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The Cybernetic Hypothesis

Introspection is often necessary in academic work, not simply concerning the objects of the mind but also the actual manner in which intellectual work is done. This typically comes under the heading of methodology. Yet the meaning of methodology is not always clear, particularly within the so-called theory disciplines that span Marxism, feminism, poststructuralism, psychoanalysis, and related fields. Some prefer the self-serving and somewhat vain conviction that theory and methodology are one and the same pursuit. Hence "doing theory" would seem to preempt the thorny exercise of methodological introspection, rendering it moot. Why speak of method when theory is nothing but method? Why worry about other tasks when theory is king?

Yet the reality of higher education contradicts such pat conclusions. In fact, academic halls are teeming with a vast array of different research methods, from the positivistic expediency of quantitative investigation, to the staging of ethnographic interviews, to the narrative reductions of historiography, to the various instrumentalized strains of hermeneutics such as the Marxist reading, the feminist reading, or the psychoanalytic reading.

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In other words, methodology today has a distinctly liberal profile. For every taste, there is a method to match. For every predilection, there is a satisfaction to be had. In order to be successful today, a student or scholar must internalize the many options and enact them appropriately given the task at hand; this method for that problem, followed by a new method for the next. In this sense, methodology today is often more a question of appropriateness than existential fit, more a question of personal style than universal context, more a question of pragmatism than unwavering conviction.

But appropriateness is a thorny business, and not everyone agrees on matters of taste. Many methodological discussions devolve into a sort of popularity contest. Who advocates what method and for what purpose? Which general equivalent trumps all others? Is it sexuality, or is it class, or is it the *logos*, the archive, the gaze, desire, play, excess, singularity, resistance, or perhaps life itself, elevating one methodological formation above all others in a triumphant critique (to end all future critique)?

A contradiction thus emerges: the historical forces that generate liberal ecumenicalism are the same forces that strive to canalize and entrain such heterogeneity under a single symbolic order. The liberal profile of contemporary scholarly methodology is thus a kind of method-effect in which diversity of method is simultaneously asserted and withheld.

The situation is even more puzzling, however, as many humanities disciplines have in recent years marked a shift away from qualitative methods, as diverse and multitudinous as they are, in favor of more quantitative and empirical research techniques. In an apparent rebuff to methodological ecumenicalism, the positivistic expediency of quantitative research has tended to outflank other methods within Western modernity, as today's debate around digital humanities again makes clear. Appeals to empirical verification, to the reduction of complexity into simplicity, to the principles of repeatability and objectivity, to the sequential logic of the syllogism or the deductive argument—appeals, in short, to the paradigm of Enlightenment reason handed down since the Baroque turn of Descartes, Kepler, Galileo, and Leibniz—have gradually edged out all the others. A liberal array of possibilities galvanized to a single methodological tendency—but why, and how?

Perhaps the very question of method refers to that moment in history when knowledge becomes production, when knowledge loses its absolute claims to immanent efficacy, when knowledge ceases being intuitive and must be legitimized via recourse to some kind of metadiscourse. The ability to speak authoritatively is not a newfound right bestowed on humanity in the modern period, as recounted in the various narratives around triumphant secularism, the death of God, and the rise of reason. Today, such authority is precisely the thing corrupted and debased into all manner of intellectual haggling. Method is already fragmented when it arrives; the apotheosis comes later.

So to observe that quantitative, rationalistic methods became dominant is not simply to claim that scientific positivism won the battle of wits, having transformed the nature of knowledge production and truth since the early modern period. It is also something else, for the liberal iteration of methodologies (in the plural) is itself a method-effect. The liberal iteration is precisely the only flavor available to anyone subscribing to the cult of scientific positivism in the first place.

What other mode could possibly be as efficient as pure suitability itself, pure individual appropriateness, the raw granularity of every body satiated by its own unique specificity? As with post-Fordism, what results is a field of infinite customization, where each thinker has a method tailored to his or her preferences. Such capacious liberalism takes great pride in the fact that no single methodological authority can ever truly be triumphant, whether that authority be God, *jouissance*, pragmatic reasonableness, or positivistic verifiability. In other words, even in the face of the seeming liberal fragmentation of the many methodologies, such liberalism nevertheless simultaneously enshrines the law of positivistic efficiency, for what could be more efficient than infinite customization? What better way to wrangle this rainbow coalition than to grant everyone in it the freedom to do what he or she will? Standardize the world and kill the spirit, but empower difference and the individual is unchained. In short, under post-Fordism, liberal ecumenicalism and positivistic efficiency share a special relationship.

For cultural workers, this presents something of a problem. The triumph of quantitative methods seems to devalue and exclude much of what cultural workers do. And the reverse is true as well, since many cultural workers often see little point in positivistic pursuits, regularly writing them off as wrongheaded, soulless, or myopic. Faced with such crises of method, some cultural workers prefer to withdraw into a more rigorous critical practice, not, as their detractors might claim, to cling to some sense of cloistered security granted to the armchair philosopher, but because of the newfound perspective gained from thinking in a way that is asymmetrical to the current state of affairs.

Yet humanists pursuing quantitative research methods face an additional challenge, for today's corporate titans consist of little more than highly evolved modes of quantitative research. An Internet search company's page rank algorithm taps into a mass of intellectual labor performed in the field. It supplements this laboring mass with its own intellectual labor, the labor of data extraction, storage, and processing. So in many cases, what used to be intellectual work is now industrial work. When using quantitative methodologies in the academy (spidering, sampling, surveying, parsing, and processing), one must compete broadly with the sorts of media enterprises at work in the contemporary technology sector. A cultural worker who deploys such methods is little more than a lesser Amazon or a lesser Equifax.

A century ago, capital had a monopoly on the physical materiality of production. Now it has a monopoly on the immaterial sphere of informatic commerce. Industry has finally moved into the realm of intellectual labor, and by most reports it is excelling beyond all expectations. Many scholarly researchers must therefore face a startling fact: the corporate sector simply has far superior data reserves at its disposal. Thus, in the information society, the scholar of information will forever be trapped in a deficit of resources, playing catch-up behind the scads of mathematics PhDs on staff at Google. Never before in history have immaterial and informatic assets been so closely intertwined with capital.

But beyond the challenge of unequal talent and resources is the question of critical efficacy. Is it appropriate to deploy positivistic techniques against those self-same positivistic techniques? In a former time, such criticism would not have been valid or even necessary. Marx was writing against a system that laid no specific claims to the apparatus of knowledge production itself—even if it was fueled by a persistent and pernicious form of ideological misrecognition. Yet, today the state of affairs is entirely reversed. The new spirit of capitalism is found in brainwork, self-measurement and self-fashioning, perpetual critique and innovation, data creation and extraction. In short, doing capitalist work and doing intellectual work—of any variety, bourgeois or progressive—are more aligned today than they have ever been.[1] Hence there appears something of a moral crisis concerning the very validity of scholarly methodologies. Such methods are at best underfunded and impotent cousins to the new algorithmic industries and at worst unknowing shills for that same system of canalization and debasement. The question is no longer "can we use the master's tools to take down the master's house?" Today the question is "can we still use our own tools now that the master has taken them up?"

Beyond simply asserting or describing the existence of a certain social, cultural, and economic paradigm, beyond simply moralizing about it or fomenting some kind of reinvigorated "hermeneutics of suspicion" fashioned to debunk it, I wish to shift tone and provide a more detailed picture of the contemporary landscape. How and when were the seeds of the digital universe planted? What are the historical conditions that had to be developed in order for the concept of the *digital humanities* to make sense? When and how did the creation and recombination of knowledge gain its distinctly liberal profile in which each thinker may pursue his or her own autonomous goals? Why would such an arrangement be beneficial for the extraction of surplus-value? The aim here is thus to explore the history of digital society in classic Foucauldian fashion, to explore some of the "conditions of possibility" for cybernetic society. Norbert Wiener invented the science of cybernetics, of course, but what conditions of possibility had to have been invented in years prior for him to be able to innovate? Claude Shannon put forth a new model of information science, but what conditions of possibility had to exist already for the world to be conceived as information in the first place? Thus I offer a slightly different history of cybernetics not to overturn the existing histories, but to extend and reorient them. This supplementary history starts earlier in the twentieth century (with important additional precedents in the nineteenth that we must skip for the moment) and continues to the present day, relying on sources drawn from media, culture, technology, and philosophy.

The basic argument I wish to propose here is that the liberal hue of contemporary methodology—with quantitative positivism serving as the "governor" of the rainbow coalition—is chiefly due to a single historical phenomenon that has taken place over roughly the last century. Taking a page from the French collective Tiqqun, we might label this historical phenomenon the *cybernetic hypothesis.* Such a hypothesis refers to a specific epistemological regime in which systems or networks combine both human and nonhuman agents in mutual communication and command. Along with the many related fields that parallel cybernetics—network sciences like ecology, systems theory, and graph theory; the sciences of economic decision such as game theory and rational choice theory; information science and signal processing; behaviorism, cognitivism, and the post-Freudian sciences of the subject—the cybernetic hypothesis has come to dominate the production and regulation of society and culture.[2] Tiqqun views the cybernetic hypothesis as a new kind of social management involving both human and nonhuman assets. "[A]t the end of the twentieth century the image of steering, that is to say management, has become the primary metaphor to describe not only politics but all of human activity as well" (44).

Indeed, in the last few decades we have witnessed the fulfillment of the cybernetic hypothesis with the rise of computers and media in both academia and society at large. This has produced a number of contentious debates around the nature and culture of knowledge work. Perhaps the most active conversation concerns the status of hermeneutics and critique, or "what it means to read today." Some assert that the turn toward computers and media destabilizes the typical way in which texts are read and interpreted.[3] The discussion often hinges on the rise of digital media and the way in which it seems to destabilize the stalwart critical and interpretive techniques of reading. Some argue that digitality shifts the focus away from things like style, symbol, and allegory, and toward things like technique, materiality, and the archive. As Stephen Best and Sharon Marcus have recently argued, computers are "weak interpreters" that produce "more accurate knowledge about texts" and hence jibe well with a new kind of reader characterized by "minimal critical agency" (17). Franco Moretti's argument in *Distant Reading* is similar: computers are useful readers because they improve empirical accuracy by performing kinds of research that are difficult for humans, such as reading vastly larger corpuses, identifying emergent phenomena via clustering algorithms, and mapping numerous data points spatially (fig. 1). Many of these scholarly exchanges are still quite active today, and among a number of important references I will merely cite Alan Liu's thorough description of the current state of digital humanities (2013) and Elizabeth Weed's response to Best and Marcus in defense of a certain kind of criticality (2012). Indeed, the present special issue of *differences* has been designed with precisely this debate in mind.

By labeling it a hypothesis, Tiqqun meant to stress the provisional nature of cybernetics and the computational and media society it entails. They meant that cybernetics is a technological proposal and thus, like any experimental hypothesis, subject to ratification or indeed refutation. Like Tiqqun, I also wish to historicize this digital universe, describing it less as our collective fate than as a series of specific shifts in the foundations of knowledge and culture.

The cybernetic hypothesis may be defined broadly or narrowly. In the most narrow sense, cybernetics comes from the work of Wiener and his important research in the years immediately following World War II.[4] Yet in a more general sense, cybernetics refers to any kind of regulatory system in which human and nonhuman agents are connected in networks

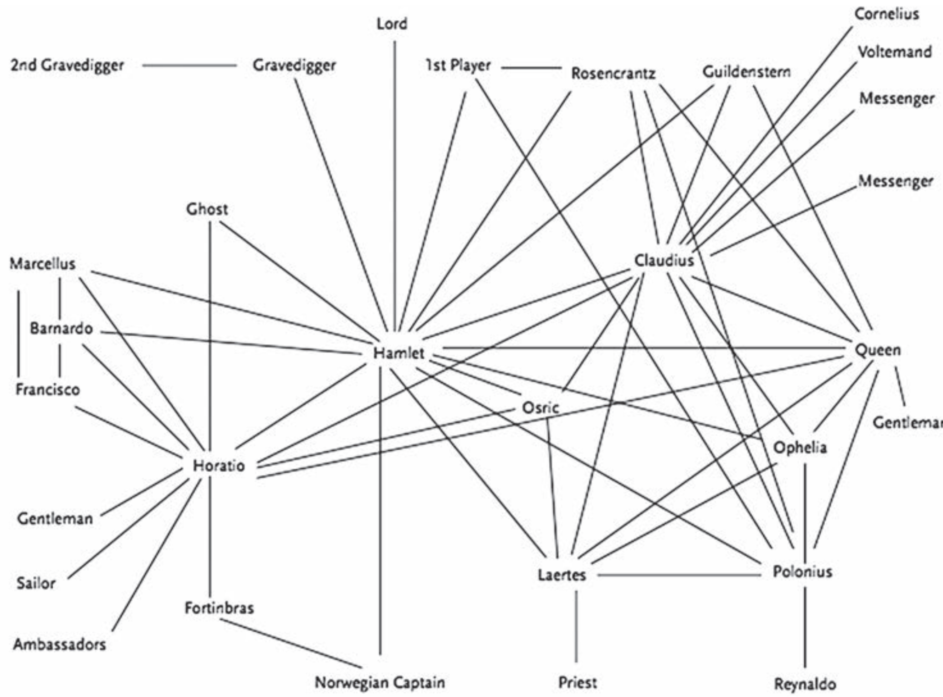


Figure 1
Network graph illustrating character relationships in Shakespeare's *Hamlet*. Each character is displayed as a discrete entity within a network; characters are connected according to specific protocols such as whether or not they speak lines together on stage at the same time.

Source: Moretti 213

of control and communication. Because of this, cybernetics is often credited with inaugurating a particular historical relationship between subject and world. Specifically, cybernetics refashions the world as a *system* and refashions the subject as an *agent*.

A system is an aggregation of things brought together to form a complex whole. Cybernetics aims to view the world as one or more systems. The systems may be arranged and linked laterally or stacked orthogonally as system, subsystem, and super system. Here I will assume a network model for systems, meaning an architecture of nodes and links in which interaction and communication may pass from one point in the system to another. Indeed, an important characteristic of cybernetic systems is an internal message loop in which messages originating within the system also effect the operation of the system. This results in dynamic change, and, as a result, systems use feedback in order to mitigate imbalance and pursue homeostasis. Given their overall complexity, cybernetic systems also require a high level of control. Thus such systems require a subsidiary mechanism for overall organization and management. Given these qualities, systems are also best understood as "algorithmic," which is to say operational or executable rather than static or descriptive, in that they prescribe a set of possible behaviors and then facilitate the step-by-step execution of those behaviors according to dynamic variables originating from within the system.

An agent is an entity capable of carrying out an action. Cybernetics assumes that an agent may be either animal or machine, human or nonhuman. Thus an aircraft pilot may be an agent, but so too are the dials and controls in the cockpit, since they carry out the actions of collecting and distributing vital information such as altitude and speed. Together the pilot and the aircraft form a cybernetic system. Agents in such systems are assumed to be autonomous to themselves and arranged on "equal footing" vis-à-vis the system as a whole. What this means is that, while agents may be wildly different in their relative size and power, each agent is endowed with the power of local decision according to the variables and functions within its own local scope. Thus while the pilot and instruments are not equal in power or type, they interoperate as equal peers to the extent that each may accommodate inputs and outputs and each may influence the outcome of the overall system. Agents are thus understood as more or less autonomous and equal at the level of their systematicity. In fact, agents are nothing more than subsystems within the super system. Given the existence of multiple agents, systems also display the quality of self-organization, meaning that no external metaphysics defines or dictates the behavior of the system. Systems are thus self-determining and rely on a high degree of reflexivity and self-referentiality in order to work properly.

This kind of agent infrastructure produces a few important results, the first having to do with the agents themselves, and the second having to do with the kind of messages that flow between them. First, while cybernetic systems do not require digital message encoding per se (analog signals work just fine in a thermostat, for example), such systems are digital at the level of infrastructure due to a necessarily atomistic architecture. Like the lines and boxes on a flow chart, discrete entities are separated by communications links (fig. 2). This is sometimes called an object-oriented infrastructure because it describes a system of objects (of whatever kind) that may connect or communicate. It results in a regular, discrete structure—similar to crystals—in which cells function like black boxes and interact diagrammatically rather than hierarchically.

Second, it is necessary to consider the messages themselves that propagate through cybernetic systems, not simply the agents that send them. Cybernetic systems are understood in terms of the sending, receiving, and processing of information. And such information is by definition highly encoded so that it may propagate and interface with agents in

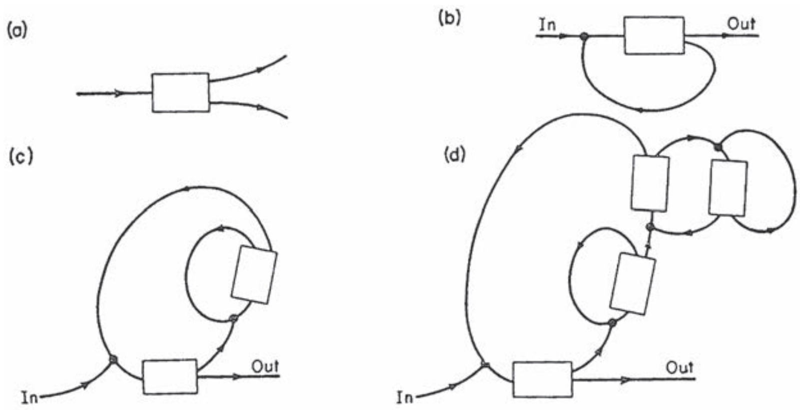


Figure 2
Illustration from the Herman H. Goldstine and John von Neumann paper "Planning and Coding Problems for an Electronic Computing Instrument" (158), an influential 1947 text that helped solidify conventions in computation and programming around principles of systematicity, diagrammatic flow, and encapsulation or "black boxing."

predictable ways. At the same time, such information is often uncoupled from a human observer, given that information may be gathered, processed, and re-sent by instruments regardless of human intervention. Thus, just like the agents within the system, information also gains a relative autonomy when deployed within a cybernetic environment because it may directly effect certain outcomes without the intervention of a human actor.

The words *media* and *cybernetics* are not synonyms, of course, despite the insinuations thus far. And one should acknowledge the important technical and sociohistorical distinctions that separate the two terms. Yet it is clear that, considered in the most general sense, cybernetics treats the world as if it were a system of mediation. Where metaphysics deals with the bilateral expressions of essence and instance, cybernetics assumes a baseline multilateralism across broad swaths of different instances interacting and influencing one another. Where phenomenology addresses itself to the relationship between subject and world, cybernetics concerns itself with systems of multiple agents communicating and influencing one another. Thus, the cybernetic hypothesis begins from the elemental assumption that everything is a system of mediation.

But where did the cybernetic hypothesis come from? What are the historical conditions of possibility that gave rise to it? Without duplicating the important work of historians and critics like Katherine Hayles or Lily Kay, I wish to revisit a couple of moments from the history of computation and cybernetics in order to shed more light on the present conjuncture. By returning to the work of Lewis Richardson, Warren Weaver, John von Neumann, and Paul Otlet, I hope to show the emergence of a new conception of society and culture, one that revolves around three basic trends: 1) an *atomist's* conception of the world as an array of discrete entities; 2) an *occasionalist's* conception of a pervasive media apparatus to interconnect these many entities; and 3) a *royalist's* conception of a sovereign or regulatory function necessary to manage and administrate the system as a whole.

Crystalline Space

In 1922, through what he labeled a strictly "numerical process," the English mathematician Lewis Richardson proposed a massive chess game to span the continents, a system to predict weather via a cellular space of distributed meteorological sensors (fig. 3). He used the term *lattice* to describe this new device, borrowing a word from crystallography. Then, making a dramatic conceptual leap that would later influence John von Neumann and the science of cellular automata, Richardson proposed that these many sprawling intercontinental cells coordinate to form a single computational system.

> *[W]e take a piece of paper ruled in large squares, like a chessboard, and let it represent a map. The lines forming the squares are taken as meridians and parallels of longitude—an unusual thing in map projection. Next, we lay down the convention that all numbers written inside a square relate to the latitude and longitude of its center. [. . .] It is seen that pressure and momentum alternate in a pattern, which is such that, if a chessboard had been used, the pressures would all appear on the red squares, and the momenta all on the white ones, or vice versa. (Richardson 5)*

The computational framework extends vertically too, rising through four distinct atmospheric layers.[5]

His language is that of complex and nonlinear systems, borrowed, in particular, from thermodynamics. It is the language of eddy movements, laminar stresses, air viscosity, turbulence, heat flows, and conductivity. Using the same discourse that would later influence theorists like Gilles Deleuze and Félix Guattari, Richardson includes a whole section on "heterogeneity" and speaks in terms of the "molecular" and "molar" levels. He discusses the complexity of interactions between layers and the turbulence that results. Then, with a wink, Richardson adds a little rhyme to help remember it all: "We realize thus that: big whirls have little whirls that feed on their velocity, and little whirls have lesser whirls and so on to viscosity" (66).

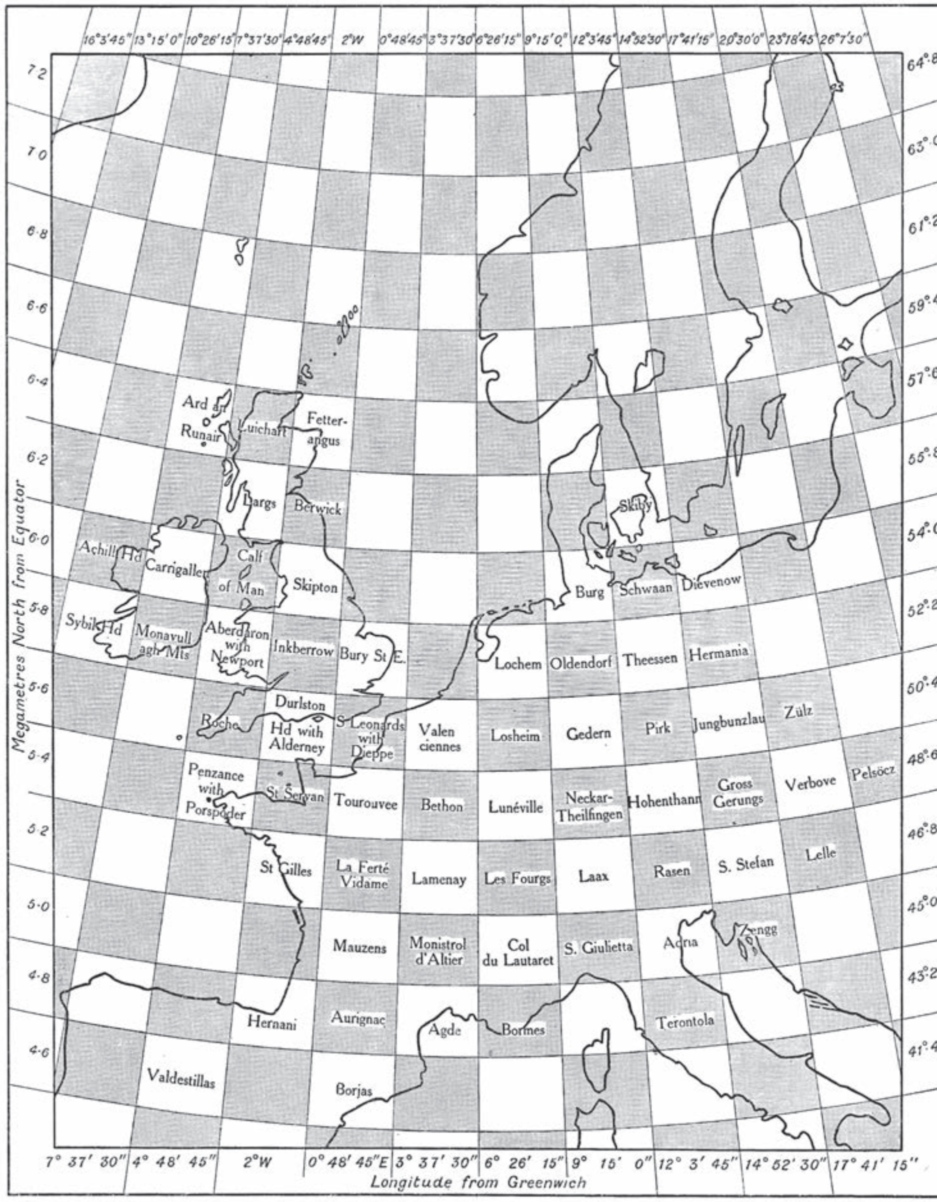


Figure 3
"An arrangement of meteorological stations designed to fit with the chief mechanical properties of the atmosphere. Other considerations have been here disregarded. Pressure to be observed at the centre of each shaded chequer, velocity at the centre of each white chequer."

Source: Richardson frontispiece.

Simply overlaying a grid on a map is not the attraction of Richardson's system for the present investigation. For in Richardson's case the grid is not primarily a spatial technology. In fact while the grid exists in an entirely abstract geometric space oblivious to national borders or geographic features, as does the system of latitude and longitude, it is, more importantly, a *latticework of parallel calculation.* Each square is represented by a number that feeds into an overall algorithm for modeling atmospheric phenomena.

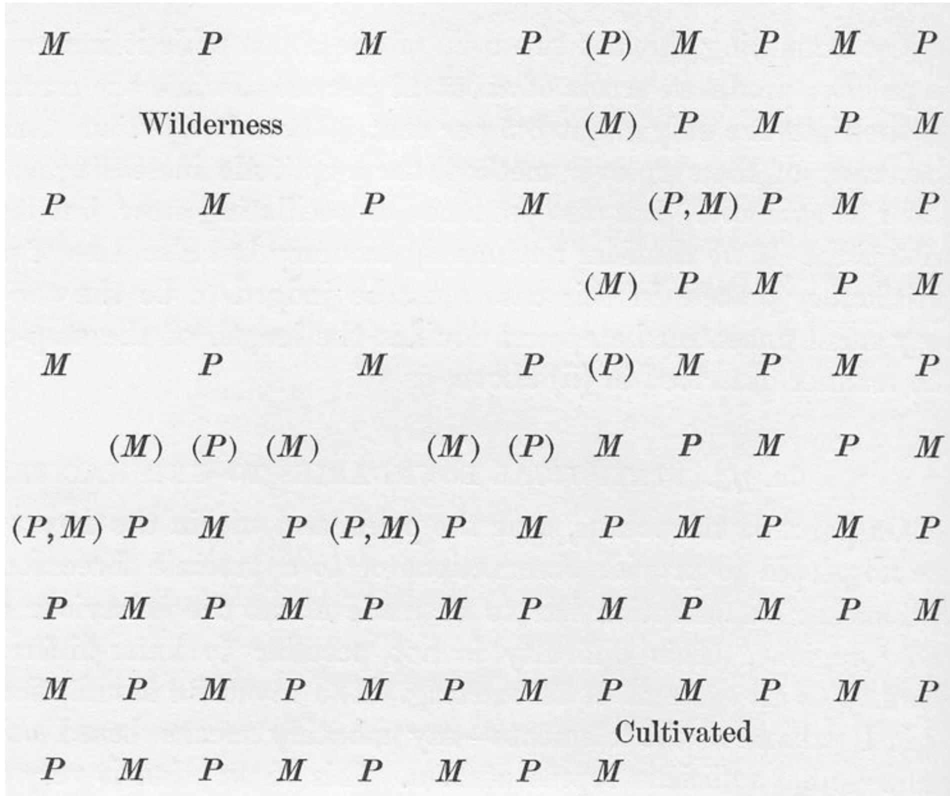
As the cyberneticists would later discover, the establishment of this kind of lattice or crystalline space requires the encapsulation and obfuscation of each individual crystalline cell, a technique that scientists call "black boxing." The phenomenon is quite evident in Richardson even though he was researching and writing several years prior to the invention of cybernetics proper. With each square represented by a single number located on the map at the coordinates of its center, the square is effectively black boxed. No subsquare information is necessary in Richardson's system. Once the lower bounds of the grid's granularity are determined, each cell essentially becomes an atom: uncuttable, impenetrable, and invisible. Its functionality is purely an outward relation to the lattice as a whole, never inward toward any kind of microcosm or interiority. In today's parlance, the cell has a "surface" or "interface" that may be read, yet any sort of deeper investigation beyond the interface is unnecessary.

Richardson proposed to test his system by way of pen and paper calculations. "Let us now illustrate and test the proposals of the foregoing chapters by applying them to a definite case supplied by Nature and measured in one of the most complete sets of observations on record" (181). His goal was to reproduce the same framework that was empirically measurable, or in his words, to enact a "lattice-reproducing process." "The initial data are arranged in a pattern which, by borrowing a term from crystallography, we may call a 'space-lattice.' Wherever in the lattice a pressure was given, there the numerical process must yield a pressure. And so for all the other meteorological elements. Such a numerical process will be referred to as a 'lattice-reproducing process'" (156). In this way, Richardson's "process" is a kind of writing system in which multiple cells are written in parallel based on a set of complex nonlinear computations. In essence, his goal was to inscribe, in parallel, a matrix framework that corresponds to actually observed measurements.

But Richardson was also aware that his lattice would necessarily be internally complex, that it would require bringing together heterogeneous elements. He referred to this as variations in the "density" of the lattice (fig. 4). Just as an open ocean or a remote wilderness would likely have fewer meteorological sensors, the grid in that zone would have to be spaced wider apart, whereas a heavily populated part of the land mass would have a surplus of sensors and therefore a tightly interwoven framework. Grid systems of course do not breed consistency and equality, as is often

Figure 4
Map showing weather pressure (P) and momentum (M) spanning the interface between a sparsely inhabited sector marked "wilderness" and a densely inhabited sector marked "cultivated."

Source: Richardson 154



erroneously thought. Grid systems are technologies of structured inequality. So, reflecting the so-called asymmetry principle of networks—the principle that networks are always internally asymmetrical—Richardson developed a technique for dealing with unequal density resolutions that by necessity must be "interfaced" or integrated into the same overall map. He called these thresholds "joints." Such joints must be established between the low resolution zones of the wilderness or the open ocean and the high resolution zones of the cultivated areas and the land masses (as opposed to the sea). This is not dissimilar to the way in which a digital communication network will interface high-volume "backbone" channels with low-volume "capillary" channels.

> *On parts of the oceans, near the poles, and within the desert tracts of land there are no people to provide observations or to appreciate forecasts. [. . .] [T]here are other portions of the globe, especially the seas, where some rough sort of forecast might be possible and desirable if it could be carried out with a much opener*

> *network than that in use where population is dense. But the two networks must be united on the computing forms in such a way that air, represented by numbers, can flow across the joint. (153)*[6]

The cybernetic hypothesis is thus already evident in Richardson's work in the 1920s: the atomistic arrangement of a system of cells; the interconnection of such cells into coordinated action (be it computational or otherwise); and the robust management of differing and heterogeneous densities across the system as a whole.

A Regular Discrete Framework

In early 1940, Warren Weaver and John von Neumann exchanged letters discussing a hypothetical invention that would use film photography to organize an archive of mathematical articles. The goal of the device was "the coding of mathematical literature and the application of a photographic high speed selection process to hunt out all of the mathematical literature bearing on a certain topic" (29 Mar. 1940). A run-of-the-mill digital humanities project by today's standards, Weaver's proposal was unusual for the time. Here is the device as envisioned by Weaver:

> *Suppose that someone has photographed, on very long strips of movie film,* abstracts *of all the mathematical articles which have appeared since, say, 1900. Each abstract might require one exposure of "frame" of the film; and in the margin of the film there would be recorded a complex code symbol which, according to some flexible system, characterizes the nature of the article. A research mathematician might be interested in locating all the articles which treat (or indirectly bear on) some certain topic. He appeals to the library or other organization which has the above-mentioned film record. This film is placed in a machine, the operator adjusts the machine so that it will select only those abstracts which (making use of the code symbols) treat of or bear on the topic in question. The film is run through this machine with extreme rapidity (1,000 frames or abstracts a second, say) and the machine automatically photographs these desired abstracts and passes the others by. Thus in an incredibly brief time each individual abstract is, so to speak, examined for its possible interest to this particular mathematician and problem, and the ones really of interest are photographed and delivered to the person making*

Figure 5
A hypothetical recreation of what Warren Weaver's "bibliographic aid in mathematical research" might have looked like.

Credit: Alexander R. Galloway

> *the inquiry. With this complete list of abstracts in his possession, it is presumed that he would look them up, if he is located near a suitably extensive library, or would make further use of film procedures by sending to some central bureau for photographic copies of the articles. (31 Jan. 1940)*

Weaver's proposal, which he mailed simultaneously to a number of colleagues in addition to von Neumann, predates by five years a similar device proposed by Vannevar Bush in a famous article from 1945.[7] The implications of Weaver's proposal are quite stunning. Both Weaver and von Neumann were influenced by what we might call the Turing paradigm for information machines, which is to say the notion that the best way to process data is by way of a long strip of tape fed through a central machine.[8] "What is an automaton in the Post-Turing sense? It is one of the proverbial 'black boxes' which has a finite number of states which we may number 1, 2, . . . , *n*. [. . .] The change [in state] takes place by an interaction with the world outside the automaton which is considered as being a tape" (Goldstine 274). Here the "tape" comes in the form of movie film (fig. 5). But while the strips of film were linear in nature, the user of such a device would be able to follow threads through the archive in a nonlinear fashion: the researcher "proceeds to follow this thread wherever it leads him," wrote Weaver in a follow-up note to von Neumann. "[T]his thread frequently cuts across all pre-existing lines of subject classification" (29 Mar. 1940).

Such microfiche databases had been proposed before, perhaps most vividly by Paul Otlet around the turn of the twentieth century. Otlet, a Belgian lawyer and the inventor of the universal decimal classification system (which he hoped would alleviate some of the shortcomings of Dewey's system), was an innovator in the area of library and archival science. A utopian and global thinker, Otlet organized the International Institute of Bibliography in 1895, which aimed to synthesize all the different systems that existed for classifying the printed word. "By 1900 there were some 17 million cards organized along the lines of Melvil Dewey's system [. . .] . By 1908 Otlet had floated the notion of a [*sic*] international central library, with support of some 200 organizations. By 1910 he had held the first meeting of the World Congress on Bibliography" (Katz 327).

Around that same period, circa 1906–7, Otlet developed, with Robert Goldschmidt, a "projected book" called the *bibliophote*, a coinage combining the terms *biblio* (book) and *photography* (Levie 107). As in the subsequent proposals by Weaver and Bush, Otlet's bibliophote was a system for photographing books and then reproducing them via projection. The technique of microphotography was already known at the time and had, in fact, been used during the siege of Paris in 1870, when thousands of letters were reproduced in miniature on film and sent via carrier pigeon, as depicted in a famous painting hanging in the Musée Carnavalet in Paris. Otlet's innovation was simply the scale of his ambition, as he sought to unify the totality of all human knowledge, photographed and filed and easy to access. With the bibliophote as building block and in a culmination of his life's work, having enlisted Le Corbusier as chief architect and Nobel Peace Prize laureate Henri La Fontaine as collaborator, Otlet launched an ambitious initiative in 1910 called the *Mundaneum*, which although never realized was designed as a home for all the world's knowledge, classified and archived inside a massive library facility to be located on the shores of Lake Geneva (fig. 6). "Humanity has arrived today at the stage of globalization," he pronounced (Otlet and Le Corbusier 2).

Weaver's own "digital humanities" project was of course much more modest in scale yet, at the same time, more immediately realizable. Contrary to the conventions of cinematic film production, which aims to fuse successive frames together in linear sequence to achieve the illusion of movement, Weaver's proposal leveraged the inherently digital nature of film's discrete framework of successive frames to assemble a miniature archive that could be processed rapidly by computer (see fig. 5). There was to be no mediatic continuity between each cell in Weaver's film; continuity was to be achieved in other ways, via the recombination of cellular units into

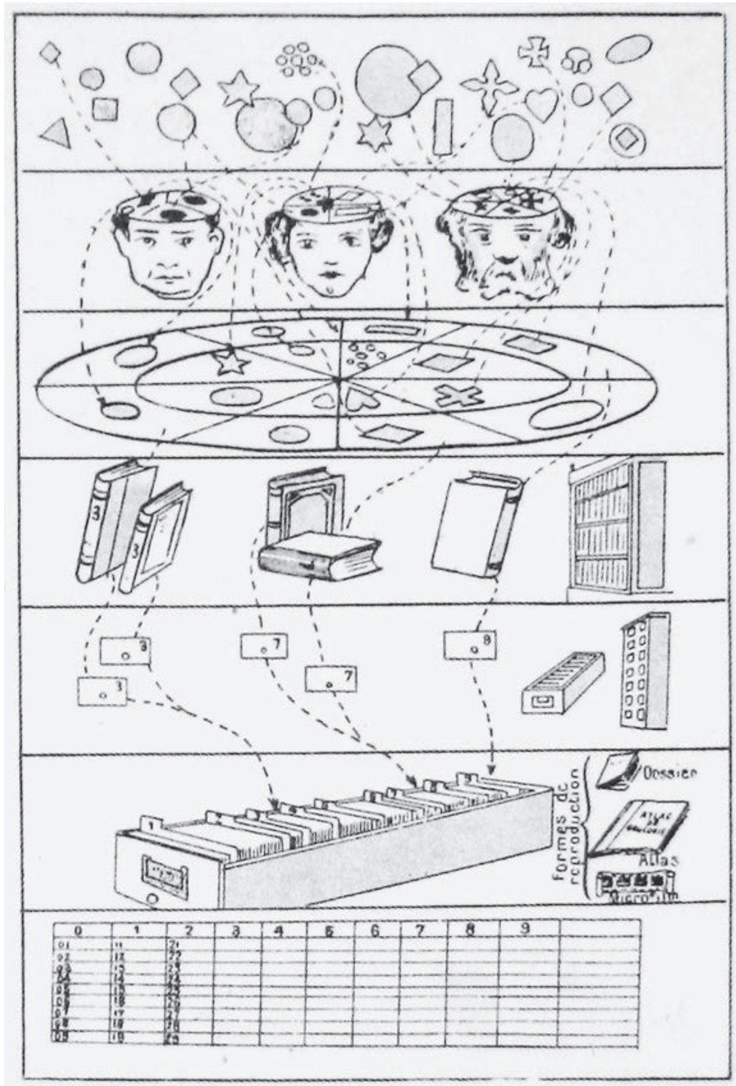


Figure 6
A hierarchy of systems of knowledge labeled (from top to bottom) things, intelligent beings, scientific knowledge, books, bibliographic catalogs, the encyclopedia, and classification.

Source: Otlet et al. 151

codified sequences and patterns. It was, shall we say, a kind of structural film *avant la lettre*. Recall the key features of Weaver's device:

- a database built from a cellular array consisting of one frame per text;
- a frame rate that was an order of magnitude more rapid than standardized cinematic projection;
- symbolic codes for addressing and classifying each entry in the cellular array;

- photography for storage, and rephotography for retrieval;[9]
- associative browsing of subject themes.

Weaver's "complex code symbols" are also notable. Guiding both the addressing and classification of each database entry, Weaver provided a kind of metalayer of pointers into this memory heap. One can assume that the system would have worked much like Herman Hollerith's tabulator and sorter, with binary holes designating different classification headings. All photographic cells marked with an appropriate dot in the "nonlinear differential equations" box would be rephotographed and returned in response to a query of that nature, and so on, just as Hollerith's punch cards contained boxes for the different census categories. So the logic of classification is also a logic of selection. Putting all this together, Weaver envisioned a device that would make it more efficient to locate material in the archive, that would assist the researcher in his or her inferences, that would open up inductive and associative pathways through information, and that would in fact be disruptive of existing classification systems, placing the individual intellect at the heart of the informatic system.

Weaver fretted over a few things. Could it be built? Would his peers want to use it? And, ultimately more important, how could a coding scheme be flexible enough to describe all the nuances of each article accurately? How could stored articles be made forward compatible if the coding schema ever needed to be updated? The solution was found in the coding scheme itself: he advised von Neumann to use "at least 12" symbols, because that amount of combinatory latitude would certainly afford "a complete functional characterization" of the text in question (31 Jan. 1940).

Although Weaver's "bibliographic aid" was never built, it stands as a useful signpost for the new media systems being invented during and after World War II. It aggregates a whole series of techniques and approaches that would rise in importance in the second half of the twentieth century. Summarizing from this brief discussion of Richardson, Weaver, von Neumann, and Otlet, these techniques and approaches include:

- an epistemology rooted in arrays or systems containing discrete entities;
- the division of each entity into system and subsystem, in which the subsystem is encapsulated and obfuscated (or "black boxed");
- the opening of specific codified interfaces for each entity;
- the superimposition of a mediative layer to interconnect each entity in the system (via the entity's interface);

- the regularization of difference or asymmetry within the apparatus itself, be it semiotic asymmetry (index/content) or functional symmetry (command/execution).

These are some of the characteristics of the cybernetic hypothesis. The historical examples just offered are certainly not the only stories that could be told. They should not supplant existing histories and genealogies of cybernetic society or preclude newer discoveries from being made. I offer them as short historical snapshots of the general regime of the cybernetic hypothesis, as a way both to widen the historical window beyond the conventional locus of 1947–48 and to introduce a set of references that explicitly ties the cybernetic hypothesis to contemporary literary and humanities research. In other words, I view the cybernetic hypothesis not as a more or less neutral development merely limited to a few small scientific fields, but as a broad social and cultural ethos with influence across a number of fields and practices. From this perspective, recent developments in digital humanities appear not so much as radical or bold new innovations, but as a natural evolution stemming from several decades of historical momentum, a final period at the end of a very long sentence.

Problems and Proposals

The debate over digital humanities is thus properly framed as a debate not simply over this or that research methodology but over a general regime of knowledge going back several decades at least. Given what we have established thus far—that digital methods are at best a benign part of the zeitgeist and at worst a promulgation of late twentieth-century computationalism—let me end by itemizing a series of problems and challenges that anyone partaking in digital methods must consider.

Hegemony, Recapitulation, and Symmetry

Given the hegemonic status of computers in contemporary life—a position endorsed by everyone from Kevin Kelly and Thomas Friedman to Manuel Castells and Michael Hardt and Antonio Negri—to propose computer-centric research methodologies is to propose that the humanities follow a trend toward normalization with the dominant rather than of differentiation from it. This will present a problem to certain intellectual endeavors that value deviation over normalization, heterodoxy over orthodoxy.

Moreover, the problem of hegemony is not simply limited to a hierarchy of domination and subordination. It also implicates the types of utterances that are made within such a hierarchy, particularly whether or not certain claims about knowledge or reality are recapitulative or critical of the hegemonic position. The nature and role of criticism is at the heart of contemporary debates over the digital humanities, as many wonder if criticism is still necessary and interpretation still valid. It is thus obligatory to identify the changing fortunes of critique as a specific shift in the relative value of recapitulative versus contestational claims.

Given the problems of hegemony and recapitulation, we must also ask whether the role of humanities research is to be a symmetrical mirror of trends in larger society or an asymmetrical rethinking of those larger trends. When the social and economic infrastructure is structured in such and such a way, is it the role of humanities researchers to redesign their discipline so that it is symmetrical with that infrastructure? Google views society as a network of value-producing agents (whose unpaid labor generates immense profits); is it, then, the role of university English departments also to propose that society is a network of value-producing agents? Object-oriented computer languages propose that entities can be abstracted into "objects" with codified interfaces that perform certain measurable functions; is it, then, necessary for literary researchers to view novels or poems as objects with codified interfaces that perform certain measurable functions? The issue here is not simply recapitulation (speaking the same or speaking different), but a structure of symmetry versus asymmetry (the propagation and extension of regular structure).

Whether or not critique remains viable, we must still ponder the original Kantian question: is thought as such dictated by the regularity of an inherited structure, or is thought only possible by virtue of an asymmetrical and autopositional posture vis-à-vis the object of contemplation? Having inherited the computer, are we obligated to think with it?

Ideology, Deskilling, and Proletarianization

A second cluster of terms reveals a different challenge faced by the digital humanities. Call it the *Zuhandenheit* problem: we live within the cybernetic universe without necessarily being conscious of it and we use these digital tools without necessarily reflecting on them. Of course, the naturalization of tools can be good and useful in certain contexts, and literature and art are admittedly inseparable from *techne* at a more fundamental level. But the naturalization of technology has reached unprecedented levels with the advent of digital machines. Nature likes to hide itself, and it's no different with computers. One must be dispassionate about this infrastructure of obfuscation, identifying when and how it is beneficial and when and how it is not.

Ever since Kant and Marx inaugurated the modern regime of critical thought, a single notion has united the various discussions around criticality: critique is foe to ideology (or, in Kant's case, not so much ideology as dogma). Hence a new challenge to the digital humanities: if there is indeed an increase in naturalization and a corresponding decrease in criticality, does this entail a concomitant rise in the power of ideology? Digital methods tend to naturalize the process of data discovery. Do they also at the same time embolden an ideological infrastructure?

Yet, beyond these more heady inquiries into the relative validity of knowledge, a more prosaic challenge also appears: the deskilling problem, or what Best and Marcus call the "minimization of agency" (17). The digital humanities assume certain things about human subjects. While seeming to embed scholars and students more firmly in data, digital tools tend to do the opposite. Highly codified interfaces reduce the spectrum of possible input to a few keywords or algorithmic parameters. Those who were formerly scholars or experts in a certain area are now recast as mere tool users beholden to the affordances of the tool—while students spend ever more time mastering menus and buttons, becoming literate in a digital device rather than a literary corpus.

Thus while Best and Marcus praise the minimization of agency—a spectacular reversal from the 1980s and 1990s when agency was all the rage in theoretical circles—we might be wise to acknowledge the "dark side" of a dissipated human agency. Low-agency scholars are deskilled scholars, proletarianized thinkers denuded of their authority to make claims (at least claims that haven't been culled directly from a measurement device). Low-agency scholars are adjunct workers with precarious economic roles to play in the university, their standing diminished relative to the increased power of academic administrators, presidents, chancellors, and trustees. Critique is foe to ideology, but, particularly in Marx's case, critique is also a necessary technique for revealing the conditions of proletarianization. As the Marxist tradition has persuasively demonstrated, capital itself thrives most when the proletariat identifies positively with the very structure of its own debasement.[10] Thus the tools and trinkets we find so seductive, digital or otherwise, are the same devices that fragment and reorganize social life around specific economic mandates.

What I hope to suggest with these challenges and provocations is not so much a doom and gloom view of digital humanities, but rather a sober assessment of the problems faced by the academy and a view, provisional at best, of the kinds of solutions that might be possible. Scholars must make their own assessments of the challenges posed by digital humanities. How does the advent of the computer change humanistic research? How will it be possible to use computers while avoiding the difficulties just itemized, the epistemological challenges around hegemony, recapitulation, and symmetry and the more political challenges of ideology, deskilling, and proletarianization? Speaking as a programmer who has been writing and releasing software for several years both within and without the research context, I hope to ally myself with those innovating technical research methods, as they exist now and as they might exist in the future. Personally, my own efforts have followed a multimodal strategy of producing academic writing concurrent with software production, the goal of which being not to quarantine criticality, but rather to *unify* critical theory and digital media around the technique of allegory. Others will find an approach that is most appropriate to them.

This is not to advocate for some kind of rote digitization of the humanities, not to say that every child must be given a laptop. Few things will cripple the humanities more than the uncritical "adoption of tools" or the continued encroachment of positivistic research methods borrowed from cognitive science, neuroscience, computer science, or elsewhere. One should be very skeptical of the Googlization of the academy.[11]

Rather, we might follow the lead of someone like Richard Rogers, with his Digital Methods research initiative, or the pioneering research techniques invented by artists like Natalie Jeremijenko or Trevor Paglen. These and other approaches exhibit the kind of creativity and care necessary for understanding and responding to the growing industrialization of mind and body.

As humanist scholars in the liberal arts, are we outgunned and outclassed by capital? Indeed we are—now more than ever. Yet as humanists we have access to something more important. We have access to what François Laruelle calls the "weak force" of persons in their generic humanity. The goal, then, is not to challenge the data miners at their own game, for we will always be underfunded and understaffed. The point is to withdraw from the game altogether and continue to pursue the very questions that technoscience has always bungled, beholden as it is to specific ideological and industrial mandates. The weak force grants us access to the generic commonality of history and society and the various aesthetic and cultural phenomena that not only populate this history but, as its flesh and blood, are history itself.

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Notes

1 For three spectacular yet rather different testimonials to this effect see Boltanski and Chiapello; Fraser; Liu, *Laws*.

2 A number of accounts have helped fill out this history, including Geoghegan; Turner.

3 For some of the basic contours of this debate, itself complex and divergent, see Best and Marcus; Latour; Love. The various discussions around "close reading," "distant reading," "surface reading," and "descriptive reading" also clash and intermingle with the existing art historical discourse on close viewing and distant viewing, or what Aloïs Riegl called the tactile and optical qualities of art.

4 Norbert Wiener's landmark text, *Cybernetics: Or Control and Communication in the Animal and the Machine*, was originally published in 1948.

5 Richardson elaborates:

> *It is desirable to have one conventional dividing surface at or near the natural boundary between the stratosphere and troposphere [. . .]. Secondly, that to represent the convergence of currents at the bottom of a cyclone and the divergence at the top, the troposphere must be divided into at least two layers. Thirdly, that the lowest kilometre is distinguished from all the others by the disturbance due to the ground. Thus it appears desirable to divide the atmosphere into not less than 4 layers. (16–17)*

6 Richardson even goes so far as to work out the numbers for an optimal interface between these two unequal networks. "It is seen that the ninefold reduction gives a neater joint than the fourfold, in the sense that the latter involves more interpolations" (153). By experimenting with a ninefold or fourfold reduction, Richardson was discovering what numbers would fit best, in order to avoid "a violent change in the lattice" (155). Nevertheless, it should be noted that he was not advocating an overall reduction in the disparity of cellular density between differently classified zones. Thus the asymmetry principle that governs networked relations is demonstrated even here in embryonic form.

7 One might also compare Weaver's device to the so-called Zuse palimpsest, the film stock used by Konrad Zuse to encode binary data for his z3 computer, completed in 1941. As Zuse recounts, "During the war I couldn't get ordinary commercial punched-tape machines, which were then already in use in the telephone business for 5-track punched tape. I built my own punching and reading devices and used normal film-strips—[Helmut] Schreyer's idea. They were punched with a simple manual keypunch" (63). Of course

Zuse's filmstrips had no direct relationship to photography or cinema; the image on the filmstrip was unimportant, a mere trace of the medium's former life.

8 Such a paradigm has a much longer history, by way of Joseph Marie Jacquard's industrial weaving system at the dawn of the nineteenth century, which featured a strip of digitally encoded input (the "software") feeding into a central processing device (the "hardware"). Likewise, even Jacquard's loom had important antecedents in other looms made by Brösel circa 1680, Basile Bouchon in 1725, Jean Philippe Falcon in 1734, and other kinds of devices either built or proposed by Jacques de Vaucanson in 1750, not to mention some of the musical devices in Athanasius Kircher's *Musurgia Universalis* (1650).

9 The use of rephotography for retrieval might sound odd, yet in the 1940s, there were essentially no printers in existence, at least not as we think of them today. A common technique for "printing" on early computers was to take a photograph of the computer's oscilloscope screen, assuming it had a screen at all, and then develop the photograph. So Weaver's suggestion that the "search results" would be rephotographed is in keeping with the media conventions of the time.

10 Jameson's "Reification and Utopia in Mass Culture" is an important touchstone in such a tradition.

11 My home institution, New York University, announced an agreement with Google in the fall of 2010 that migrated much of the university's data flow to Google Apps for Education, including e-mail, calendaring, document sharing, and collaboration tools. The recent revelation that Google has for several years been sharing its data stream with the National Security Agency only adds to the moral complexities of this type of industrial outsourcing.

Works Cited

Best, Stephen, and Sharon Marcus. "Surface Reading: An Introduction." *Representations* 108 (2009): 1–21.

Boltanski, Luc, and Ève Chiapello. *The New Spirit of Capitalism*. Trans. Gregory Elliott. London: Verso, 2005.

Bush, Vannevar. "As We May Think." *Atlantic Monthly* July 1945: 101–8.

Fraser, Nancy. *Fortunes of Feminism: From State-Managed Capitalism to Neoliberal Crisis*. London: Verso, 2013.

Geoghegan, Bernard Dionysius. "From Information Theory to French Theory: Jakobson, Lévi-Strauss, and the Cybernetic Apparatus." *Critical Inquiry* 38 (2011): 96–126.

Goldstine, Herman. *The Computer from Pascal to von Neumann*. Princeton: Princeton UP, 1972.

Goldstine, Herman, and John von Neumann. "Planning and Coding Problems for an Electronic Computing Instrument, Part II, Volume 1." *Papers of John von Neumann on Computing and Computer Theory*. Ed. William Aspray and Arthur Burks. Cambridge: MIT P, 1987. 151–222.

Hayles, N. Katherine. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago: U of Chicago P, 1999.

Jameson, Fredric. "Reification and Utopia in Mass Culture." *Signatures of the Visible*. New York: Routledge, 1992. 9–34.

Katz, Bill. *Cuneiform to Computer: A History of Reference Sources*. London: Scarecrow, 1998.

Kay, Lily. *Who Wrote the Book of Life? A History of the Genetic Code*. Stanford: Stanford UP, 2000.

Kircher, Athanasius. *Musurgia Universalis*. Rome, 1650.

Laruelle, François. *Introduction aux sciences génériques*. Paris: Pétra, 2008.

Latour, Bruno. "Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern." *Critical Inquiry* 30.2 (Winter 2004): 225–48.

Levie, Françoise. *L'Homme qui voulait classer le monde: Paul Otlet et le Mundaneum*. Bruxelles: Impressions Nouvelles, 2006.

Liu, Alan. *The Laws of Cool: Knowledge Work and the Culture of Information*. Chicago: U of Chicago P, 2004.

———. "The Meaning of the Digital Humanities." PMLA 128.2 (2013): 409–23.

Love, Heather. "Close but Not Deep: Literary Ethics and the Descriptive Turn." *New Literary History* 41 (2010): 371–91.

Moretti, Franco. *Distant Reading*. London: Verso, 2013.

Otlet, Paul, and Le Corbusier. *Mundaneum*. Brussels: Union des Associations Internationales, 1928.

Otlet, Paul, et al. *Cent ans de l'Office international de bibliographie: 1895–1995*. Mons: Mundaneum, 1995.

Richardson, Lewis. *Weather Prediction by Numerical Process*. Cambridge: Cambridge UP, 1922.

Riegl, Aloïs. *Late Roman Art Industry*. Trans. Rolf Winkes. Rome: Bretschneider, 1985.

Rogers, Richard. *Digital Methods*. Cambridge: MIT P, 2013.

Shannon, Claude, and Warren Weaver. *The Mathematical Theory of Communication*. Champaign: U of Illinois P, 1971.

Tiqqun. "L'Hypothèse cybernétique." *Tiqqun* 2 (2001): 40–83.

Turing, Alan. "On Computable Numbers, with an Application to the *Entscheidungsproblem*." *Proceedings of the London Mathematical Society* 42 (1937): 230–65.

Turner, Fred. *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*. Chicago: U of Chicago P, 2008.

Weaver, Warren. Letter to John von Neumann. 31 Jan. 1940. MS. John von Neumann Papers. Library of Congress, Washington, DC.

———. Letter to John von Neumann. 29 Mar. 1940. MS. John von Neumann Papers. Library of Congress, Washington, DC.

Weed, Elizabeth. "The Way We Read Now." *History of the Present: A Journal of Critical History* 2.1 (2012): 95–106.

Wiener, Norbert. *Cybernetics: Or Control and Communication in the Animal and the Machine*. Cambridge: MIT P, 1965.

Zuse, Konrad. *The Computer—My Life*. Berlin: Springer, 1984.