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In the tragedy *Agamemnon* Aeschylus describes two types of networks. The first, an actual communications network, is described in detail but remains off stage. The second, a meshwork of traps, while visible and present is but a symbol of larger machinations. The communications network is a chain of fire beacons, spanning a few hundred miles, that carries the message of the fall of Troy back to Argos, thus warning of the victor Agamemnon's imminent homecoming. "Ida first launched his blazing beam; thence to this place / Beacon lit beacon in relays of flame" (281–83), Clytemnestra explains, describing each of the dozen nodes in the overland chain.[1] "They blazed in turn, kindling their pile of withered heath, / And passed the signal on" (294–95). But later, upon the return of Agamemnon to his hearth, a second net is deployed, this one a "vast voluminous net" (1382) used by Clytemnestra to ensnare her husband and bring about his ruin. This voluminous net, later decried by the chorus as a "foul spider's web" (1492) finds form in a symbol: the sea of purple textile created by Clytemnestra and her weavers to adorn the threshold of the house, upon which Agamemnon is eventually convinced to tread, against his better judgment.[2] With that silken step Agamemnon is, as Aegisthus gloats in the final lines of the play, "tangled in a net the avenging Furies wove" (1580), his fate at Clytemnestra's bloody hands all but sealed. Sensing that her wait is nearly over, the coy betrayer entices Agamemnon with mock concern:

> Why, if my lord received as many wounds as Rumour,
> Plying from Troy to Argos, gave him, he is a net,
> All holes! (866–68)

Indeed, the image of the hero as netting, materializes in the play's final scenes as Agamemnon's body is perforated three times. Before it is recounted by Clytemnestra, the murder, and the weaponized net necessary for its consummation, is foreseen by Cassandra:

There, there! O terror! What is this new sight?
A hunting-net, Death's weapon of attack!
And she who hunts is she who shared his bed. (1114–16)

Networks thus oscillate between two related but incompatible formal structures. On one side, the chain of triumph; on the other, the web of ruin.

In *Agamemnon* the chain of triumph is linear, efficient, and functional. It is contagious and additive as it moves. The lighting of one hilltop beacon does not dim or dilute the previous node but effectively compounds it. The chain of triumph is communicative and telepresent. It is directional. It follows a chain of command. It is constitutive of reality rather than destructive of it. And perhaps most evocative: the chain of triumph is made of pure energy. It is Iris and Hermes combined.

The web of ruin is none of these things. It is a nonlinear mesh, not a linear chain, designed to ensnare and delimit even the most intractable opponent. It is commonly characterized as a swarm, or a pack of animals, unknowable in quality and innumerable in form. The divine referent is not Iris or Hermes but the Furies. Less concerned with connectivity, the web brings with it a flood of insatiable persecution. This net is not a tonic, tethering together distant elements, but a solvent set on dissolving those ties. It follows the network of fire beacons, and the web undoes the chain. Only Clytemnestra's net can trap Ilium's conqueror, eviscerating the house of Atreus.

In *Agamemnon*, the first play of Aeschylus's Orestes trilogy, the Furies are mentioned only in passing. In the third play, *The Eumenides*, the Furies saturate the narrative so fully that they are personified in the chorus, an actual character but one that can only be represented by a multiplicity of bodies. What were three in Virgil are twelve in Aeschylus (in Euripides they are fifteen). In tragedy the chorus is generally a signifier for the social community. It is not a synonym for "the masses" or "the people" but simply "the group." This makes *The Eumenides* unusual, for what were stern, scolding elders in *Agamemnon* and clamoring female maidservants in the second play, *The Libation Bearers*, have in the third devolved into a personification of vengeance itself, but in a divine, which is to say nonhuman, form. This is no longer the "group" but the swarm. The web of ruin, symbolized in the first two plays by Clytemnestra's textiles—her weaponized nets and sea of purple fabric, but also the tentacles of fabric forming the straightjacket-like robe used to subdue Agamemnon (what Orestes in *The Libation Bearers* calls "a trap, not of iron, but of thread"; 493)—this web of ruin is no longer a symbol but an incarnation of networked presence itself. The Furies are the web of ruin personified.

Hermes (as the chain of triumph) appears in *The Eumenides* too, if only for an instant, shepherding Orestes in his travel from Delphi to Athens. So while Athena and the concept of justice dominate the final play, the Furies indicate the lingering threat of networked forms of being (if not networked vengeance).

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I begin this discussion of networks with classical texts for several reasons. The first is to introduce, from the foundations of Western literature, the two tropes of the chain of triumph and the web of ruin, which are helpful for understanding the power of networks both then and now. The second is to put in question, at the outset, the assumption that networks are exclusively endemic to the late twentieth and early twenty-first centuries and, more pointedly, that networks are somehow synonymous with the technologies of modernity or postmodernity, such as the telegraph or the Internet.

The third reason is to broach the question of the internal inconsistency or inequity of the network form (what contemporary network theorists call the "power law," or nonrandom, distribution of network assets such as links). There are many kinds of networks; they are not internally simple, nor globally uniform. Some networks are rigid and hierarchical, while others are flexible and resist hierarchy. Some networks, like the chain of triumph, tend to create order; others, like the web of ruin, to dissolve it. In the hands of the American military, networks are classified not only as communications tools but as weapons systems, while in the hands of antiglobalization activists, networks are mobilized as tools for disruption and evasion. Thus, I mean to point out the differences between different kinds of networks, both in their architectonic shape and in their values and motivations, but also to point out that different network forms might be in conflict with one another and, indeed, might be specifically derived to exploit or disrupt other network forms (just as terrorist networks exploit global networks of travel, mobile communications, and mass media). "It is worth recalling at this point," wrote Michel Foucault, "the old Greek adage, that arithmetic should be taught in democracies, for it teaches relations of equality, but that geometry alone should be reserved for oligarchies, as it demonstrates the proportions within inequality." Hence we should remember that the networks described by graph theory, the topological cousin of geometry, are not at all immune to questions of internal inconsistency or inequity.[3]

A final reason is to define networks not as abstract concepts describing shape or structure, but as specific technologies of power, organization, and control. Admittedly my opening citations are literary in nature, but the networks described in Aeschylus (the chain of hilltop beacons, the hunter's net) are concrete, material technologies. And in each case the networks in question, be they chains of triumph or webs of ruin, are the material bearers of power as it appears in the world. Nets are tools for hunting and fishing, but they are also weapons used in warfare alongside the shield and the bow. This is crucial to one's present understanding—that networks are often symbols for, or actual embodiments of, real world power and control. So as tropes the chain of triumph and the web of ruin do not constitute a holistic theory of networks but rather two windows into the various forms of networked organization, both structural and political.

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The English term *network* is a compound formed from the Old Saxon words *net*, an open-weave fabric used for catching or confining animals or objects, and *werk*, both an act of doing and the structure or thing resulting from the act. (In Aeschylus the term is *diktyon* [διχτυον], a network, system, or grid.) In media studies the term appears most often in analyses of communications technologies. In this context, networks refer to broadcast technologies for creation and distribution such as radio and television networks, telecommunication technologies such as telegraph and telephone networks, and information processing and transfer systems such as the Internet. Networks are significant, too, in material and industrial systems (logistical networks for commodity flows, transportation networks of various kinds), the biological and life sciences (ecology, neuroscience, genetics), and several branches of mathematics (graph theory, topology). In the social sciences and humanities, sociology and anthropology study networks in social and cultural contexts, and economics in the analysis of markets, while fields such as semiotics view language and culture as complex networks of meaning-making and exchange.

Certain connotative assumptions tie together these many different uses of the term. First, networks are understood as systems of interconnectivity. More than simply an aggregation of parts, they must hold those parts in constant relation. Thus a forest is not a network, but a forest's *ecosystem* is. A population is not in itself a network, but a population engaged in a market economy may well be. Second, networks assume a certain level of complexity. Simple systems are almost never understood as networks, but it is almost programmatic that complex systems—protein signaling inside cells, flows of global capital—be characterized as such. Thus it is no wonder that networks often serve as allegorical indices for many different types of complex systems in the contemporary landscape.

In addition to the classical tradition mentioned at the outset there exists a constellation of influences from modern science and philosophy that inform today's cybernetic, networked environment. "If I were to choose a patron saint for cybernetics out of the history of science, I should have to choose Leibniz," wrote Norbert Wiener, the MIT mathematician and defense researcher (1965, 12). Indeed from the early modern period both Leibniz and Spinoza articulate prototypical approximations of machinic and networklike arrangements. Leibniz, with his *Monadology*, describes a smooth, universal network of "monads," each of which is singular but contains within itself a mirror of the totality. In the *Ethics* Spinoza identifies a universal substance, from whose infinite attributes thought and extension emerge to form the human body. The affections of the human body superimpose onto substance a distributed network of relations and counterrelations, a theory further developed by the French philosopher Gilles Deleuze. In the twentieth century Ludwig von Bertalanffy, with the science of general systems theory, and Wiener, with the science of cybernetics, helped describe open and closed systems, how subsystems are nested within systems, and how communication and control pass from one part of a system to another. In roughly the same period Claude Shannon and Warren Weaver put forth their information theory which defined communication in terms not solely of semantics but of the relative integrity of symbolic patterns and the amount of unpredictability contained in the languages used to construct those patterns (see chapter 11, "Information"). In mathematics, graph theory is also a key influence. It provides a vocabulary for understanding networks, known simply as graphs, as groups of nodes and links.

Cybernetic systems are essentially communication networks in which information may pass between system components, effecting their ongoing states. Wiener's influential book *Cybernetics, or Control and Communication in the Animal and the Machine*, looked across disciplines—from electrical engineering to neurophysiology—and suggested that human, animal, and mechanical systems were united in their ability to handle input and output data in the ongoing management of the system (see chapter 10, "Cybernetics"). A central aspect to such cybernetic systems was feedback, which implied a degree of self-reflexivity in any web of relationships.[4] Information, for Wiener, is a statistical choice from among the "noise" of the surrounding world, and as such it implies an apparatus with the ability to instantiate the very act of choice or selection.[5] Wiener refers to this ability as "control by informative feedback." Like Aeschylus's chain of triumph, networks in Wiener are always efficient and directed. They are machinic in nature and act to better integrate complex assemblies of bodies and technologies into functional, systemic wholes.

Wiener formed the term *cybernetic* from the Greek word *kubernetes*, or "steersman," alluding also to the nineteenth-century writings of Clerk Maxwell on "governors" which he suggests is a Latin corruption of the same Greek term.

While Wiener was doing cybernetic research on antiaircraft ballistics, his colleague Claude Shannon was doing telecommunications research for Bell Labs. Much of Shannon's work with Warren Weaver is acknowledged as the foundation for modern telecommunications networks, and can be said to have paved the way for the idea of the ARPAnet in the late 1960s. Shannon's work, while much less interdisciplinary than Wiener's, resonated with cybernetics in its effort to define "information" as the key component of communications technologies (indeed, Wiener cites Shannon's work directly). Shannon and Weaver's information theory emphasized the quantitative view of information, even at the expense of considerations of quality or content. As they state, "information must not be confused with meaning. In fact, two messages, one of which is heavily loaded with meaning and the other which is pure nonsense, can be exactly equivalent, from the present viewpoint, as regards information" (1963, 8). Such a hard-nosed technical view can still be seen today in the Internet's implementation of packet-switching, in which chunks of data are fragmented and routed to destination addresses. While these data packets can be interpreted to reveal content, the technical functioning has as its implicit priority the delivery of quantity X from point A to point B.

If both cybernetics (Wiener) and information theory (Shannon) imply a quantitative, statistical view of information networks, a third contemporaneous approach offers a slight alternative. Trained as a biologist, Ludwig von Bertalanffy developed a "general systems theory" that differs significantly from the views of Wiener or Shannon (see chapter 9, "Communication"). Wiener viewed human, animal, and mechanical systems together from an electrical engineering perspective, while Shannon viewed human users as separate from the communications technologies they used. By contrast, von Bertalanffy stressed the view of human or technological systems from a biological standpoint. In doing so, he elaborated theoretical distinctions between open and closed systems and showed how subsystems are always nested within larger systems (a model that would be adopted wholesale in the layered construction of Internet protocols). As he states:

> The organism is not a static system closed to the outside and always containing the identical components; it is an open system in a quasi-steady state, maintained constant in its mass relations in a continuous change

> of component material and energies, in which material continually enters from, and leaves into, the outside environment. (1976, 121)

This view has several consequences. One is that while von Bertalanffy does have a definition of "information," it plays much less of a role in the overall regulation of the system than other factors. Information is central to any living network, but it is nothing without an overall logic for utilizing it as a resource. In other words, the logics for the handling of information are just as important as the idea of information itself.

Another consequence is that von Bertalanffy's systems theory, in its organicist outlook, provides a means of understanding information in biological terms, rather than those of engineering or communications. This is not to suggest that systems theory is in any way more accurate or successful than the theories of Wiener or Shannon. But what the genealogies of cybernetics, information theory, and systems theory do show is that an informatic worldview entails an ambivalent relation to the material world. On the one hand, information is seen as abstract, quantitative, reducible to a calculus of management and regulation—this is the disembodied, immaterial conception referred to above. On the other hand, cybernetics, information theory, and systems theory all show how information is immanently material, configured into military technology, communications media, and even biological systems.

The preponderance of scientific literature on cybernetic interconnectivity and associative systems outlined here, coupled with the emergence of the World Wide Web (a specific set of networking technologies including the HyperText Transfer Protocol [HTTP] and HyperText Markup Language [HTML] developed by Tim Berners-Lee in 1990–1991), resulted in an explosion of both popular and academic writing on the subject in the mid-1990s. This bookshelf includes what Geert Lovink calls "the libertarian values of pre-dotcom Internet pioneers"—Richard Barbrook's critique of the "Californian Ideology," Mark Dery's hallucinatory reportage, John Perry Barlow's "Declaration of the Independence of Cyberspace," and Eben Moglen's "dotCommunist Manifesto"— but also everything from popular books on chaos and complexity in the information economy (Kevin Kelly, Esther Dyson, Ray Kurzweil, Nicholas Negroponte), to theories of emergence and self-organization (Steven Johnson, Manuel DeLanda), to theories of the virtual (Pierre Lévy, Mark Poster, Brian Massumi), and cyber law (Lawrence Lessig, Yochai Benkler).[6] Influenced by cultural studies, critical theory, and science and technology studies, scholars such as Espen Aarseth, Jay Bolter, Wendy Hui Kyong Chun, Richard Grusin, Marina Grzinic, Donna Haraway, Katherine Hayles, Lev Manovich, Lisa Nakamura, Sadie Plant, Allucquère Rosanne Stone, and

Sherry Turkle have written about networks from the perspective of online identity formation, nonlinearity and interactivity, network aesthetics, hermeneutics, and the social uses of software.[7] Another influential discourse achieving prominence in this period comes at the intersection of social network theory, graph theory, and topology. With its roots in Leonhard Euler's 1736 proof of the insolvability of the "seven bridges of Königsberg" puzzle and the "small world" experiments of twentieth-century psychologist Stanley Milgram, contemporary debates in social network theory address issues such as network growth and topological change, the random or nonrandom distribution of links across networks, and the clustering and interconnectedness of network subgroups.[8]

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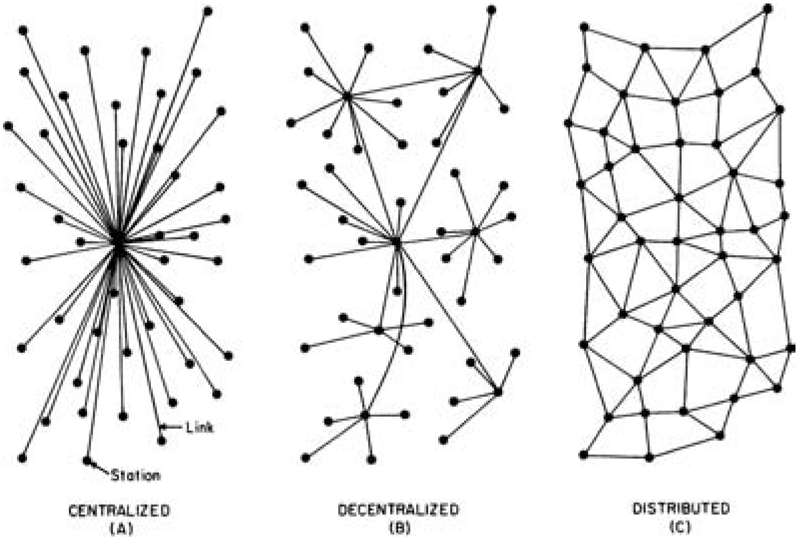
While networks and discourse on networks are not new, what distinguishes the present moment may be that normative claims about different network architectures and their internecine struggles have reversed themselves. If the old scenario was one in which the web of ruin, in the form of the distributed network, was perceived as a solvent or threat vis-à-vis more centralized control (i.e., the notion that the Orestes trilogy is fundamentally about Athenian justice), then the new scenario is one in which the web is perceived as entirely vital, even necessary. One is witnessing, as Peter Galison succinctly puts it, a "war against the center."[9] The web of ruin has finally outclassed the chain of triumph. Today the Furies are the operative divinity, not Iris or Hermes. This is the case across the board, for hegemonic forces but also for more progressive political movements. One might speak of the new social movements of the 1960s and their decentralized structures, what Jo Freeman so interestingly assessed in her 1970 essay "The Tyranny of Structurelessness."[10] But in the same breath one must admit that the Hardt-Negrian notion of empire—"a dynamic and flexible systemic structure that is articulated horizontally"—is formally identical to the very movements intent on abolishing it.[11] "We're tired of trees," wrote Deleuze and Guattari. But it did not take long for those same words to be spoken in the highest echelons of the transnationals, or behind the closed doors of the Pentagon, or deep within other former bastions of pyramidal hierarchy.

The "war against the center" is, indeed, evident in a variety of milieus worth sketching out here in greater resolution. In doing so, however, it is imperative that any critical appraisal of the Web or of networks remain dissatisfied with making speculative, "broadband" claims, what Lovink calls the unfortunate quest for a General Network Theory (a quest I myself have no doubt pursued). Thus it is necessary to delve into some of the more technical and historical details implicit in the trope of the web of ruin. By this I mean the assumption that, following Clytemnestra's model, networks have the potential to dehierarchize, disrupt, and dissolve rigid structures of all varieties. This thread runs from Hans Magnus Enzensberger's chart of emancipated versus repressive media, to Deleuze and Guattari's "rhizome," to Galison and his "war against the center" (or, essentially, against centralized networks), and even to RAND researchers John Arquilla and David Ronfeldt and their theory of "netwar."[12] All these thinkers adopt the Clytemnestra model; they assume that networks exist in an antagonistic relationship to authority, that networks are the sole form of organization that can possibly threaten entrenched, fortified power centers.

This trend was articulated distinctly in the 1960s by Paul Baran (1964), who conceived of the distributed network, an extremely complex network topology that contains within it a curious synthesis of both the web of ruin and the chain of triumph. The distributed or "mesh" network is spread out horizontally with a large number of links connecting all nodes. No single node acts as master of the network. Each node making local decisions about network topology and message sending, thus spreading organization and control is integrated broadly across the entire mesh. Baran contrasted the distributed network from the centralized or "star" network, which is characterized by a singular hub with a number of branches extending to peripheral nodes. A third form, the decentralized network, is a mixture of the first two: it combines a number of hierarchical star subnetworks, the hubs of which are interconnected via backbone links into a larger amalgam. The distributed network, distinct from its centralized and decentralized cousins, is a specific architecture characterized by equity between nodes, bidirectional links, a high degree of redundancy, and a general lack of internal hierarchy.

For sending messages, Baran's distributed network relies on a technology called packet-switching, which allows messages to break themselves into small fragments. Each fragment, or packet, then finds its own way to its destination. Once there, the packets reassemble themselves to create the original message. The ARPAnet, started in 1969 by the Advanced Research Projects Agency (ARPA) at the U.S. Department of Defense, was the first network to use Baran's packet-switching technology. (Note that the term *packet-switching* was invented, not by Baran, but by British scientist Donald Davies, who, without knowing of Baran's work, also invented a system for sending small packets of information over a distributed network. It was Baran's affiliation with RAND and his proximity to the newly emerging ARPA network in America that solidified his historical legacy.) At the same time, Leonard Kleinrock published his research on network flow and queuing theory. Kleinrock's focus was to analyze



Centralized, decentralized, and distributed networks. Baran (1964). Copyright 1964 by Rand Corporation. Reproduced with permission.

stochastic flow through networks, which is to say, flow that is not steady or predictable but in which "both the time between successive arrivals to the system and the demand placed on the channel by each of these arrivals are random quantities."[13] Kleinrock's research on queuing would become important for the design of network nodes such as routers.

During the 1970s and 1980s the ARPAnet, later dubbed the Internet, benefited from the drafting of a number of technological standards called protocols. A computer protocol is a set of recommendations and rules for implementing a technical standard. The protocols that govern much of the Internet are contained in what are called RFC (Request for Comments) documents. The expression derives from a memorandum titled "Host Software," sent by Steve Crocker on April 7, 1969, which is known today as RFC 1. The RFCs, published by the Internet Engineering Task Force (IETF), are freely available (archived online in a number of locations, they may be retrieved via a normal Web search) and are used predominantly by engineers who wish to build hardware or software that meets common specifications. Since 1969, a few thousand RFC documents have been released, and they, along with a larger constellation of global technological standards, constitute the system of organization and control known as protocol. Protocols are systems of material organization; they structure relationships of bits and atoms and how they flow through the distributed networks in which they are embedded.

While he did not invent automated communications networks, I consider Baran to be the "father" of protocological systems, not simply because of his position in the historical emergence of distributed networks, but because he explicitly understood that distributed networks create new, robust structures for organization and control; they do not *remove* organization and control. Compared to pyramidal hierarchies, networks are indeed flimsy, ineffective, and disorganized. But this relationship of asymmetry is precisely what, in the long run, makes networks so robust. The web of ruin can be highly effective. Baran understood that the Cold War model relied upon a decentralized system of targets—cities, and military bases, mostly—and so, if a new targetless model of organization could be rolled out (the smooth, distributed network), a new strategic advantage could be gained. Distributed networks have become hegemonic only recently, and because of this it is relatively easy to lapse back into the thinking of a time when networks were disruptive of power centers, when the guerilla threatened the army, when the nomadic horde threatened the citadel. But this is no longer the case. The distributed network is the new citadel, the new army, the new power.

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In closing, I would like to identify a few details of networked media that have important ramifications for a critical theory of the network form.

The first is that, following Shannon and Weaver, informatic networks are relatively indifferent to semantic content and interpretation. Data is parsed, not "read" in any conventional sense. Media objects are defined at the intersection between two protocols (two technologies) but not as a result of some human being's semantic projection onto that data. This is readily illustrated via McLuhan's notion that any new medium contains within it older media: film contains still photographs as frames, a Web page contains images and text, and so on. With digital media McLuhan's principle has become law. Since all is information, any recognizable "content" is merely the artificial parsing of that substrate data into predictable, template-driven chunks. This can be seen in the concept of a checksum, a simple numeric signature that appears in all network messages. A checksum is computed from scanning the "content" of a message, not realized via any bona fide act of "reading." Any machinic understanding of content is derived as an epiphenomenon of human behavior, as seen in the page rank algorithms used by search engines. Following the argument above that the Furies have replaced Hermes (and perhaps Iris too) as the operative divinity, this might be referred to as the antihermeneutic tendency of networks. In short, a new model of reading will have to be explored, one that is not hermeneutic in nature but instead based on cybernetic parsing, scanning, rearranging, filtering, and interpolating. This new model of reading will need to be based on an immanent or machinic notion of software. The question now is not simply *logos* (discourse) but *ergon* (work). Networks are not simply textual entities, they are entities in a constant labor with themselves.

The second ramification is what might be called the political tragedy of interactivity. Interactivity and network bidirectionality was famously held up as a sort of utopia by Bertolt Brecht in his short fragments on radio, and later reprised by Enzensberger as the heart and soul of an "emancipated" media. Today, however, interactivity is one of the core instruments of control and organization. Like the web of ruin, networks ensnare in the very act of connection. Yet like the chain of triumph, networks are exceedingly efficient at articulating and conveying messages bidirectionally (this is what graph theory terms an "undirected" graph). Today, organisms must communicate whether they want to or not. This is essentially why "communication" and "control" are inextricably linked in Wiener's concept of cybernetics. Organisms are "captured," to use Phil Agre's terminology, using any number of informatic codes and rubrics. Clicks are accumulated. Behaviors are mined for meaningful data or tracked for illegal data. Even the genome is prospected for rare or otherwise useful sequences. Enzensberger's desire to change the media from the unidirectional model of fascism to the bidirectional model of radical democracy was laudable, and germane to the political movements of the time. Yet today bidirectionality is not the saving grace it once was thought to be, due to the incorporation of bi- and multidirectionality into the networked technologies of control and organization. Today, interactivity means total participation, universal capture. The chain of triumph is not a monologue but a multilogue.

The third ramification is the tendency for software to privilege surface over source, while at the same time championing sources as absolutely essential even when hidden. What does this mean? Software is often understood as existing on various levels. At the level of authorship, it exists as "source code," a human-readable text that contains commands written in a high-level computer language such as C++. When this source code is compiled, these commands are translated into machine-readable code called an executable application, consisting of basic commands that can be understood by the hardware of the machine. This application creates a third modality, the "runtime" experience of the user who launches and runs the software. These three modalities—source, executable application, and interface—are crucial aspects of any computer technology. The interface is often considered to be primary, as it determines the actual experience of the software as it relates to a user. Yet the executable mode comprises the actual machinic commands necessary for the software to function. But at the same time, the executable is merely the result of a machinic compilation of the source code, which is thus the essential recipe or score for the realized work. So for software "source" to work it must appear in a form it is not (the executable), only then to be experienced in a third form different entirely from the other two. This is what might be called the occult logic of software: software hides itself at exactly the moment when it expresses itself most fully. As Wendy Hui Kyong Chun notes in her work, code is never merely a source; it is always a "resource."

The tendency for software to privilege surface over source has led to social movements promoting open source software (a type of software in which both source code and executable are made available to users). Yet this surfacing effect is insidious, and reappears even within so-called open source software. There is a design approach in computer science known as encapsulation, whereby code is segregated into modular units, sometimes called objects or libraries, with which one interacts via interfaces. In this sense, software itself acts like a network, a network of message-sending simulated entirely within an abstract informatic space. The software objects are the nodes in the network and messages are sent via an "edge" consisting of any two object's interfaces. The interface acts as the sole conduit for communication into and out of the object or library. The source of the object or library itself is hidden. Computer scientists use encapsulation for a variety of reasons, all of them practical. It makes the code easier to maintain and simpler to implement. The practice pervades a whole variety of computer languages and programming environments, including open code software. The open source movement, then, is not enough; something like an "open runtime" movement might also be required, in which the dialectic of obscurantism and transparency, a longtime stalwart in aesthetics and philosophy, is interrogated as a central problem, if not *the* central problem, of software. The paradox of networked relations is thus the following: the networked other is always obscured, but experiencing the essence of the other, even in its obscurity, is assumed to be the ultimate goal of any networked relation. For example, in the discourse of complexity theory it is the very obscurity of the networked totality that is first posited, only to be overcome, via the phenomenon of "emergence" into the new spiritual essence of the "collective intelligence."

A fourth and final ramification of this new, topsy-turvy relationship between the chain of triumph and the web of ruin is that it suggests new scenes of political interest. There are a number of options possible in this regard. Using the network as a fulcrum, I will suggest two avenues: (1) political questions that issue from a formal congruency "within" the network, and (2) political questions that issue from the space of the "without."

One of the basic qualities of a net—the gaps or holes that allow, in the case of fishing, water and smaller objects to pass through—is neglected by topology and graph theory. Graph properties are topological in nature; the edges are infinitely elastic, meaning that a graph's nodes can be moved at random, producing networks that look completely different but are still isomorphic. Connectivity between nodes outweighs any spatial concern. For example, it is possible for a parallelogram and a rectangle to be isomorphic in graph theory, whereas in geometry this is not the case (except in the special instance of the parallelogram with all right angles). In general, the geometry of the space in which a graph is embedded does not indicate anything meaningful about the graph. From this we may assert that graph theory has no theory of the gap. Graphs are nets without holes. Or at least they are nets in which the specific shape and quality of the holes (which do exist) have no consequence whatsoever. Graphs assert the hole, but only as an exclusion from the whole, as something that is present but unable to act. Graphs are nets for which the "offline" has been prohibited from discourse. They "suspend" the hole, both in an ontological sense and literally, as a suspension hanging from webs of knots and thread. Of course this is a feature of graph theory, not a shortcoming.

But it may also be a liability. Thus one may identify today a number of new scenes of political interest that come from without. These are movements that speak from the position of the holes in the graph. Perhaps in a former time this was called Ludditism. Today, with the general augmentation of network technologies throughout social space, it encompasses all exclusionary and extra-network concerns: Agamben's notion of "bare life"; the politics of imprisonment, extradition, and habeas corpus (today's "dark" prisons take a cue from Devil's Island and the former penal colonies); the initiative by the West to "wire" Africa; Mehdi Belhaj Kacem's notion of being "imprisoned on the outside"; precarious labor and post-Fordism; biometrics and the expansion of what counts as empirically measurable and semiologically expressive data (following the tragedy of interactivity described above); the question of topographical resolution in the field of geography; and so on. The primary issue here is the notion of intelligibility. Who or what is excluded from networked presence? What are the necessary conditions in any specific situation for an entity to be excluded from the network? What price must be paid in exclusion? What *larger* price must be paid for inclusion? "Before the law sits a gatekeeper," wrote Kafka.

On the other hand, one may cite all the network-centric diagrams for political resistance viable under modernity and the passage into postmodernity: grassroots organizations, guerrilla warfare, anarcho-syndicalism, and other rhizomatic movements. These are all "formally within" the network mode because they are themselves formally constituted as distributed or decentralized networks of some kind or another.[14] (One may also argue that it is the very formal asymmetry of the rhizomatic movements vis-à-vis centralized antagonists that provides the basis of the rhizome's potency, but that is the topic of another essay.) Yet after the powers-that-be have migrated into the distributed network as well, thereby co-opting the very tools of the former left, new models for political action are required. A new exploit is necessary, one that is as asymmetrical in relationship to distributed networks as the distributed network was to the power centers of modernity, or as Clytemnestra's "vast voluminous net" was to Agamemnon's militaristic efficiency. But this new exploit is never outside the network, it is always formally within it. Thus certain intra-anti-network movements have also emerged. An example is Hakim Bey's model of the temporary autonomous zone, or, following the example of the Furies, the Electronic Disturbance Theatre's system of online electronic swarming. In the realm of the nonhuman, computer viruses and worms have innovated, perhaps totally haphazardly, a new model of intra–anti-network infection and disruption that takes advantage of the homogeneity of distributed networks and their ability to propagate information. At the same time hackers seek out logical exploits in networked machines that allow for inversions and modulations in the normal functionality of those machines.

These techniques are not yet fully formed and in many cases are politically naïve if not retrograde, as with the case of the virus. Yet they do begin to sketch out a new model of networked organization and, via silhouette, an image of a counternetwork practice that is entirely native to the network form. Coupled with the scenes located outside of or at the borders of the network, as well as the "problem" of interactivity, the matter of surfaces and sources, and the antihermeneutic impulse, one begins to see the spectrum of issues at play in a critical theory of the network form.

Notes

1. Parenthetical citations refer to line numbers from the Greek text. The translation is from Aeschylus, *The Oresteian Trilogy*, trans. Philip Vellacott (New York: Penguin, 1956).

2. The concordance between textiles and spiderwebs is noted again later in Ovid with the story of Arachne, the haughty weaver maiden whom Athena transforms into a spider: "her hair and then her eyes and ears fell off, and all her body sank. And at her sides, her slender fingers clung to her as legs. The rest is belly; but from this, Arachne spins out a thread; again she practices her weaver's art, as once she fashioned webs" (book 6, lines 141–45). Ovid, *Metamorphoses*, trans. Allen Bandelbaum (New York: Harcourt, 1993), 183. Arachne reappears in Dante (*Inferno*, canto 17; *Purgatorio*, canto 12) as an allegorical figure for the poet himself, undone at the hands of his own artistic creation. The thread used to weave the pictorial textile becomes a noose with which Arachne tries to hang herself in defiance of the goddess. But the noose becomes a web again, referring back to the "spinning" of the artist, be it of tales or tapestries.

3. Michel Foucault, *The Archaeology of Knowledge* (New York: Pantheon, 1972), 219. As branches of mathematics, geometry and graph theory are as different as they are similar. They share the Euclidean concepts of point and line (translated to *vertex* and *edge* in graph theory), yet being essentially topological, graph theory lacks any concept of angle (between lines) or polygonal surface area (the holes or gaps between strands of the net) both of which are central to Euclidean geometry. One counterexample in which the geometry of the graph's embedded space matters is the planar graph, which is a graph drawn so that no edges intersect except at nodes. Yet even the planar graph is topologically elastic in ways prohibited in classical geometry.

4. Wiener describes feedback as follows: "It has long been clear to me that the modern ultra-rapid computing machine was in principle an ideal central nervous system to an apparatus for automatic control. . . . With the aid of strain gauges or similar agencies to read the performance of these motor organs and to report, to 'feed back,' to the central control system as an artificial kinesthetic sense, we are already in a position to construct artificial machines of almost any degree of elaborateness of performance" (1965, 27).

5. "Just as the amount of information in a system is a measure of its degree of organization, so the entropy of a system is a measure of its degree of disorganization; and the one is simply the negative of the other" (Wiener 1965, 11).

6. See Benkler (2006), as well as Geert Lovink, *My First Recession* (Rotterdam: V2, 2003), 12; Richard Barbrook and Andy Cameron, "Californian Ideology," and John Perry Barlow, "A Declaration of the Independence of Cyberspace," in *Crypto Anarchy, Cyberstates, and Pirate Utopias*, ed. Peter Ludow (Cambridge, MA: MIT Press, 2001); Mark Dery, *Escape Velocity* (New York: Grove Press, 1996); Eben Moglen, "The dotCommunist Manifesto," http://emoglen.law.columbia.edu/publications/dcm.html (accessed November 5, 2005); Kevin Kelly, *Out of Control* (New York: Perseus, 1995); Esther Dyson, *Release 2.0* (New York: Broadway, 1997); Ray Kurzweil, *The Age of Spiritual Machines* (New York: Penguin, 1999); Nicholas Negroponte, *Being Digital* (New York: Knopf, 1995); Steven Johnson, *Emergence* (New York: Scribner, 2002); Manuel DeLanda, *A Thousand Years of Nonlinear History* (New York: Zone, 2000); Pierre Lévy, *Becoming Virtual* (New York: Plenum, 1998); Mark Poster, *What's the Matter with the Internet?* (Minneapolis: University of Minnesota Press, 2001); Brian Massumi, *Parables for the Virtual* (Durham: Duke University Press, 2002); and Lawrence Lessig, *Code and Other Laws of Cyberspace* (New York: Basic, 2000).

7. See Chun (2005) and Hayles (1999). Also Espen Aarseth, *Cybertext* (Baltimore: Johns Hopkins University Press, 1997); Jay Bolter and Richard Grusin, *Remediation* (Cambridge, MA: MIT Press, 2000); Marina Grzinic, "Exposure Time, the Aura, and Telerobotics" in *The Robot in the Garden*, ed. Ken Goldberg (Cambridge, MA: MIT Press, 2000); Donna Haraway, *Simians, Cyborgs, and Women* (New York: Routledge, 1991); Lev Manovich, *The Language of New Media* (Cambridge, MA: MIT Press, 2001); Lisa Nakamura, *Cybertypes* (New York: Routledge, 2002); Sadie Plant, *Zeros + Ones* (New York: Fourth Estate, 1997); Allucquère Rosanne Stone, *The War of Desire and Technology at the Close of the Mechanical Age* (Cambridge, MA: MIT Press, 1996); Sherry Turkle, *Life on the Screen* (New York: Simon & Schuster, 1997).

8. For a good overview of social network theory and graph theory, see Barabási (2002).

9. Peter Galison, "War against the Center," *Grey Room* 4 (Summer 2001): 7–33.

10. Jo Freeman, "The Tyranny of Structurelessness," http://www.jofreeman.com/joreen/tyranny.htm (accessed January 4, 2006).

11. Michael Hardt and Antonio Negri, *Empire* (Cambridge, MA: Harvard University Press, 2000), 13,

12. See Deleuze and Guattari (1987) and Arquilla and Ronfeldt (2001). Also Hans Magnus Enzensberger, "Constituents of a Theory of the Media" in Noah Wardrip-Fruin and Nick Montfort, Eds., *The New Media Reader* (Cambridge, MA: MIT Press, 2003); Galison, "War Against the Center."

13. Leonard Kleinrock, *Communication Nets* (New York: Dover, 1964).

14. This is analogous to how "noise" is defined in information theory. One might romantically think that noise is some postmodern godsend to combat the rigidity of digital code. However, in information science, noise is not the opposite of information, defined by Shannon and Weaver as the amount of entropy in message construction. Simply put, more noise (generally) means more information. Hence noise is an intra-informatic problem, not an extra-informatic problem.

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