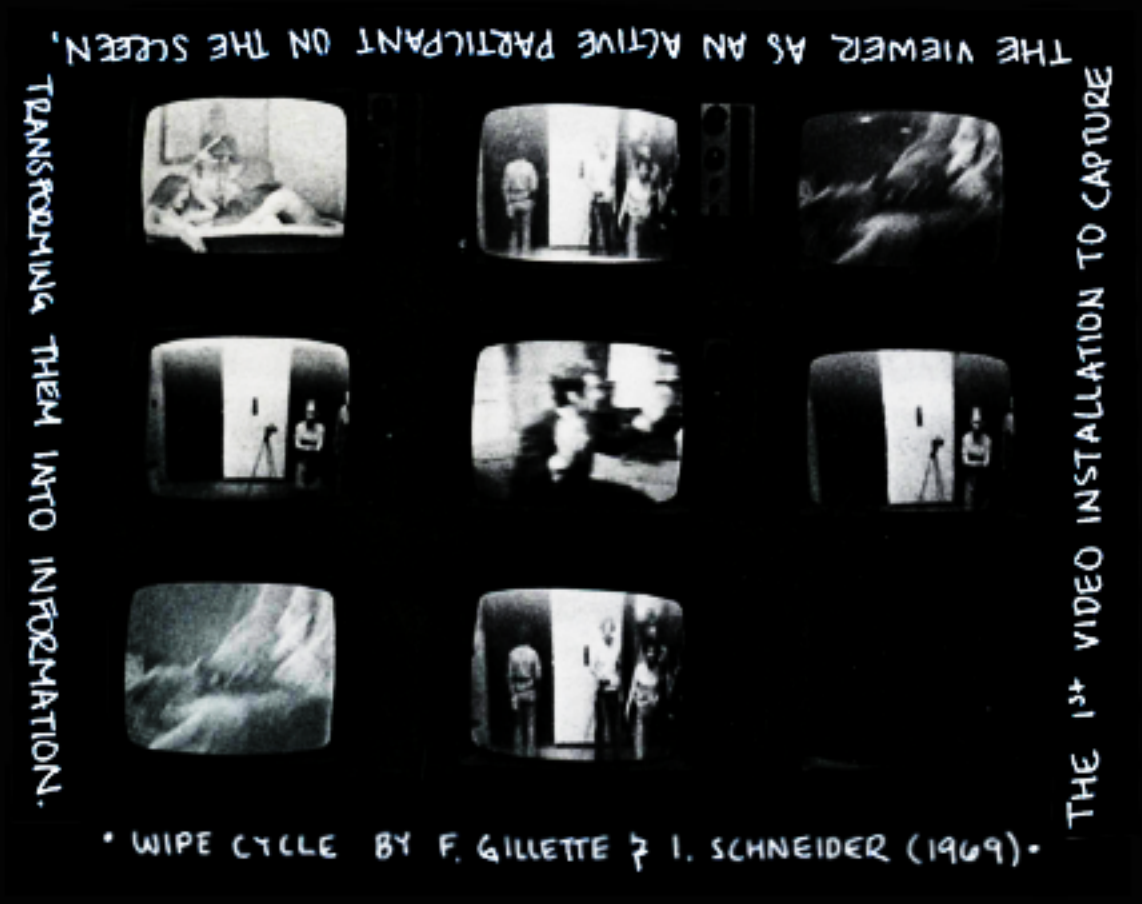
HYPERTEXT

An epistemological and global perspective on cyber-utopianism and the computerized society



Sarah Fingerhood

Definitions and Intent

Let me introduce the word "hypertext"***** to mean a body of written or pictorial material interconnected in such a complex way that it could not conveniently be presented or represented on paper. It may contain summaries, or maps of its contents and their interrelations; it may contain annotations, additions and footnotes from scholars who have examined it. Let me suggest that such an object and system, properly designed and administered, could have great potential for education, increasing the student's range of choices, his sense of freedom, his motivation, and his intellectual grasp******. Such a system could grow indefinitely, gradually including more and more of the world's written knowledge. However, its internal file structure would have to be built to accept growth, change and complex informational arrangements. The ELF is such a file structure.

THE 1ST INTRODUCTION OF THE WORD "HYPERTEXT" FROM TED NELSON'S ARTICLE, "A FILE STRUCTURE FOR THE COMPLEX, THE CHANGING, & THE INDETERMINATE." (1965)

When hypertext first emerged in early computing theories, it demonstrated a new era of humans-computer interaction and thus, opened the floodgates of public imagination concerning the possibilities computing and cyberspace could have on humanity. Mainly, the little blue link expanded horizons in the face of the coming Information Era to say that society could do more than become smarter, faster, and bigger. We could also become wiser.

And yet, we know today that rather than liberate us, new technology and limitless information has often invited new inequalities, dilemmas, and conflict into society. As James Baldwin notes, "the great force of history comes from the fact that we carry it within us, are unconsciously controlled by it in many ways, and history is literally present in all that we do." In looking at the social and technical development of hypertext since its inception, perhaps we can learn where we went wrong and what to consider in the coming technological developments.

All Watched Over By Machines of Loving Grace

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

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

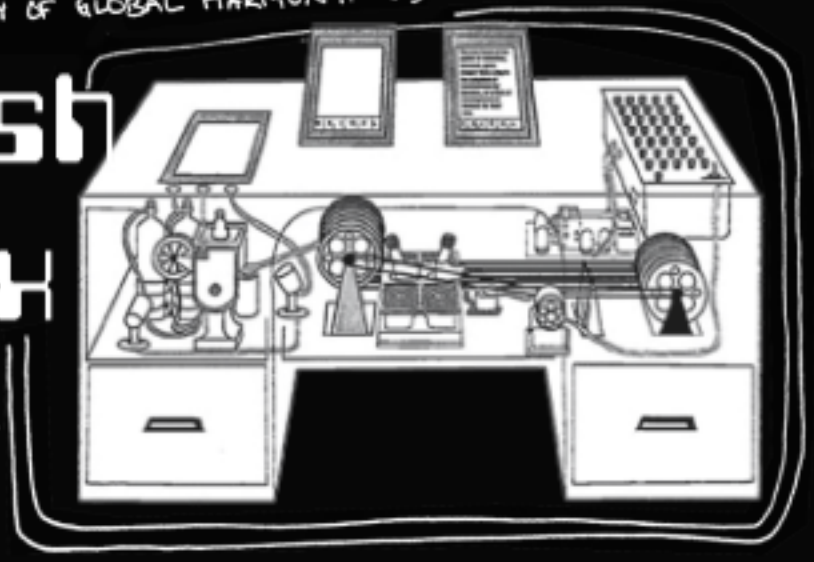
I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,
and all watched over
by machines of loving grace.

RICHARD
BRAUTIGAN
(1967)

Cybernetics: the science of communication and control in animals & machine

"TO A GENERATION THAT HAD GROWN UP IN A WORLD BESET BY MASSIVE ARMIES & THREAT OF NUCEAR HOLOCAUST, THE CYBERNETIC NOTION OF THE GLOBE AS A SINGLE, INTERTWINED PATTERN OF INFORMATION WAS DEEPLY COMFORTING: IN THE INVISIBLE PLAY OF INFORMATION, MANY THOUGHT THERE COULD BE THE POSSIBILITY OF GLOBAL HARMONY." (1)

Vannevar Bush & The Memex



In his article "As We May Think," published in the Atlantic in 1945, Vannevar Bush presented the "Memex," a "hypothetical information-retrieval system… in which a person's every 'book, record, or communication' was microfilmed and cataloged." (2)

While Bush was the chairman of the National Defense Research Committee (NDRC), his wartime research projects were deeply informed by cybernetic theories. The emerging field of cybernetics evolved out of the use of statistical methods to factor location, motion, and the human pilot when predicting the future course of an enemy airplane. In cybernetics, "the enemy bomber and the anti-aircraft fire-control system each depended on both mechanical and human components." (3) To reconcile these distinct elements, cybernetics chose to "imagine the soldiers who control the airplanes and the anti-aircraft apparatus as mechanical devices [themselves] so as to be able to model their behavior using mathematical formulas."(4) These early conceptual models painted the first picture of "humans and machines as dynamic, collaborating elements in a single, highly fluid, socio-technical system," therefore laying the foundation for an optimistic belief in the evolution of man via machines.(5)

The advent of the Memex was a reaction to two simultaneous societal shifts: (1) the unmistakable destruction of human nature visible in WWII and (2) the onset of the Information Era.

In a cyber-utopian fashion, Bush imagined technology as the bridge between these two cultural happenings- as in, technology would be the tool to help humans access enlightenment.The Memex, in its ability to organize, store,and retrieve limitless knowledge, is an apparatus to help humans acquire and harness their own wisdom in the face of unparalleled information.

"THE APPLICATIONS OF SCIENCE HAVE BUILT MAN A WELL-SUPPLIED HOUSE, & ARE TEACHING HIM TO LIVE HEALTHILY THEREIN. THEY HAVE ENABLED HIM TO THROW MASSES OF PEOPLE AGAINST ONE ANOTHER WITH CRUEL WEAPONS. THEY YET MAY ALLOW HIM TRULY TO ENCOMPASS THE GREAT RECORD & TO GROW IN THE WISDOM OF RACE EXPERIENCE. HE MAY PERISH IN CONFLICT BEFORE HE LEARNS TO WIELD THAT RECORD FOR HIS TRUE GOOD. YET, IN THE APPLICATION OF SCIENCE TO THE NEEDS & DESIRES OF MAN, IT WOULD SEEM A SINGULARLY UNFORTUNATE STAGE AT WHICH TO TERMINATE THE PROCESS, OR TO LOSE HOPE AS TO THE OUTCOME." (6)

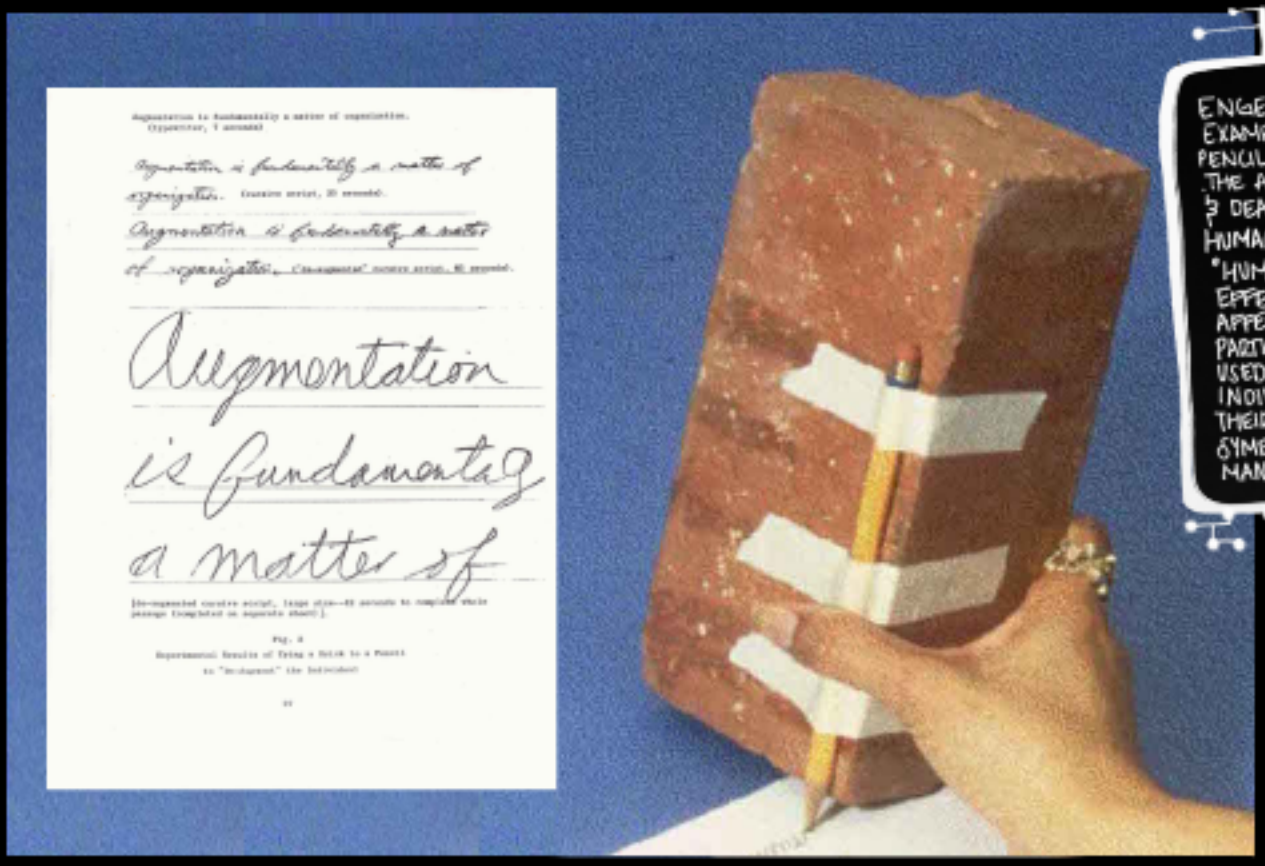
Despite such a noble endeavor for human wisdom and peace, the pitfalls of human nature seem inescapable. In a great cosmic irony, in 1919 Bush co-founded a radio-tube supplier company called Raytheon, the predecessor to the largest military weapon manufacturer in the world today.(7)

IN THE 1960s, BUSH'S VISION OF THE MEMEX INSPIRED THE TWO INDEPENDENT CO-CREATORS OF HYPERTEXT...

1. Doug Engelbart

During WWII, while deployed by the Navy in the Phillippines, Doug Engelbart read Bush's "As We May Think," setting him off on a trajectory that dreamed of a "new kind of human" formulated between the co-evolution of computers and their users. (8)

In 1962, Engelbart published "Augmenting Human Intellect: A Conceptual Framework," which outlined his radical vision for an interactive computer display that navigated interconnected pieces of knowledge- i.e. hypertext. Faced with the emerging Information Era, Engelbart's theories mirrored Bush in their fears that the world had become too big to understand. Subsequently, "the complexity/urgency factor had transcended what humans [could] cope with." (9) Once again, technology seemed to be the tool to help us overcome our own limitations. A computerized society was not just our predestined future, but our savior.



ENGELBART USES THE EXAMPLE OF A BRICK-PENCIL TO EXPLAIN THE AUGMENTATION & DEAUGMENTATION OF HUMAN INTELLIGENCE: "HUMAN INTELLECTUAL EFFECTIVENESS CAN BE AFFECTED BY THE PARTICULAR MEANS USED BY INDIVIDUALS FOR THEIR EXTERNAL SYMBOL MANIPULATION" (10)

At his Stanford Research Institute laboratory, funded by the Office of Naval Research, Engelbart developed much of the technology he envisioned for the augmentation of human intelligence. In 1968, in what would later be called "The Mother of All Demos," Engelbart shocked the world by presenting his oN-Line System (NLS) to the public, which showed for the first time capabilities of hypertext, file linking, word processing and the mouse to create real-time human-computer interaction.

"THE COMPUTER WORLD IS NOT JUST TECHNICALITY & RAZZLE-DAZZLE. IT IS A CONTINUAL WAR OVER SOFTWARE POLITICS & PARADIGMS. WITH IDEAS WHICH ARE STILL RADICAL, WE FIGHT ON."
- Project Xanadu Site
Xanadu.net

"A SYSTEMS HUMANIST" Ted H. Nelson

EVERYTHING IS DEEPLY INTERTWINGLED.

Unbeknowst to Engelbart, in 1960 Ted Nelson, a graduate student at Harvard University, coined the term "hyerptext" when he founded Project Xanadu, a supposed universal, democratic hypertext library.

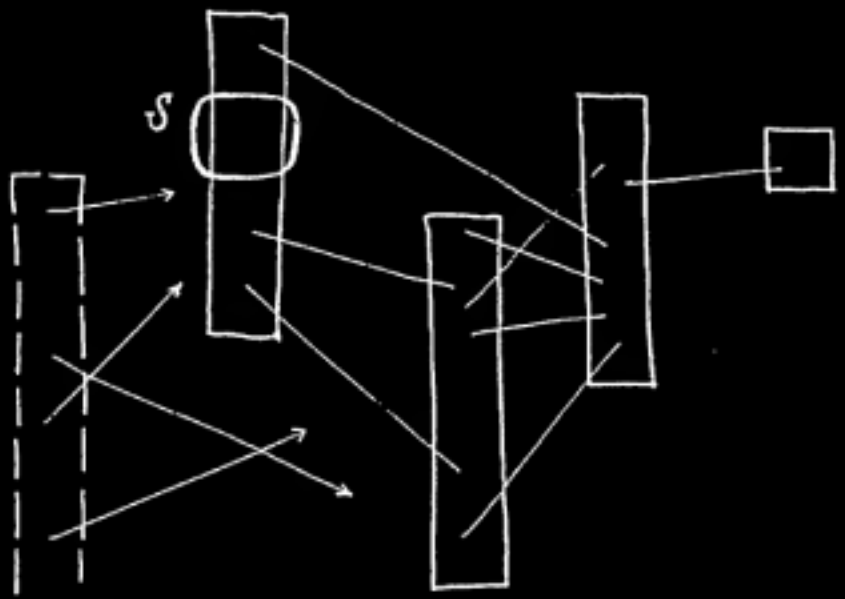
Influenced by cybernetic's view of the parallel nature of organisms and machines, Nelson said the idea of hypertext came to him while observing the swirling currents under his grandfasther's boat. The currents seemed to represent the "chaotic transformation of all relationsips and the irrevocable decay associated with the flow of time."(11) In response, Xanadu would "organize this chaos, to channel this temperal flow, [while] at the same time preeserving all the 'true interconnections' which held it together." (12)

For Nelson, these technologies would liberate humans from the constraints of worldly knowledge by using a vast digital net\ organization and structure.

Xanadu is premised on the ideas of non-sequential writing, transculusion and the visible connectivitv of pages and documents in order to faciliate a new kind of writing and communication.

PROCESS OF INCLUDING A PORTION OF ONE DOCUMENT INTO THE BODY OF A SECOND DOCUMENT

Project Xanadu is still an unfinished software 60 yeaars later and is often called the longest-running vaporware project in the history of computing.



A simple hypertext appears on a television screen. The long strips are documents it can roam over. Not only can viewer leap along the connection lines indicated; he can also add indexes and commentaries to help in mutual comparison (dashed strip)—a facility of Xanadu system, "the magic carpet of the mind." (13)

"I CONTEND THAT THE PURPOSE OF COMPUTERS IS HUMAN FREEDOM. AND THE BETTER WORLD WE MUST HAVE WILL BE ONE IN WHICH COMPUTERS MAKE LIFE SIMPLER, NOT HARDER, ALLOW US TO TIE TOGETHER OUR WORK & HAVE CONTROL OF IT, & BRING US CLARIFYING OVERVIEWS & UNDERSTANDING OF EVERYTHING WE SEE & DO."
- TED NELSON

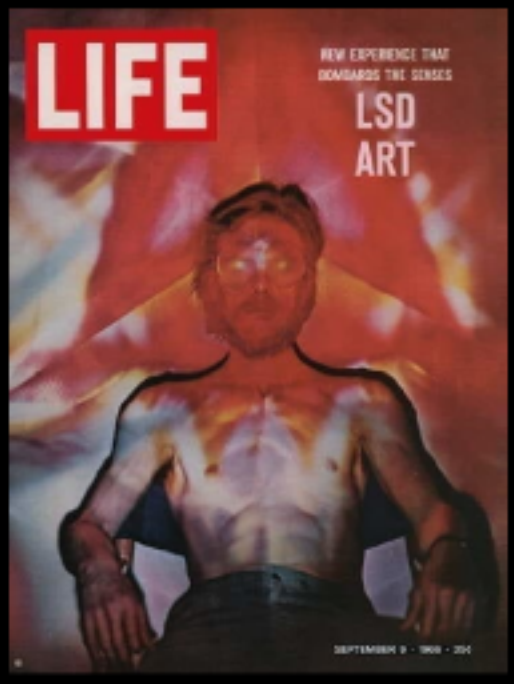
Art & Cyber-Utopianism

While Engelbart and Nelson were respectively products of elite military or academic spheres, ideas about an emerging cyber-utopia were permeating the societal imagination in the 1960s. As these technologies began to integrate slowly into the general pubilc, artists and creatives across America were inspireed by what cybernetics and computing representeed for a new world.

Groups and artists like USCO, Robert Rauschenberg, and the Merry Pranksters demonstrated how the countercultural sentiments of the 1960s drew inspiration from cybernetic and computing theories.

SCANNING (1963)

"Rauschenberg offered up a view of artistic practice as leveled collaboration among artists, audience, and materials. At another level, though, [his] work echoed and ultimately celebrated a migration toward the decentralized, system-oriented forms of thought then occuring at the center of the scientific establishment." (14)



LIFE COVER ON SEPT. 9, 1966 FEATURING USCO'S "SHRINE" IN A COVER STORY ON PSYCHEDELIC ART

GERD STERN'S NO OW NOW
ONE OF USCO'S MANTRAS (1966-70)

"...light, electricity, and mystical 'energy' generally played a rolee in USCO's work very much like the one 'information' plays in Wienerian cybernetics: they become universal forces that, functioning as the sources and content of all 'systems' (biological, social, and mechanical), made it possible for individual people, groups, and artifacts to be seen as mirrors of one another." (15)

"USCO 'unites the cults of mysticism and technology as a basis for introspection and communication." (16)

MEMEX (JUNE, 1945)

US BECOMES THE 1ST & ONLY NATION TO USE AN ATOMIC BOMB (AUG. 1945)

WIENER COINS "CYBERNETICS" (1948)

TED NELSON COINS "HYPERTEXT" & LAUNCHES XANADU (1960)

ANDY VAN DAM & THE HYPERTEXT EDITING SYSTEM (1967)

DOUG ENGELBART'S "MOTHER OF ALL DEMOS" (1968)

XEROX ALTO DESK (1973)

THE ASPEN MOVIE MAP (1977)

TIM BERNERS-LEE CREATES ENQUIRE (1980)

APPLE INTRODUCES HYPERCARD (1987)

WORLD WIDE WEB AT CERN BECOMES 1ST GLOBAL HYPERTEXT (1991)

FROM DREAMING OF

DIGITAL UTOPIAS

"For the New Communalists, in contrast, and for much of the broader counterculture, cybernetics and systems theory offered an ideological alternative. Like Norbert Wiener two decades earlier, many in the counterculture saw in cybernetics a vision of a world built not around vertical hierarchies and top-down flows of power, but around looping circuits of energy and information. These circuits presented the possibility of a stable social order based not on the psychologically distressing chains of command that characterized military and corporate life, but on the ebb and flow of communication. (17)

TO

CYBERSPACE REALITY

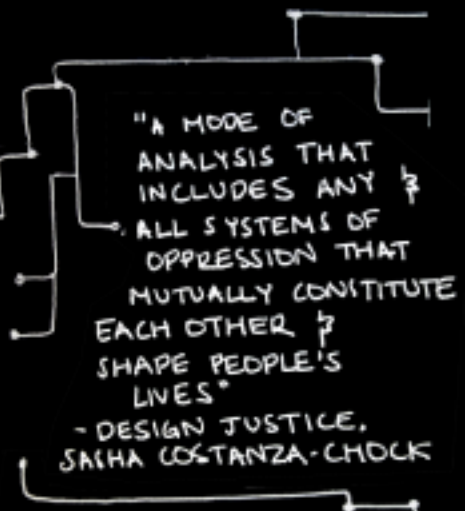
"We shifted from a wide-eyed optimism about technology's liberating potential to a dystopian obsession with biased algorithms, surveillance capitalism, and job-displacing robots."(18)

What happened to our cyber-utopian dream?

Fundamentally, technology is not a neutral artifact and as an information infrastructure, hypertext must be understood as a means of introducing, shaping, and enforcing social relations. When programmers viewed hypertext as a mere tool to liberate us from the short-comings of humanity, they remained blind to the ways in which those short-comings would become embedded in the technology itself.

{Theories}

Feminist standpoint theory supposes that "all knowledge attempts are socially oriented," and thus, "knowledge production is inevitably enmeshed in acts of power." (19) Therefore, this theory rejects the notion of neutrality because everyone's conception of knowledge, information, and truth is shaped by their status within the matrix of domination. Subjugated standpoints, which result in partial perspectives, situated knowledge, and subjugated knowledge, also negate the idea of universal or absolute truth as no one group has a clear angle on the world. Ultimately, these lenses emphasize the need to "valorize the marginal perspectives of knowledge, so as to expose the unexamined assumptions of dominant epistemological paradigms [and] avoid distorted or one-sided accounts of life." (20)



To build off standpoint theory, Arturo Escobar in his book "Designs for the Pluriverse," explains how a Global South perspective to design deconstructs Eurocentric, patriarchal ontologies and epistemologies that we have often accepted as natural or inevitable. Escobar claims that if we think new thoughts outside of the epistemic space of Western social theory and into subjugated worlds, "we might find more compelling answers to the strong questions posed by the current conjuncture of modern problems with insufficient modern solutions." (21) Moreover, Escobar introduces the difference between patriarchal and matristic cultures; the former being a way of living that "restricts our understanding of life and nature because it leads us to search for a unidirectional manipulation of everything, given the desire to control living." (22). On the other hand, matristic living intrinsically opens up a space for coexistence of legitimacy of all forms of existing and "allows us to see and to live within interaction and co-participation of everything that is alive." (23)

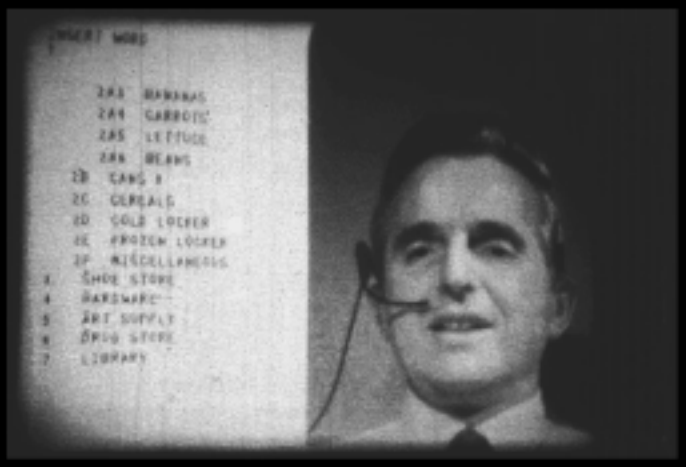
The subaltern perspective's ability to question given truths is critic... Langdon Winner's claims in "Do Artifacts Have Politics?" in which he emphas... how "if we examine social patterns that compromise the environments of technical systems, we find certain devices and systems almost invariably linked to specific ways of organizing power and authority." (24) Ruha Benjamin applies Winner's concepts to the era of big data, computing, and information systems in noting, "the simplest explanation for biased algorithms is that the humans who create them have their own deeply entrenched biases [and therefore] despite perceptions that algorithms are somehow neutral and uniquely objective, they can often reproduce and amplify existing prejudices." (25)

Applied to hypertext

The origins of hypertext begin with the father of cybernetics, Nobert Weiner, whose ultimate goal was to create order in the face of what he called the "evils" of disorganization and randomness. (26) In the way he saw them, cybernetic system's dependence on feedback loops and the processing of information across constituent parts inherently made them non-hierarchical self-regulating systems that produced order- rendering them a "source of moral good." (27)

Theories on the subaltern perspective help identify that a desire for order, categorization, and organization of knowledge are reflective of a patriarchal culture seeking control and dominance. This is further supported by the close association between all early developments of hypertext, the U.S. military, and/or elite universities.

The values of the elite academic-military-industrial complex, which seeks to establish and maintain Western intellectual dominance globally, can be found embedded in the design of the hypertext. For instance, in Engelbart's "Mother of All Demos," (1968) he described that his NLS system was "primarily an instrument and a vehicle for helping humans to operate within the domain of complex information structures," while presenting a non-linear, but materially hierarchical display of information with categorizations and subsets. (28)



While creating a subset of "apple sauce," "bean soup," and "tomato soup" under the category of "can materials" may seem mundane, Engelbart's organization of information demonstrates the very hyper-rationality that defines dominant Eurocentric epistemologies. The global south perspective informs us that a central feature of coloniality is "the categorization and hierarchical classification of differences," which eventually leads to the "suppression, devaluing, subordination, or even destruction of forms of knowledge and being that do not conform to the dominant form of modernity." (29) Thus, this version of hypertext's information structure validates a belief in logical truth as the only grounds for knowledge about an objective world made up of things that can be known, hierarchically ordered, and manipulated, while excluding all other forms of knowing.

While Engelbart's development of the hypertext was largely influenced by military and management application, Ted Nelson seemed to focus on how to personalize computer technology for more literary and creative endeavors. Perhaps this fascination with the effect of cybernetics on individualized expression is what allowed him to recognize flaws in the technology that others did not. For instance, Nelson critiqued information retrieval systems' concern with "seeking true, ideal, or permanent codes and categories" and their ability to suit individual needs rather than mass-standardization, given that knowledge and truth are fluid and subjective. (30) The dream of Nelson's imagined information infrastructure was then that the user would view hypertext as "a multifarious, polymorphic, many-dimensional, infinite blackboard." (31)

Nevertheless, Bush, Engelbart, and Nelson all still failed to acknowledge the political nature of this technology as they all regarded hypertext as an impartial and objective tool in the pursuit of information order.

As Nelson notes when discussing the interconnected display of Project Xanadu:

> "THEREFORE THE LINES MEAN KNOWLEDGE & ORDER. NOTE THAT IN SUCH USES, IT IS THE MAN'S JOB TO DRAW THE CONNECTIONS, NOT THE MACHINE'S. THE MACHINE IS A REPOSITORY & NOT A JUDGE." (32)

Technology could never be a mere repository given that we curate the knowledge and information we input into the systems. Building off Ruha Benjamin's critique, the machine is a social actor in its own right as it is programmed with a way of knowing that reflects, reproduces, and amplifies a dominant Eurocentric, academically-elite, and Western way of thought. As sociologist and legal scholar Boaventura de Sousa Santos proposes, there is a "diversity of forms of knowledge held by those groups whose experiences can no longer be rendered legible by academic Eurocentric knowledge." (33) Perhaps the very knowledge we needed to inform a socio-technical utopia defined by wisdom was already too smothered by offline power structures to be accessible in this new medium. Moreover, the structure of the systems we built were not only unaccommodating to, but further erased, these non-dominant modes of thought.

While there are global critiques of what knowledge is reproduced online, there also exists a domestic stratification of information production. Following one study's examination of content and knowledge generation on Wikipedia, a platform which is similar to hypertext in its pursuit of an open-source, decentralized, and democratic knowledge structure, demonstrates many of these issues. Discussing how Wikipedia guidelines favor patriarchal ideas of of knowledge and participation, Ford & Wajcman note, "those who fail to master [Wikipedia technocratic system of representation, with an emphasis on facts and other modular pieces of verifiable information], either because their knowledge of the world does not fit with what Wikipedia recognizes as knowledge or because negative social interactions on the platform have led to their leaving it, will remain on Wikipedia's edges, unable to contribute and have their knowledge represented." (34) Therefore, systems, like Wikipedia and hypertext, that depend upon hierarchical, hyper-rational, and tangible information favor a Eurocentric mode of thought and reproduce both global and domestic power dynamics through their design.

Finally, even a decentralized technology specifically designed to promote knowledge access and interaction is not immune to the inherent tendencies of modern capitalist society to concentrate wealth and centralize power in the hands of few. For instance, within Engelbart's lab's focus on "knowledge work," hypertext emerged as a product of the pursuit of improving human ability to more rapidly and efficiently deal with complex situations, such as "professional problems of diplomats, executives, social scientists… attorneys, [and] designers." (35) These goals are reminiscent of a capitalist-driven optimization mindset that aims to always increase productivity. Similarly, in Ted Nelson's presentation of hypertext he cites a possible application of this technology to the spheres of business management and spy espionage. (36) Ultimately, because knowledge is not an intrinsically valuable commodity, it must be transformed and adapted to profitable power structures.

The original cultural narrative that hypertext would help humans distill wisdom from the world through aiding us in organizing, accessing, and making sense of unparalleled amounts of information in the world is nothing more than a myth left over from the techno-mystic lore of the 1960s. The forms of knowledge reproduced in these knowledge infrastructures relies on the same Eurocentric, Western, capitalist, and patriarchal hyper-rationality that led us into such messes as war and inequality in the first place. As we look forward, we can take away from history that technology will not liberate us from ourselves; to find wisdom, we must do the work of developing inclusive and plural ways of knowing, thinking, and existing.

DREAM MACHINES

"What the inventive genius of mankind has bestowed upon us in the last 100 years could have made human life care-free and happy if the development of the organizing power of man had been able to keep step with his technical advances."

-Albert Einstein

New Freedoms Through Computer Screens

Bibliography

1. Turner, Fred. From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism. University of Chicago Press, 2008.
2.Madrigal, Alexis C. "The Hut Where the Internet Began." The Atlantic, Atlantic Media Company, 15 July 2013, https://www.theatlantic.com/technology/archive/2013/07/the-hut-where-the-internet-began/277551/.
3. Turner, Fred. From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism. University of Chicago Press, 2008.
4. ibid
5. ibid
6. Bush, Vannevar. "As We May Think." The Atlantic, Atlantic Media Company, July, 1945, https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/
7. Zachary, G. Pascal. "The Godfather." Wired, Conde Nast, 1 Nov. 1997, https://www.wired.com/1997/11/es-bush/.
8. Madrigal, Alexis C. "The Hut Where the Internet Began."
9. ibid
10. Engelbart, Christina, and MRW Connected. "Augmenting Human Intellect: A Conceptual Framework - 1962 (Augment,3906,)." Augmenting Human Intellect: A Conceptual Framework - 1962 (AUGMENT,3906,) - Doug Engelbart Institute, https://dougengelbart.org/content/view/138/.
11. Ted, Nelson. "Screening the Past." Screening the Past, http://www.screeningthepast.com/issue-18-first-release/the-magical-place-of-literary-memory%e2%80%a2-xanadu/.
12. Wolf, Gary. "The Curse of Xanadu." Wired, Conde Nast, 1 June 1995, https://www.wired.com/1995/06/xanadu/.
13. Nelson, Ted. "A File Structure for The Complex, The Changing and the Indeterminate." Vassar College, Poughkeepsie, N.Y., 4 Aug, 1965.
14. Turner, Fred. From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism.
15. ibid
16. ibid
17. Weinstein, Jeremy M., et al. System Error: Where Big Tech Went Wrong and How We Can Reboot. Hodder & Stoughton, 2021.
18.Bardzell, Shaowen. "Feminist HCI: taking stock and outlining an agenda for design." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10), Association for Computing Machinery, 2010, pp.1301-1310. DOI:https://doi.org/10.1145/1753326.1753521
19. Constanza-Chock, Sasha. "Introduction: #TravelingWhileTrans, Design Justice, ad Escape from the Matrix of Domination." Design Justice, 2020. https://design-justice.pubpub.org/pub/ap8rgw5e
20. Bardzell, Shaowen. "Feminist HCI: taking stock and outlining an agenda for design."
21. Escobar, Arturo. "Designs for the pluriverse: radical interdependence, autonomy, and the making of worlds." Duke University Press, 2018. DOI: 10.1080/17547075.2019.1664496
22. ibid
23. ibid
24. ibid
25. Winner, Langdon. "Do Artifacts Have Politics?" Daedalus, Vol. 109, no.1, The MIT Press, 1980, pp.121-36, http://www.jstor.org/stable/20024652
26. Benjamin, Ruha. "Race After Technology: Abolitionist Tools for the New Jim Code." Polity, 2019.
Turner, Fred. "From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the
26.Rise of Digital Utopianism." University of Chicago Press, 2008.
27.ibid
28. Engelbart, Doug. The Mother of All Demos (1968). Youtube, uploaded by Marcel. Jul 9, 2012. https://www.youtube.com/watch?v=yJDv-zdhzMY
29. Escobar, Arturo. "Designs for the pluriverse: radical interdependence, autonomy, and the making of worlds."
30. Nelson, Ted. "A File Structure for the Complex, the Changing, and the Indeterminate.
31. ibid
32. ibid
33. Escobar, Arturo. "Designs for the pluriverse: radical interdependence, autonomy, and the making of worlds."
34. Ford, Heather & Wajcman, Judy. "'Anyone can edit,' not everyone does: Wikipedia and the gender gap." Social Studies of Science, 47(4). Pp. 511-527. (2017) DOI: 10.1177/0306312717692172
35. Engelbart, Christina & MRW Connected. "Firsts: Knowledge Work." Firsts: Knowledge Work- Doug Engelbart Institute, https://dougengelbart.org/content/view/339/.
36. Nelson, Ted. "A File Structure for the Complex, the Changing, and the Indeterminate."