelson was interested in how language manipulation could change human thinking.

The changes in writing and thinking that Nelson imagined would have immediate consequences for publishing, copyright, and other media too, he believed. Indeed, Nelson was thinking about all sorts of consequences of his vision of computers. He believed computers could be understood and used by many more people, not just engineers and mathematicians. This would generate a whole new market and industry for computers. In line with Nelson's interest in movies and images he also wanted to create a system for video editing on computers and ways to create images and graphics for film using computers.[28] Text was his main interest, but this was always intertwined with Nelson's thinking about media (especially film) more broadly.

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[27] Nils J. Nilsson, *The quest for artificial intelligence: a history of ideas and achievements* (Cambridge, UK: Cambridge University Press, 2013). On the history of LISP see John McCarthy, "History of LISP" 12 February 1979. http://jmc.stanford.edu/articles/lisp/lisp.pdf

[28] Nelson, "Where my ideas came from – for Brewster," 16 January 2010, 4. https://archive.org/details/HTbrewD11/page/n3/mode/2up

According to Nelson, all these many interlinked insights came to him very quickly in the fall of 1960 or the spring of 1961. By January 1961, Nelson had designed (and sketched out) a "rewrite parlor" to be built in Harvard Square. This would be a café to which writers could go to do something like word processing or desktop publishing on a computer.[29] During his studies, Nelson also began to work for the psychoanalyst and dolphin researcher John C. Lilly at his Communication Research Institute on Dinner Key near Miami. The Institute aimed to foster communication with dolphins and Lilly's unorthodox methods included dosing the animals with LSD. Such work appealed to Nelson's interests in novel forms of communication and mediation.

Nelson eventually graduated with a master's degree in sociology in 1963 and in the following fall took up a position teaching in sociology at Vassar College. Nelson claims that his first ideas for a hypertext system began around this time.[30] At Vassar, Nelson found space and time to begin to promote and publish his ideas. In January 1965, Nelson gave a talk titled "Computers, creativity, and the nature of the written word." In it he described his vision of computers as machines that could be used by a far wider group of people and that could be used for creative pursuits, with "ideas, words, and other things."[31] Nelson introduced his

[29] Nelson, "Where my ideas came from" (cit. n. 32), 2.

[30] Belinda Barnet, "The importance of Ted's vision" In: *Intertwingled: The work and influence of Ted Nelson*, Douglas R. Dechow and Daniele C. Struppa, eds. (Springer, 2018): 60.

[31] Sue Lumb, "Lecture on computers by Theodor Nelson," 5 January 1965. https://archive.org/details/TNsVassarInviteJan65/mode/2up

Personalized Retrieval Indexing and Document Evolution (PRIDE) system, a hypertext system for "organizing material into a coherent piece of writing."[32]

More influentially, however, later that year in August 1965, Nelson presented at the annual meeting of the Association for Computing Machinery the paper "A file structure for the changing, the complex, and the indeterminate." In it, Nelson introduced the notion of an information structure called "zippered lists." In Nelson's proposed "evolutionary file structure," individual pieces of text or images ("entries") would be arranged into ordered sets called "lists." Entries could appear in any number of lists, forming different arrangements of text; but entries in different lists could also be "linked" to one another. Two lists joined by such links were therefore "zippered" together (figure 1).[33]

[FIGURE 1]

The practical upshot of this would be that a document could be composed of any set of textual or non-textual elements. These could be combined or recombined with each other as the writer's thought processes evolved (like cut and paste). The elements could also be arranged into different documents at the same time (Nelson calls this inclusion of the same text in different documents "transclusion") and linked to one another such that one could follow an idea (or reference) from one document to another. Like Vannevar Bush's "Memex"

[32] Lauren Wedeles, "Prof. Nelson talk analyzes P.R.I.D.E." *Vassar Miscellany News*, 3 February 1965: 4-5. https://archive.org/details/TNsVassarInviteJan65/page/n1/mode/2up

[33] Nelson, "A file structure for the complex" (cit. n. 27), 89-90.

(which Nelson cited extensively), an author or reader could then follow these links according to their own unique chain of thought as they pursued an idea or tangential association.

Nelson saw this not just as tool for helping people write, but rather as a system that could potentially enable new ways of thinking, allowing for categories of knowledge to be constantly reshaped and reformulated:

> To the extent that information retrieval is concerned with seeking true or ideal or permanent codes and categories… to this extent, information retrieval seems to me to be fundamentally mistaken. The categories are chimerical (or temporal) and our categorization systems must evolve as they do. Information systems must have built in the capacity to accept the new categorization systems as they evolve from, or outside, the framework of the old.[34]

This was a technical system that engendered, Nelson believed, a philosophical intervention that could revolutionize our relationship to knowledge. No longer would we have to settle for the fixed categorizations offered by paper systems such as indexes or encyclopedias.

Nelson's presentation at the ACM was crucial for a number of reasons. The evolutionary file structure and zippered lists formed the kernel of what was to become Project Xanadu – the basic idea of a rearrangeable, updateable, and multiply-viewable document system that would persist for forty years. Nelson also here used the word "hypertext" here for the first time in print: "a body of written or pictorial material interconnected in such a

[34] Nelson, "A file structure for the complex" (cit. n. 27), 97.

complex way that it could not conveniently be presented or represented on paper."[35] Like a "hypercube" – a higher-dimensional analog of a cube that cannot exist in 3d space – hypertext cannot exist within the two-dimensionality of the printed page. The ACM also gave Nelson the opportunity to present his work to a wide audience – "most of the computer scientists in the world at that time were in the audience," he recalled.[36]

The ACM paper did not present a working system. Nelson's zippered lists and evolutionary file structure were – ironically – ideas on paper, not a computer program. But Nelson was more interested in exploring various concepts for how to use computers to manipulate media, rather than implementing them into code. Alongside his hypertext system, Nelson was also pursuing a range of other media-related projects. These included building an electronic system for video editing, creating a CGI system for movies, and software for making theatrical movies on a computer. Alongside his 1965 ACM paper, Nelson submitted a paper called "Computer-Indexed Film Handling" describing his "Cinenym" system for computer-based movie editing.[37] These efforts were all experiments in thinking about the potential uses and consequences of computers for communication.

In 1966, Nelson's left Vassar to begin a position at Harcourt Brace & World Publishers. Nelson official role was to advise the company on opportunities for computerizing aspects of their business. But Nelson had also realized that the academic world

[35] Nelson, "A file structure for the complex" (cit. n. 27), 96.

[36] Nelson, *Possiplex* (cit. n. 21).

[37] Nelson, "Where my ideas came from" (cit. n. 32), 4-5.

https://archive.org/details/HTbrewD11/

was not the best place from which to launch his ideas into practical forms; his concern with texts and presentation of information made a publishing house a potentially good fit. Based on a detailed proposal, William Jovanovich, Harcourt's president, approved a computer and budget for Nelson to develop his hypertext project under the name "Project Xanadu." Nelson promised that his system could help with "the editing of books, the design of highly complex non-book materials for publication, the facilitation of collaborative work between author and editor, experimental type-setting and making of animated movies, and aiding management in comprehending banks of data."[38] Such a system for text and media manipulation seemed to be a good investment for a publishing house.

Through Harcourt Brace and his own widening network, Nelson also came into contact with the leading developers of innovative computing systems in the late 1960s – Engelbart, Licklider, Larry Roberts at Lincoln Labs, and Don Walker at The MITRE Corporation. These meetings only further convinced Nelson of the need for Xanadu. Walker's "Oak Tree" software was based on a hierarchies – not the kind of arrangement that could allow expansive thinking. "This was the opposite of the swooping kind of interface and non-hierarchical structures I favored," Nelson thought when he saw a demonstration of Engelbart's NLS (Online System).[39] Nelson remained close friends with Engelbart, but continued to believe that Xanadu could offer something superior to what he saw at the Stanford Research Institute. Licklider, who Nelson met in 1966, shared Nelson's vision of the computer as a device for communication and the organization of information. But Licklider

[38] Nelson, "The Xanadu System: a discussion paper," 23 December 1966, 7. https://archive.org/details/TheFirstXanaduProposal1966/.

[39] Nelson, *Possiple*x (cit. n. 21), 166.

was primarily concerned with how information and knowledge could be represented and processed inside computer systems using semantic and natural language processing. He was less concerned with how this information would be presented to or experienced by the user.[40]

These contacts allowed Nelson to see not only what was possible with existing computer systems, but also to see their limitations on thinking and doing. What was needed, Nelson believed, was a foundational set of ideas for how humans could best work together with computers. "We may have anything we want on display screens," Nelson wrote in 1970, "text or diagrams or both, moving or flickering or interacting or whatever. What do we want?"[41] Xanadu was being worked out as an answer to that question.

HES TO "HYPERTYPER"

Quickly, Harcourt Brace also proved too restrictive for Nelson's explorations. In particular, Nelson was interested developing his ideas on newer, more flexible, and interactive minicomputers like the DEC-PDP machines; Harcourt, however, remained committed to IBM computers.[42] In 1967, while attending the Spring Joint Computer Conference, Nelson had run into an old classmate from Swarthmore, Andries Van Dam. Van Dam had graduated from Swarthmore and gone on to study computer science at the University of Pennsylvania.

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[40] J.C.R. Licklider, *Libraries of the future*. (Cambridge, MA: MIT Press, 1965).

[41] Nelson, "The crafting of media" from the catalog of the Jewish Museum "Software" show. 1970.

[42] Par Devon Zuegel, "Ted Nelson explores what computers could have become," video interview, 25 February 2021. https://www.notion.so/fr-fr/blog/ted-nelson

By 1967, Van Dam had been appointed at Brown University to help establish a computer science program. Nelson quickly convinced Van Dam of the potential of his proposed hypertext system.

Nelson and Van Dam were soon working together to build a system that became the Hypertext Editing System (HES). Belinda Barnet has described this system and its evolution in detail. HES implemented many aspects of Nelson's vision of Xanadu, including freeform text editing and hypertext links. But Nelson soon felt that his vision had been compromised. In particular, Van Dam's focus on producing documents for paper was, for Nelson, an anathema – he wanted hyper-documents to transcend paper and be designed for reading on the screen. Although HES garnered sponsorship from IBM and produced a working system, Nelson left the project feeling his ideas had been hijacked and diluted.[43]

What does remain of Nelson's contributions to HES are "implementation notes" – twenty-five pages of hand-written documentation on the Xanadu idea. Here, Nelson describes aspects of how he wanted Xanadu to appear to the user. For example, he describes how parallel and linked sections of text should be displayed on the screen and how they should scroll relative to one another. But the idea of these notes was not to provide instructions on exactly how to realize Xanadu, but rather to sketch a high-level, overall vision for the programmer to follow. As Nelson says, "details can be worked out by others, once they have the whole picture."[44] This "whole picture" remained sketchy, but what was being worked out

[43] Barnet, *Memory Machines* (cit. n. 4), chapter 5.

[44] Nelson, "Hypertext Implementation Notes," 10 March 1968, 9. https://archive.org/details/hin68/hin68%20Transcription%2Chin68/page/n3/mode/2up

here was certainly not the "code" for Xanadu. Rather, Nelson aimed to outline something like a "software requirements specification," describing the various functions a user ought to be able to perform with Xanadu. Nelson was concerned primarily not with the code but with what the user would *experience* in Xanadu and its effects on how they could think and act.

Leaving van Dam and Brown, Nelson continued to search for individuals and institutions who could help him transform his ideas into a working system. In 1970, Nelson found another individual who would begin to implement some parts of Xanadu for him. An investor gave Nelson some money to hire a programmer named Cal Daniels.[45] Daniels had a day job at a company called Minicomputer Systems Inc. but Nelson convinced him to also work on a hypertext project he called "Hypertyper." Nelson also used the investment to rent a small Nova computer. The plan was to sell computers with Hypertyper as a standalone word-processing system.[46]

Hypertyper aimed to include novel features at both the front and back ends. The front end, called "JOT" (Juggler of Text), "an on-line text editor intended for simple people who do not know, or want to know, anything about computers, but who are concerned with text and want to keep their minds on it."[47] JOT performed automatic capitalization and had an

[45] Nelson, *Possiplex* (cit. n. 21), 185.

[46] Nelson, "Where my ideas came from" (cit. n. 32), 7.

https://archive.org/details/HTbrewD11/page/n3/mode/2up

[47] Nelson, "JOT: Juggler of Text: Preliminary specifications" 6 March 1972, 1.

https://archive.org/details/xs-3-JOT/mode/2up

"undo" function for restoring deleted text.[48] The program included functionality for deleting, inserting, or rearranging text on screen. Rather than using line numbers or other markers, the user typed the "!" character to define places in the text where words or sentences should be moved. Such maneuvers could also be nested and labelled to produce complex rearrangements. For example, typing:

!B The !A quick !A brown fox !B ! jumps ! over the lazy dog ! !B

Resulted in:

Over the lazy dog jumps the quick brown fox.[49]

Although this appears complicated when compared with today's word processor operations, such features were simpler and far more sophisticated than existing text editing systems in the early 1970s. In 1972, for example, Wang Laboratories released its *Wang 1200* word processor. This was essentially a calculator connected to an IBM Selectric Typewriter that was able to store typed lines of text on a cassette tape. Stored text could be retrieved by printing it out on paper.[50] This was a far cry from Nelson's notion of escaping from the confines of the paper page.

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[48] "Instructions for the 1986 version of JOT," 31 March, 2017. http://xanadu.com/jotinstructions.txt

[49] Nelson, "JOT: Juggler of Text: Preliminary specifications" (cit. n. 53), 3.

[50] Jim Battle, "Wang 1200" Webpage, 7 March 2010. http://www.wang1200.org/

At the back end of Hypertyper, Nelson and Daniels also designed a new data structure for handling the JOT text. The first version of "enfilade" was a tree of text.[51] Rather than storing a text as one long string, the enfilade broke up the string into shorter strings that were stored in the branches of a tree structure (figure 2). This had the advantage that pieces of text could be inserted, deleted, rearranged by modifying the tree structure, rather than modifying the string text itself. This was designed to overcome the problems of storing large amounts of text in a small computer memory, but it became a remarkably versatile and powerful technique that was later generalized into more elaborate data structures.[52]

[FIGURE 2]

By 1972, a demonstration version of the Hypertyper was ready. By this time Nelson's money had run out and the Nova computer had to be returned, effectively ending the project. Although unsuccessful as a product, Hypertyper and JOT were experiments in how to represent and manipulate text on a computer in the most user-friendly and flexible way. JOT and Hypertyper had helped Nelson to work out what sort of underlying data structure (the "enfilade") could represent text in elementary and re-combinable units. Hypertyper suggests not only the centrality of text and writing to Nelson's thinking, but also shows how he was beginning to conceive of the relationship between computing and thinking. The processing of

[51] Nelson and Mark Miller, "Enfiladics: Enfilades and General Enfilade Theory" 19th October, 2017. http://xanadu.com/EnfTheory-D10

[52] Nelson, "Xanalogical structure, needed now more than ever: parallel documents, deep links to content, deep versioning, and deep re-use." 23 May 200-. http://www.xanadu.com.au/ted/Xusurvey/xuDation.html

words on a computer was a clear example of how different ways of organizing functions and operations on the screen could result in different interactions and produce different texts. Kirschenbaum quotes the author Ann Rice on her experience with the WordStar word processor in the early 1980s: "Well, I think once you really get used to a computer and you get used to entering information from that keyboard, things happen in your mind, I mean, you change as a writer… You're able to do things that maybe you never would have thought of doing before."[53] Nelson foresaw this possibility – that new ways of interacting with text could powerfully influence writing and thinking.

COMPUTER LIB

With Hypertyper abandoned, Nelson was once again on the move. In 1973, Joe Lipson, the vice-chancellor of the University of Illinois, invited Nelson to take up a visiting position at the Chicago Circle campus.[54] Nelson was officially asked to work with Project PLATO, an experiment in time-sharing and educational computing being run by Donald Bitzer at the University's main campus in Urbana-Champaign.[55] After seeing PLATO running however, Nelson was less than impressed, "I could see that PLATO had nothing to do with what I believed in. There was no way for students to create or store content; it was merely a way of

[53] Quoted in Kirschenbaum, *Track changes* (cit n. 10), 50.

[54] Nelson, *Possiplex* (cit. n. 21), 199.

[55] Joy Lisi Rankin, *A People's History of Computing in the United States* (Cambridge, MA: Harvard University Press 2018), chapters 6 and 7.

inflicting programs on users."[56] Nelson told Lipson he wouldn't work on PLATO. Lipson asked what he would like to spend a year doing instead. Nelson said he would write a book.

Nelson knew he wanted to write something about computers, but he didn't know exactly what. His inspiration came over dinner with his girlfriend: "I think she said something about 'Women's Lib,' still a hot topic in those days, and the name of my book came to me: Computer Lib. That said it all. That gave the book its slant, its direction, its tone, its agenda. It would be a book of liberation. The reader and I would be setting the computer free – and ourselves."[57] Although Nelson was slightly older than most "hippies" he shared much in common with what Turner has called the "new communalists."[58] With little regard for conventional social and educational structures, counting Buckminster Fuller amongst his heroes, appalled and fearful at cold war nuclear standoffs, engaged in experiments with film-making and music, and immersed in the emerging "hacker" culture of the 1960s, Nelson combined political non-conformity with a unique version techno-optimism. In these respects, Nelson's ideas are an excellent example of what David Kaiser and Patrick McCray have called "groovy science." Nelson was not opposed to information technology; he wanted to develop computers in ways that were not "hulking, depersonalized, or militarized."[59] Like other countercultural figures to whom Nelson was loosely linked (including John C. Lilly), Nelson wanted to foster forms of computing that realized their "groovy potential."

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[56] Nelson, *Possiplex* (cit. n. 21), 199.

[57] Nelson, *Possiplex* (cit. n. 21), 200.

[58] Turner, *Counterculture to cyberculture* (cit. n. 17).

[59] David Kaiser and Patrick McCray, *Groovy science: knowledge, innovation, and American counterculture* (Chicago: University of Chicago Press, 2016), 2.

Computer Lib included sections on a range of computer-related topics – where to find out more information about computers, the basics of how computers work, an introduction to a few programming languages, an outline of data structures, and summaries of the uses (and anticipated uses) of computers in various domains. Nelson's starting point was the idea that information about computers had been monopolized by computer corporations and by "programmers" and that all too often this monopoly was being used to exclude ordinary people from any conversations about computing (Nelson called this "cybercrud": "putting things over on people using computers"[60]). But computers were too important for ordinary people to be excluded from conversations about them. People needed to understanding computers, Nelson argued, because computers were already changing everything.

> I would like to alert the reader, in no uncertain terms, that the time has come to be openly attentive and critical in observing and dealing with computer systems; and to transform criticism into action… just as the atmospheric pollution fostered by GM has become a matter for citizen concern and attack through legitimate channels of protest, so too should the procedural pollution of inconsiderate computers systems become a matter for the same kinds of concern.[61]

Nelson's critique was presented in explicitly countercultural terms – large corporations, government, and powerful individuals were using computers to construct more oppressive forms of bureaucracy using computers. "If we are to have the freedoms of information we deserve as a free people, the safeguards have to be built in at the bottom, now."[62]

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[60] Nelson, *Computer Lib / Dream Machines* (Self-published, 1974), 8.

[61] Nelson, *Computer Lib* (cit. n. 67), 3.

[62] Nelson, *Computer Lib* (cit. n. 67), DM59/70.

But the aim of understanding computers was not only to critique and pick apart computerized bureaucratic systems. The computer, Nelson believed, by virtue of its versatility, could also be turned to "positive" uses. "Computers involve imagination and creation at the highest level… They are toys, they are tools, they are glorious abstractions."[63] *Computer Lib* was written before the development of the first personal computers (the Altair 8800 was released in the same year as the book was published). But Nelson saw the potential of mini-computers and microchips for developing personal, home-based uses of computers. As such, *Computer Lib* stood within a countercultural tradition that saw technology, used appropriately, as a potential liberating force. If computers could be properly harnessed, they would contribute to "making people freer" rather than oppressing them.

How exactly computers could contribution to human liberation is not explored in detail in *Computer Lib* itself. But *Computer Lib* is actually two books: "Computer Lib" begins at the front and reads like a normal text while another book-length text, "Dream Machines," is appended to the back and can be read by flipping the book over and opening the back cover. Each of these texts serves separate but complementary purposes: "Computer Lib" provides a basic, though unorthodox, introduction to computers and what they can do, while "Dream Machines" lays out various "visions" of computing and their significance ("the technicalities matter a lot, but the unifying vision matters more").[64]

[63] Nelson, *Computer Lib* (cit. n. 67), 3.

[64] Nelson, *Dream Machines* (cit. n. 67), DM2/127.

Dream Machines is a book that explores the consequences of different types of media. For Nelson, "each possible combination you choose has different precise structures implicit in it, arrangements and units which flow from these ramified details."[65] These structures, Nelson saw, would come to be critically important as computers came to dominate more and more aspects of human life. Although the technical aspects of computers and media design received significant attention, Nelson believed that these were far less important than having an overall vision or structure for the presentation and manipulation of information via computers. He called the study of such systems "Fantics" – "the art and science of presentation." Fantics included not just technical aspects of layout and design, but also psychological effects and "sociological tie-ins."[66]

Nelson first considered the word "informatics" to describe this idea, but rejected it since it was already the name of a company. But a present-day definition of informatics gives us some sense of what Nelson had in mind: the study of the representation, processing, and communication of information, especially in engineered systems.[67] Here Nelson was very much influenced by his knowledge of films and movie-making. He saw the "filmic space" of Sergei Eisenstein and Vsevolod Pudovkin as analogous to a "fantic space" occupied by the user of a computer system.[68] Nelson identified in this a way of wresting back computers from "programmers" who dominated the design of how people interacted with computers.

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[65] Nelson, *Dream Machines* (cit. n. 67), DM2/127.

[66] Nelson, *Dream Machines* (cit. n. 67), DM48/81.

[67] "What is Informatics?" University of Edinburgh, accessed 21 July 2022. https://www.ed.ac.uk/files/atoms/files/what20is20informatics.pdf

[68] Nelson, *Dream Machines* (cit. n. 67), DM49.

"Programmers cannot be allowed to dictate how [a computer program] is to behave on the basis of the underlevel structures that are convenient to them. Quite the contrary: from the fullest consideration of the richest upper-level structure we want, we the users-to-be must dictate what lower-level structures are to be prepared within."[69] Users needed to understand computers (at a fantic level) in order to be able to better demand that programmers make better ways of interacting with them, Nelson argued.

We can read fantics as a kind of political theory of new media. In particular, Nelson posited that the kinds of micro-level structures embedded in computer programs had effects on how people interacted with machines, what they could do with them, and even the kinds of ideas and thoughts that they could construct with them. Significantly, on one of the pages discussing fantics, Nelson inset a large box of text describing his "JOT" system.[70] He considered his word processor an example of how a particular way of interacting with text on a screen could produce particular ways of thinking and doing. In other words, it showed how the mode of on-screen presentation (the fantic space, to use Nelson's terminology) could affect the final product (in this case, a piece of text). Nelson critiqued the PLATO system for what he saw as a high degree of arbitrariness in the way users had to interact with it – the way it presented information and allowed users to navigate did not seem intuitive (at least to Nelson), thus limiting what users could do. For Nelson this was not just a problem of correct programming, but a problem of correctly understanding how people think, how people interact, how people write, and designing a system accordingly.

[69] Nelson, *Dream Machines* (cit. n. 67), DM50/79.

[70] Nelson, *Dream Machines* (cit. n. 67), DM50/79.

Nelson believed that the ultimate fantic space would represent the "true content and structure of human thought." It would be the perfect tool for the evaluating, analyzing, and synthesizing ideas. For Nelson, this was hypertext. That meant "new forms of writing, appearing on computer screens, that will branch or perform at the reader's command."[71] Hypertext would allow computer users to write, organize, and communicate ideas in the most effective possible way, allowing people to jump from one idea to the next just as one's brain would do. The computer, with appropriately designed fantic systems, would make it possible to escape the forms of "sequential" writing that were necessitated by pencil and paper.

Within this context, Project Xanadu should be understood as Nelson's design for a fantic space that would satisfy his requirements. In *Dream Machines*, the description of Project Xanadu is presented almost as an addendum to Nelson's more general ideas about fantics. Xanadu is Nelson's attempt to realize his theory in code. "Xanadu," Nelson explains, "is my dream."[72] Reading *Computer Lib / Dream Machine* as a whole, Xanadu is significant not as a piece of code or software but as an ideal of how computers can become "liberating" machines – that is, how they can realize the countercultural dream of re-framing or re-deploying a technology such as to enhance freedom. Xanadu, Nelson believed, would realize the potential of computers to manipulate media in a free-associational way that puts the fewest constraints on human thinking and action.

LITERARY MACHINES

[71] Nelson, *Dream Machines* (cit. n. 67), DM58/71.

[72] Nelson, *Dream Machines* (cit. n. 67), DM56/73.

Nelson's book was a success, appealing to a growing groups of computer hobbyists and enthusiasts around the United States. Hundreds of orders poured in from around the country.[73] In the book, Nelson had proposed to sell Xanadu as a standalone system for the home user. It would be an integrated piece of hardware and software, potentially running on a mini-computer, for viewing, manipulating, and creating texts. Nelson's vision of the transformational effects of new media required more than coding – they required the kind of evangelical work to promote computers to the public that Nelson had discovered he was good at. For this, more people needed to have access to computers. In 1976, Nelson met Ray Borrill – a pioneer in computer retailing – at the first World Altair convention. Nelson convinced him (and some others) to team up to found the "itty bitty machine" (ibm) company, a retail store selling computer kits in Evanston, Illinois.[74] Itty bitty is largely remembered for being one of the few retail stores to sell the Apple I computer.[75] But it also became a platform for Nelson to promote his vision of personal computing, which he did through the store's advertising material, through talks at various computer conferences, and through another book, *Home Computer Revolution* (1977).

Nelson plans at itty bitty involved developing software to be sold with the computers. In practice, this meant continuing to develop Xanadu. His business partners did not see the value in these endeavors and Nelson became increasingly frustrated. In the fall of 1977, he was invited return to Swarthmore to teach two classes on computers. The next few years, and in particular the summer of 1979, were the most productive for the production of Xanadu

[73] Nelson, *Literary Machines*, (Mindful Press, 1987 (87.1)), 1/33.

[74] Ray Borrill, "Ted Nelson," 15 June 2005. https://www.resistors.org/index.php/Ted_Nelson.

[75] Borrill,"Ted Nelson" (cit n. 82).

code. In 1978, Nelson managed to assemble a group of programmers – Roger Gregory, Mark Miller, Stuart Greene, Eric Hill, and Roland King – "for the final assault."[76] During the "Swarthmore summer," the group rented a house together and began to restructure and redesign the Xanadu system: "We had expected to get to coding much sooner, but that's not how it worked out. Everything had to be rethought from top to bottom." This continued into the fall of 1979, with Mark Miller and Roger Gregory continuing to build the Xanadu code.

But even during these years of productive coding, Nelson was also writing prolifically *about* Xanadu too. In 1981, he published *Literary Machines*, intended not only to be a "report on Project Xanadu" but also a tract about "knowledge, education, and freedom."[77] As with *Computer Lib / Dream Machine*, Nelson's book was not intended to be a technical report on a software system. Rather, Nelson aimed to outline his philosophical and sociological vision for how computers could and should be used for writing, communication, and creativity. The repeated attempts to code and re-code Xanadu as a working system, led Nelson to provide a more fully articulated view of the effects of new media and information technologies on society.

The underlying tenet of Nelson's philosophy was that categories for thinking do not and should not remain fixed. Nelson's background had always made him an unconventional thinker – one whose ideas did not fit into boxes provided by others. This suspicion formed the basis of Nelson's idea for building an information system that did not pre-suppose or lock-in particular categories. This "must be a tolerant system which allows [categories] to

[76] Nelson, *Literary Machines* (cit. n. 81), 1/35.

[77] Nelson, *Literary Machines* (cit. n. 81), title page.

cohabit comfortably, helps track their variations and disparities, and is forever ready to accommodate new arrangements on top of those already present."[78] Allowing the fullest expression of creative freedom for a computer user meant having software in which the fundamental structure was maximally open to revision.

But Nelson's immersion in the worlds of literature and publishing also allowed him to see this problem in fundamentally textual terms. Literature, as Nelson saw it, was already a developed technology for connecting different ideas expressed in text. "Literature is an ongoing system of interconnecting documents," Nelson wrote.[79] Any document or book, Nelson saw, was part of an ongoing conversation, re-interpretation, and set of connections with previously written documents. These connections might be more explicit (such as footnotes in a scientific journal article) or less explicit (such as allusions to previous works). This system was flexible enough to allow ideas to be re-evaluated and adapted for present-day purposes as fields and domains of knowledge evolved. For Nelson, any text was fundamentally intertextual.

Necessarily, this intertextuality meant that writing was a collective act and that publishing was fundamentally about sharing and contributing to a community. Idealistically, Nelson imagined that Xanadu had to be a universal and shared systems, a global system. There would be a single "pool" of text, images, and storage that could be re-worked and re-displayed in different ways for different users and different uses. "This makes it possible to

[78] Nelson, *Literary Machines* (cit. n. 81), 1/24.

[79] Nelson, *Literary Machines* (cit. n. 81), 2/9.

make new things out of old, sharing material between units."[80] Just as literature provided a held-in-common or collective body of knowledge, the "xanalogical structure" would make all media available to everyone. Nelson called this a "public repository system with pluralistic re-use."[81]

Hypertext was based on not only the idea of mirroring the flexibility of human thinking, but also on copying successful aspects of the existing systems of literature. Project Xanadu would allow a realization of "writing" or "literature" in its most general form. That is, as a fully collective, wholly intertextual, and totally flexible system. "We believe there is something very right about the existing system of literature… And so we have tried to mirror, and replicate, and extend, existing literary structure…"[82] But Nelson's system was not just a conservative one; he knew that the possibilities opened up by reading and writing onscreen allowed users to do very new and different things. Xanadu was designed to take advantage of this. For one thing, a given piece of text only had to exist once the hypertext database. If Shakespeare's *Hamlet* existed in the database, anyone who wished to quote "To be or not to be" could link directly to the soliloquy; the text of the speech would be borrowed across into the new document ("transclusion"). Unlike WWW hyperlinks, such a link could not "break" – once something was in xanaspace, it was there forever. If the link disappeared, the quoted text itself would disappear too. A hyperlink (or Xanalink) would allow a user to jump across to the original text of the whole play, if they so wished. Once within the text of *Hamlet*, a user could also find out what other documents were linked to it, discovering alternative

[80] Nelson, *Literary Machines* (cit. n. 81), 0/5.

[81] Nelson, *Literary Machines* (cit. n. 81), 0/10

[82] Nelson, *Literary Machines* (cit n. 81), 2/12.

versions or commentaries. This essentially meant that Xanalinks could be navigated in two directions (on the WWW a user can follow outgoing links from a document, but you cannot query what links are incoming to the document you are viewing). Screen writing and reading (via Xanadu) would also allow a variety of version control mechanisms: side-by-side comparison of different versions and the ability to step back to a previous version. Nelson also suggested systems of copyright and credit for his system in which authors would receive micropayments every time their text was used.

Nelson saw in this the potential for a new form of pluralism that went beyond what was possible with conventional literature. Anyone could modify, reversion, and republish anything. Rather than creating chaos or a crisis of authority, Nelson perceived this as absolutely fundamental for counteracting the potentially constricting forces of the computerized and networked world.

> The reader of a book can close it or skip to the ending. In some new environments, such as Computer-Assisted Instruction, it is possible to trap the user fully, giving him or her no options whatever except what the planner intended, with no overview and no way to step out of it. I submit that this can be highly oppressive and is not our free tradition.[83]

Nelson goes on to note that artificial intelligence systems could also be deciding what readers see. Xanadu would allow escapes from these forms of control over text and content. By making it possible for anyone to add, publish, rework, and edit, such domination over literary production would become much more difficult. Xanadu, for Nelson, was as much a political project as it is a technical one.

[83] Nelson, *Literary Machines* (cit. n. 81), 3/20.

Nelson's critical idea here – the idea at the heart of Xanadu – is that the underlying structure of a database or file or makes all the difference. It makes a difference not only to what a user can write, not only to what they can do with the system, but potentially also to what they are allowed to read and allowed to think. The micro-structure of information or text and the organization of such structures on a technical level is a problem that has implications for freedom and control.

CONCLUSION

Despite the coding successes of the early 1980s, Xanadu was never quite completed. Gregory, Nelson, and Miller continued to work on the project in between paying jobs. In 1983, Nelson and Gregory set up the Xanadu Operating Company (XOC Inc.) to keep the project alive. In 1988, XOC was acquired by the Silicon Valley company Autodesk with Mark Miller serving as the chief designer. An almost-working version known as Xanadu 88.1 was finished in 1988 but this was never "subjected to quality control or released as a product."[84] Autodesk dropped the project in 1992. Of course, during those same years, an alternative hypertext system known as the World Wide Web was designed by Tim Berners-Lee. Its subsequent success has dominated any discussion about hypertext and its textual and political possibilities.

[84] Xanadu Australia, "Xanadu FAQ" 12 April 2002.

http://www.xanadu.com.au/general/faq.html

But from the vantage point of 2023, with the World Wide Web plagued by problems of misinformation and dominated by a handful of large Internet corporations, many of Nelson's ideas seem remarkably important. The notion of computers as not *mere tools* but as powerful augmenters of the human intellect allowed Nelson to perceive the political implications of computing in clear terms. First, Nelson's insistence on the importance of attribution and the traceability of text – while generating complexities for code – offered an important warning about the dangers of unmoored hypertextual information. Second, for Nelson, computers offered a means of "de-structuring" information (or, at least, presenting information in ways that could be radically restructured). The problem, according to Nelson, was that the structure of software or code shaped the form and the content of what could be produced. The wrong kinds of structures would lead to limits and constraints on free expression. Nelson anticipated many of the problems that would arise with a completely "open" system like the Web – content would disappear, text would become impossible to trace, copyright would be violated. Not only that, but the "freewheeling" nature of the web has, in the long term, left it especially vulnerable to capture by corporate interests just as Nelson saw in the 1970s.

Companies who have been able to organize and represent online information in coherent ways (Google, Facebook, Yahoo!, Amazon, Baidu, Tencent, Alibaba) now dominate the Web almost entirely. They pose exactly the kind of threat that Nelson feared, "trapping the user" into viewing particular content or following particular informational paths. The ways in which we now mostly commonly interact with information online is within strictly prescribed formats and structures - such as those provided by Google, Facebook, Twitter, or Instagram – just as Nelson predicted. The Web offered simplicity and high-degree of flexibility, but in doing so it left open the possibility for far more rigid

structures to be built on top of it. As many Internet scholars have argued, the majority of those structures are oriented towards capturing our attention and diverting it towards advertising.[85] The harvesting of our data online allows companies to further refine the ways in which they direct users down very specific informational paths that - rather than maximizing freedom of expression or thought – maximize our buying and selling.

Nelson's theory also suggested ways in which the low-level structure of databases and files has important implications for how think. Overly rigid structures, or those imposed in a top-down way by corporations or governments would constrain thinking and action. This prefigured ideas in fields such as information studies and critical data studies. Bowker and Star's *Sorting Things Out* (1999), for example, showed how the categories used by mundane-looking forms and files could have broad social and political implications, affecting how we think about races or diseases.[86] Other have extended these ideas further into electronic databases and classification systems across a range of domains. The kinds of thinking about the politics of information technologies that has become a hallmark of history of technology and related disciplines shares important similarities with Nelson's ideas that were developed in through his development of hypertext and other tools. Nelson's unique immersion into text and media in the 1960s led him to think of Xanadu not as a piece of code or software, but as a "literary machine" for intervening in society and politics. His critiques were, in effect, co-produced with the technologies he attempted to build.

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[85] For example: Siva Vaidhyanathan, *The Googlization of everything: and why we should worry* (Berkeley: University of California Press, 2012).

[86] Geoffrey C. Bowker and Susan Leigh Star, *Sorting things out: classification and its consequences* (Cambridge, MIT Press, 1999).

Nelson began to articulate his vision of hypertext at the almost the same time as McLuhan was publishing his ideas. Like McLuhan, Nelson saw the ways in which electronic media had the potential to transform human creativity and thinking. Nelson was not only a close observer of computers and their potential, but also an observer influenced by the sensibilities of the 1960s counterculture. This allowed him to especially attuned to various ways in which computers could be utilized to either foster or prevent certain kinds of thoughts or actions. In his autobiography, Nelson recounts a meeting with McLuhan in Toronto in 1979:

> I started to tell McLuhan about hypertext, and he intoned something like, 'The computer cannot alter its plan of action in any way!'… In other words, he didn't get it at all. He didn't understand that the possible variations of computer behavior are what make the computer so powerful…[87]

According to Nelson, McLuhan treated "electronic media" as one kind of thing, not a multi-purpose and flexible machine. By failing to differentiate between the different possibilities inherent in different file and data structures, McLuhan failed to see the political potential of computing. Not only did Nelson see this potential, but he articulated a means of understanding and mitigating its profound social and political effects.

McLuhan's view is also significant for what it tells us about his notion of computing and code – computers followed unalterable "plans of action," simply following the rules or code that they have been provided with. Nelson understood that computers were not one thing and that they could, especially when working in tandem with humans, exhibit different

[87] Nelson, *Possiplex* (cit. n. 21), 228.

kinds of behavior. The introduction to this volume describes how, in the 1960s, artificial intelligence researchers (like Herbert Simon) and educators (like Omar Khayyam Moore), inspired by cognitive science, created environments and systems for computers-humans interaction. Devices like Talking Typewriter – like Nelson's JOT or HyperTyper – encouraged learning, creativity, autonomy. Nelson saw computers not as rule-following code machines but as devices that could combine with humans to produce creative intellectual output. They were machines for craft as well as for code.

Figure 1: Zippered lists (“A file structure for the complex, the changing, the indeterminate”)

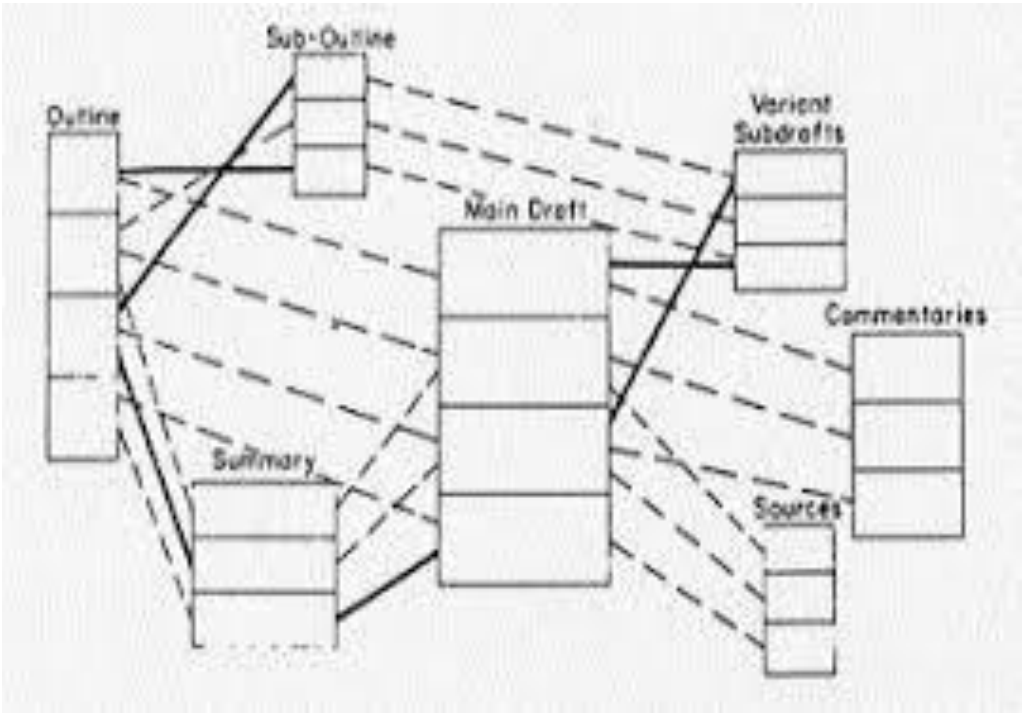

Figure 2: Enfilade data structure (http://xanadu.com/tech/)