IIa: The Problem, or How It All Began

the quickest of overviews • ***computing prehistory (until 1948 or so)*** • *logic, abstraction, and the Platonic backhand* • *George Boole* • *Bertrand Russell* • *the perfectibility of thought* • ***information theory & the cyberneticists (the 1950s and 1960s)*** • *Claude Shannon* • *Norbert Wiener* • ***mixing with the counterculture*** • *the power of the interdisciplinary* • *Stewart Brand* • *Wired* • ***the problem: information today*** • *genes, memes, and information* • *cybernetic art and design* • *criticism from the trenches: Ellen Ullman and Jaron Lanier*

The language and ideas we use today to discuss the relationship between machines, data, and humanity remains that of the engineers who developed digital technology in the years around the Second World War, working for the U.S. government, Bell Labs, and ARPA–funded university departments. The men — and they were pretty much all men — who laid the foundations for computer engineering worked with assumptions and aspirations based in Claude Shannon's information theory, itself heir to nineteenth-century assumptions about mathematics and the perfectibility of human thought, and Norbert Wiener's follow-on theories of cybernetics. Both of these featured as topics of discussion and elaboration at the ten Macy Conferences, from 1948 through 1953. The conferences were the source of many small and large assumptions about the meaning and uses of computers and their relationships to humans; these assumptions spread to larger cultural venues through the the next few decades as the cyberneticists met the counterculture, often as a result of the ever-present Stewart Brand. Total saturation was reached in the 1990s when *Wired*, also founded in part by Brand, wove the story of our networked age from these same strands.

As N. Katherine Hayles relates in her thorough and insightful investigation of the evolution of cybernetic theories, the information theory that took hold at the conferences was one that “conceptualized information as an entity distinct from the substrates carrying it” (ix) and finds its essential cybernetic expression in the notion that “humans and machines are brothers under the skin.” (50)

As she explains, the arguments in the case,

> were deployed along three fronts. The first was concerned with the construction of information as a theoretical entity; the second with the construction of (human) neural structures so that they were seen as flows of information; the third with the construction of artifacts that translated information flows into observable operations, thereby making the flows “real.” (50)

The idea that we see expressed in watcher objects today, that data is out there to be gathered and deployed, to be hoovered up and processed into life-changing suggestions, is predicated on this first front, the theoretical construction of information as “a mathematical quantity, weightless as sunshine, moving the rarefied realm of pure possibility, not tied down to bodies or material instantiations.” (Hayles 56)

We hear its echo in arguments that “information wants to be free,” as if information is its own form with its own desires. We see it in suggestions that properly anonymized, data is free of us, and in the notion underlying most watcher objects: that data lives in the aether to be harvested and milled.

This is how we understand data and technology today and sometimes we forget it is a specific point of view with a definitive origin.

Computing Prehistory

James Gleick depicts this origin in *The Information*, a work of popular information hagiography that takes a teleological perspective on the development of our concept of information from prehistory to today. Fortunately, the book's intellectual flaw is its strength as a source for us, providing history alongside a prime demonstration of the methods used to present particular ideas about information as incontrovertible facts of nature.

Gleick begins by locating pre-information concepts historically in African talking drums and the use of bonfires and lanterns as signals in wars from the Trojan war to the American Revolution. These, however, are not true codes because as unwritten works they are unable to access the logical powers of abstraction. "Logic might be imagined to exist independent of writing — syllogisms can be spoken as well as written — ," he writes,

> but it did not. Speech is too fleeting to allow for analysis. Logic descended from the written word .... Logic turns the act of abstraction into a tool for determining what is true and what is false: truth can be discovered in words alone, apart from concrete experience. (Gleick 37–38)

The development of writing, whose primary characteristic is that it "separated the speaker from the listener, by so many miles or years" (Gleick 30) is the crucial break between the preliterate and contextual and the abstract, a break required so that we may have technology. But writing is not pure enough.

> The paths of logic into modern thought are roundabout, broken and complex. Since the paradoxes [that arise under close examinations of logic] seem to be in language, or about language, one way to banish them was to purify the medium: eliminate ambiguous words and wooly syntax, employ symbols that were rigorous and pure. To turn, that is, to mathematics. By the beginning of the twentieth century, it seemed that only a system of purpose-built symbols could make logic work properly — free of errors and paradoxes. This dream was to prove illusory; the paradoxes would creep back in, but no one could hope to understand until the paths of logic and mathematics converged. (Gleick 41)

Throughout his history, Gleick repeatedly emphasizes progress as the continued spread of abstraction or rather recognition of the immanent abstract in the world. This is fundamental to the deployment of what Hayles terms the Platonic backhand, one of "two moves in particular that played important roles in constructing the information/materiality hierarchy," which is to say, the construction of information as weightless. She explains,

> The Platonic backhand works from inferring from the world's noisy multiplicity a simplified abstraction. So far so good: this is what theorizing should do. The problem comes when we

> move circles around to constitute the abstraction as the originary form from which the world's multiplicity derives. Then complexity appears as a "fuzzing up" of an essential reality rather than as a manifestation of the world's holistic nature. (Hayles 12)

Thus in Gleick's telling, each moment in the history is a step towards recognizing the abstract truth until it all bursts for around us, the core of life as genetic information and the core of ideas as memes.

Charles Babbage's great insight upon the discovery of Joseph-Marie Jacquard's loom cards is the recognition of abstraction:

> What caught Babbage's fancy was not the weaving but rather the encoding .... The notion of abstracting information away from its physical substrate required careful emphasis. (Gleick 109)

Form remains despite changes in thread or color. Ada Lovelace's genius is the same — she extends the discovery of essential abstraction into processes themselves. (Gleick 116–17)

As is the case for Hayles, my argument is not that abstraction is useless, incorrect or not crucial to computing. Rather, I'm arguing it is foundational and that is problematic. "The point of highlighting such moments," she writes, "is to make clear how much had to be erased to arrive at such abstractions as bodiless information." (12) The point here of calling attention to the valorization of abstraction is to consider the stories we tell to make such severing appear natural as well as historical.

To return to history, in this story, the “the paths of logic and mathematics converged” most strikingly in the work of George Boole, who gave his name to Boolean logic, the system of logic that lays at the heart of computers today. For Gleick, Boole is a conqueror: “Until now logic had belonged to philosophy. Boole was claiming possession on behalf of mathematics.” (Gleick 164) In this slippage, logic as a way of describing a search for truth moves from one option among many ways to investigate the world and the meaning of our existence in it — that is from a philosophy — into a claim to the factual description mathematics is meant to be.

Boole’s system encoded logical propositions into mathematical equations.

> The encoding, the conversion from one modality to the other, served a purpose. … In the case of symbolic logic, the new form was suitable for manipulation by a calculus. The symbols were like little capsules, protecting their delicate cargo from the wind and fog of everyday communication. How much safer to write [an equation] than the real-language proposition for which, in a typical Boolean example it stood ….
>
> The safety came in no small part from draining the words of meaning. …
>
> [Language] was seen distinctly now as an instrument with two separate functions: expression and thought. Thinking came first, or so people assumed. To Boole, logic *was* thought — polished and purified. (Gleick 165)

In this description, a number of interesting phenomena can be observed. We see the bifurcation of information, described in terms of language, and its carrying case. We see the Platonic backhand, with the transmutation of logic into thought and messy, fuzzy, imperfect language relegated to expression. We see these expressed in terms of *safety*, defining intelligible meaning as dangerous.

The development of this argument into the perfection of the mathematical finds it apotheosis in the work of Bertrand Russell, in particular his collaboration with Alfred North Whitehead, the *Principia Mathematica*.

> [T]heir ambition was nothing less than the perfection of all mathematics. This was finally possible, they claimed, through the instrument of symbolic logic, with its obsidian signs and implacable rules. Their mission was to prove every mathematical fact. The process of proof, when carried out properly, should be mechanical. In contrast to words, *symbolism*, they declared, **enables "perfectly precise expression."** (Gleick 178, emphasis mine)

However, Gleick recounts, "The more rigorously they built, the more paradoxes they found." (179) Russell's primary paradox, the one named for him, was to consider the set of all sets that are not members of themselves.

> To eliminate Russell's paradox, Russell took drastic measures. The enabling factor seemed to be the peculiar recursion within the offending statement …. Russell's paradoxical set relies on the meta-set: a set of sets. So the problem was the crossing of levels, or, as Russell termed it, a mixing of types. His solution:

> declare it illegal, taboo, out of bounds. No mixing different levels of abstraction. No self-reference; no self-containment. (Gleick 180–81)

This was logic finally pure, contextless and ultimately atomized. The Platonic backhand is complete; no messy life is admitted.

It was in this environment of thought that Claude Shannon took up Boole's logic and eventually developed his theory of information. This work took place alongside mechanical computing developments, such as Vannevar Bush's Differential Analyzer, on which Shannon had worked at MIT, and the ENIAC, developed during World War II.

The theory and machine would collide after the war and, with the invention of the transistor, send us headlong into the computer age.

Information Theory & the Cyberneticists (the 1950s and 1960s)

Significant development of and discussion around the theory of human-computer-information relationships occurred in the late 1940s and early 1950s at the Macy Conferences. It was there that Shannon brought information theory to his compatriots and there that Norbert Wiener developed cybernetics.

When Claude Shannon first discussed his information theory as a mathematical theory of probability unconcerned with the content of the messages it described, he emphasized its limited applicability to problems of sending messages, as many as possible, through contemporary communications systems. (Hayles 54) However, within the context of postwar scientism, the allure of abstract and simple theory was too much to resist.

Or, as JCR Licklider put it,

> It is probably dangerous to use this theory of information in fields for which it was not designed, but I think the danger will not keep people from using it. (quoted in Gleick 233)

Reflexivity, Russell's old outlawed bugaboo and an alternative theory of information promulgated by Donald MacKay, suggests that context and structure are vital to understanding information, that "subjectivity, far from being a morass to be avoided, is precisely what enables information and meaning to be connected." Reflexivity, however, "lost because specifying and delimiting context quickly ballooned into an unmanageable project" in the minds of researchers. (Hayles 56–57)

That is, the culture of post-war technology, metastasizing the true gains of engineering into an assertion of the preeminent value of mathematic description — abstract and simplified over messy and difficult — encouraged the adoption of a theory that refused to consider context and the production of meaning. Rather it claimed information as a free material, divorced from energy or matter. Along with these claims came an emphasis on systems as vessels for homeostasis, the closed-loop alternative to the observer-influenced and subjective reflexivity.

This was Norbert Wiener's cybernetics. Wiener was a child prodigy who began by studying symbolic logic with Russell and spent the war years working on anti-aircraft systems. He considered information theory and cybernetics to be the same theory under different names, but he suggested the applicability was far wider: “Cybernetics, he wrote in his memoirs, amounted to ’a new interpretation of man, of man’s knowledge in the universe, and of society.” (Gleick 237–38) Or, as Hugh Dubberly and Paul Pangaro put it, “the study of what in a human context is sometimes loosely described as thinking and in engineering is known as control and communication.” (Dubberly & Pangaro 130)

The conceptual gains and losses in the triumph of Shannon and Wiener over MacKay can be understood by contrasting the implications of these viewpoints. As Hayles puts it,

> The price [contextless information] pays for this universality is its divorce from representation.... The price [reflexive information] pays for embodiment is difficulty of quantification and loss of universality.... Making information a thing allies it with homeostasis, for so defined, it can be transported into any medium and maintain a stable quantitative value.... Making information an action links it with reflexivity, for then its effect on the receiver must be taken into account.... (56–57)

She continues to point out that homeostatic systems re-enact the same pathologization of difference as Anglo-American engineering culture.

> Carolyn Marvin notes a decontextualized construction of information has important ideological implications, including an Anglo-American ethnocentrism that regards digital information as more important than more context-bound analog information. (19)

Using Norbert Wiener's electronic rat as an example of the embodiment of homeostatic ideas and the tendency to "_construct the human in terms of the machine_," Hayles writes,

> Presuppositions embodied in the electronic rat include the idea that both humans and cybernetic machines are goal-seeking mechanisms that learn, through corrective feedback, to reach a stable state. Both are information processors that tend toward homeostasis when they are functioning correctly.
>
> Given these assumptions, it was perhaps predictable that reflexivity should be constructed as neurosis in this model. (65)

Now competing information theories are not merely a sign of different approaches, but context becomes sickness itself. As Hayles relates, cybernetics eventually moved on to incorporate questions of reflexivity and context. This slightly loosened version of cybernetics began to spread into the counterculture. As it did, it carried the primary belief in unmoored information into wider culture as the rebels of the 1960s became the technical establishment of the 1990s and beyond.

Mixing With the Counterculture

But how did a theory, even a compelling one, move from the defense department, industrial labs, and universities into wider culture? Fred Turner, in a foundational work of computing history, *From Cyberculture to Counterculture*, asserts cybernetic ideas spread through interdisciplinary sharing and concomitant legitimacy exchange, both within the confines of the Macy Conferences and in postwar research projects as a whole. He explains,

> The power of cybernetics and systems theory to facilitate interdisciplinary collaboration emerged in large part thanks to the entrepreneurship of Norbert Wiener and the research climate of World War II. Wiener did not create the discipline of cybernetics out of thin air; rather he pulled its analytical terms together by bridging multiple, if formerly segregated scientific communities. …
>
> Because of the changes in scientific practice brought about by World War II, specialists in one discipline began to do things that had previously been considered the proper domain of specialists in other areas. They could justify such leaps across disciplinary boundaries by drawing on the rhetoric of cybernetics. If biological principles were at work in machines, then why shouldn't a physiologist contribute to work on computers? If "information" was the lifeblood of automatons, human beings, and societies alike, why shouldn't a mechanical engineer become a social critic? With such justifications, Wiener and a string of later cyberneticians and systems theorists reached across disciplinary boundaries and claimed a universal relevance for their new "science." (Turner 24–25)

While research projects across the country — many funded by Macy attender, futuristic dream weaver (see his "Man-Computer Symbiosis"), and defense department employee J.C.R. Licklider —put these ideas into daily practice, the conferences made sure the ideas were strong and they spread as far as possible.

> Over time, the Macy conferences helped refine a number of cybernetic concepts .... They also sent individual participants back to their home disciplines with a deep systems orientation toward their work and a habit of deploying informational and systems metaphors. In this way the Macy meetings helped transform cybernetics into one of the dominant intellectual paradigms of the postwar era. (Turner 26–27)

Once this dominance was established in universities and industrial research communities, it was just one more step from the institutions of the Bay Area and Silicon Valley to the wider counterculture.

In “How Cybernetics Connects Computing, Counterculture & Design,” Dubberly and Pangaro take up the “universal discipline,” as Geoffey Bowker calls cybernetics (quoted in Turner 25), and charts its interlocking paths. The diagram that accompanies the essay literally draws the lines between Macy attendees like Licklider, Wiener, Gregory Bateson, Margaret Mead and Heinz von Forester; scions of personal computer development at places like PARC, SRI and the MIT Media Lab; and counterculture figures like Ken Kesey. At the center stands Stewart Brand, Merry Prankster, founder of the *Whole Earth* catalog and *Wired*, and general connector. “Brand traveled between — and connected — several communities,” they write, “cybernetics (Bateson, Mead, and von Forester), computing (Englebart, Kay, Nelson and Negroponte), and of course counterculture (Ken Kesey, the Merry Pranksters, and other communards.” (Dubberly & Pangaro 137)

The canonical Brand-facilitated interface between the counterculture and the cyberneticists was of course the *Whole Earth Catalog*, first published in 1968. Here back-to-the-land standards like wood stoves were for sale next to early computers and books from Wiener and von Forester.

However as Felicity D. Scott recounts it was not the only one. There was "Spacewar," Brand's article for *Rolling Stone*, that

> worked to naturalize the connection between a distinctly techno-utopian … image of a better world promised through technology and the alternative ethos of hippie culture, to script a future for "hippie modernism" not within the low-tech, do-it-yourself domain prevailing within the *Whole Earth Catalog* but rather in the less-than-accessible world of computers that nevertheless haunted its pages. Desublimating this connection to computers, the text focused on the intermingling or cohabitation of the "youthful fervor and firm dis-Establishmentarianism of the freaks who design computer science" with the military and corporate interests funding the computer industry, for whom such freaks often worked.… (Scott 103)

In addition to this popular storytelling, there were also personal encounters staged by Brand.

> Brand's entrepreneurial brokering of "a series of encounters" or "network forums" to bring these groups together was not incidental to the emergence and conception of what Turner calls networked modes of techno-social life, fostering an ethos of feedback-based communication and a common vision of technology as a tool for personal and social change. (Scott 103)

Cybenetic communication is at it again.

While this paper cannot delve deeply into the transformation from computers as instrument of war to computers as personal empowerment (and besides Fred Turner has done such a thorough job before us), the transformation was well underway by the time the Portola Institute was founded in 1966 and completed as *Wired* rolled out in 1993. As Turner explains, this was all Brand and his compatriots.

In the last two decades of the twentieth century,

> ideas born within _Whole Earth_–derived network forums became key frames through which both public and professional technologists sought to comprehend the potential social impact of information and information technologies. …
>
> At the same time, and by means of the same social processes, members of the Whole Earth network made themselves visible and credible spokesmen for the socio-technical visions they had helped create. …
>
> Brand and other writers and editors of Whole Earth publications developed extraordinary reputations as journalists, [winning prizes for both the *Whole Earth Catalog* and *Wired*]. They did so, however, by building the communities on whose activities they were reporting. (Turner 6–7)

As their fame grew and they were able to tell their stories to higher levels of powerful men, the values and stories of cybernetics, including atomized information became as natural facts of life, essential to computing and all technological progress.

The Problem: Information Today

This comes to full bloom in a book like Gleick's. Not only does the story of technological progress become a teleology of abstraction but the cybernetic understanding of information becomes universal.

In the chapter "Entropy and Its Demons" information and entropy are shown to be the same and physics and universal laws are subject to cybernetic understanding. Then in "Life's Own Code" RNA and DNA are information technologies on the level of the body. Humans are in fact tiny computers. Even our minds are not spared: "Into the Meme Pool" demonstrates that ideas are just as subject to systems laws "as the neurons they inhabit." (Gleick 311)

Gleick also draws in art technologies, identifying a fundamental difference of type between painting and early photography.

> By painting or drawing, an artist — with skill, training, and long labor — reconstructs what the eye might see. By contrast, a daguerreotype is in some sense the thing itself — the information, stored, in an instant. (Gleick 376)

Ignoring the incredibly narrow conception of painting, the idea that a photograph or daguerreotype is more real is also predicated on the cybernetic notion of information transfer, where truth can be sent from reality to a storage medium untainted by the choices and interpretations of a mind is pure cybernetic thinking.

These ideas were taken up in more complex and exploratory way by artists throughout the 1960s and 1970s, from Gordon Pask and his *Colloquy of Mobiles* at ICA London's *Cybernetic Serendipity* to Ant Farm and their *Truckstop Network* and pneumatic structures.

They also found their way into design projects like the Cranbrook design trip undertaken in 1973 by students of a new interdisciplinary design program in "product, graphic, and interior architecture." Illustrated by Katherine McCoy and Edward Fella, the piece includes "a lexicon of the terms the students encountered during their visits — *adhocism, head dudes, design freaks, architecture machines, pneumatic-nomadic environment* — which paints a linguistic landscape of emerging design philosophies. (Blauvelt 256–57)

Dubberly and Pangaro's essay ultimately ties cybernetic thoughts from art into the DNA of contemporary interaction design itself.

> What Pask said about architecture also applies to design for human-computer interaction. A software program interacts with its "users," serving them and also constraining their behavior. Software, too, only makes sense when framed as part of larger systems that also include humans. These larger systems are what interaction designers design. …
>
> In many ways the story of cybernetics is the prehistory or backstory of interaction design.… Wiener's notion of feedback is the very foundation of interaction design, and thus the foundation of any framing of design as engaging people rather than simply as giving form to objects. (140)

Not only do these ideas animate the designs of the technology we use today, but the carved away abstractions animate our programmers — even when it is problematic.

Ellen Ullman, whose memoir of life as a programmer appeared in 1997 — right around the time the first dotcom boom took off and *Wired* started showing up in everyday homes — tells it like this:

> I'd like to think computers are neutral, a tool like, any other, a hammer that can build a house or smash a skull. But there is something in the system itself, in the formal logic of programs and data, that recreates the world in its own image. ... We think we are creating the system for our own purposes. We believe we are making it in our own image. We call the microprocessor the "brain"; we say the machine has "memory." But the computer is not really like us. It is a projection of a very slim part of ourselves: that portion devoted to logic, order, rule, and clarity....
>
> We place this small projection of ourselves all around us and we make ourselves reliant on it. To keep information, buy gas, save money, write a letter — we can't live without it any longer. The only problem is this: the more we surround ourselves with a narrowed notion of existence, the more narrow existence becomes. We conform to the range of motion the system allows. We must be more orderly, more logical. Answer the question, Yes or No, OK or Cancel. (90)

The systems that Dubberly and Pangaro love to design can become a straightjacket on the ground and the people who are implementing the systems, living with them closely, may be the first to notice.

More inside-the-house criticism comes from Jaron Lanier, a longtime software engineer known for contributing to early virtual reality work. He picks up the argument against the conflation of machines and humanity in his manifesto *You Are Not a Gadget*. After establishing his engineering-insider bonafides, Lanier hits out at a contemporary culture where we accommodate ourselves to the limitations of machines:

> When developers of digital technologies design a program that requires you to interact with a computer as if it were a person, they ask you to accept in some corner of your brains that you might also be conceived of as a program.(4)

That is, as the cyberneticists suggest, human thought and free information are portrayed as one and the same. Lanier ties this to a penchant for self-abdication, in this case expressed as thinking machines will know us better than ourselves, a sickness to which many prominent technologists are prone. The same dreams that Lanier critiques coming from "cybernetic totalists" like Marvin Minsky and Chris Anderson (once editor-in-chief of *Wired*) — dreams of uploadable minds and science robots who iterate on theories we no longer understand — are those Hayles identifies as the outcome of cybernetic theories. These "post-biological" hopes and all the humanity usurping developments they support are rooted in the initial division of information from agar, the likeness of neuron and circuit that frees data and divorces it from the analog context — the bodies — in which it arises.

Lanier also identifies some of the microaggressions that flow from this conception citing the myriad ways we are asked to accommodate databases and their schema. In this fitting ourselves, we do seem to lose some of the value of being known and recognized for our idiosyncrasies. In defense, he too suggests an embrace of difference and context, the same that appears at the heart of reflexivity. "A real friendship ought to introduce each person to unexpected weirdness in the other." (52) While this is phrased in a more, um, *Northern California* manner than I might choose, the articulation is resonant.

The conception of information as a "free-floating, decontextualized, quantifiable entity" is the result of a centuries long project tying technological progress to abstraction and this brand of abstraction into the core of our artistic and scientific cultures. It powers watcher objects and a culture that seems to shear off our idiosyncrasies. How can we fight back?

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