Bureau d'Etudes. *Psy-war Bio-war,*
2003. Detail.

Uri Geller
Business
Consultancy

MOSSAD

work top

Geller also claims to
have briefed Israeli
intelligence on the
SRI studies.

California in 1974. Financed by Werner Erhard,
Jean Lanier and the late George Koopman, the
PCRG nurtured the creation of books like Space-
Time and Beyond, The Tao of Physics, The Dancing
Wu Li Masters, Cosmic Trigger, and The Roots of
Consciousness. The group included the physicists
and authors, Fred Alan Wolf, Nick Herbert and
Fritjof Capra, along with Saul Paul Sirag, Henry
Dakis, Robert Anton Wilson, Uri Geller, Barbara
Honegger, the late Brendan O Regan, George
Leonard, Gary Zukav, Ira Einhorn, and artist Lynn
Hershmann.

http://www.esalen.org/

Parapsychology
Research Group
Inc.

www.espresearch.com

Dragon
Project
Trust (DPT)

Paul
Devereux

The Galactic Federation of Worlds (GF)

???

the Galactic Federation grew and became a very l
and powerful federation of worlds devoted to univ
peace and prosperity. Now there are millions of mem
from across our galaxy.

President

working with Lockheed Martin Missiles &
Space Co. In April, 1996, he co-chaired
a session on "Advanced Sensor
Technologies" at the Aerospace/Defense
Sensing and Controls conference.

Russell
Targ

Bay Research
Institute

OT (Operating Theta's) Level III
left in the mid-1970's

Bigelow
Foundation

Heffer
Research
Institute

International
Foundation
for Advanced
Study.

National
Institute of
Discovery
Science.

Robert
Bigelow

1985

http://www.uri-geller.com/

Uri
Geller

the UFO Briefing Document, 1996

Doctor Sturrock, Professor Emeritus of physics at
Stanford University, based his book on a report that
was released to the press in 1998 and was published
in 1999. The report entitled, "Physical Evidence Related
to UFO Reports," was originally published as the
proceeding of a workshop held with the support of
Laurance Rockefeller between September 29 and
October 4, 1997. It was developed by Dr Sturrock and a
committee of distinguished scientists. Dr Sturrock was
Professor of Space Science and Physics and Deputy
Director for the Centre for Space Sciences and
Astrophysics at Stanford.

In April, 1997,
Bigelow donated $3.7
million dollars to the
University of Nevada
to found the Bigelow
Chair of Consciousness
Studies

Boundary
Institute

director of the Consciousness
Research Division

Dean
Radin

was engaged in R&D on advanced
telecommunications systems at
AT&T's Bell Laboratories and later
at GTE Laboratories. He is
presently involved in psi research
programs at a major university
medical school, a Silicon Valley
think tank named Boundary Institute,
and the Institute of Noetic Sciences,
where he is Senior Scientist.
www.psiresearch.org

http://www.acemake.com
The Dragon Project, latterly the Dragon Project
Trust (DPT), was founded in 1977 in order to
mount an interdisciplinary investigation into the
rumour (existing in both folklore and modern
anecdote) that certain prehistoric sites had unusual
forces or energies associated with them. The DPT,
a loose and shifting consortium of volunteers from
various disciplines, conducted many years of
physical monitoring at sites in the UK, and other
countries. In the end, it was concluded that most
stories about "energies" were likely to have no
foundation in fact, and in a few cases might be
due to mind states and psychological effects
produced by certain locations. But hard evidence
of magnetic and radiation anomalies was found at
some sites, and some questionable evidence of
infrared and ultrasonic effects also. In addition, it
was found that the kind of locations favoured by
megalith builders tended to have a higher than
average incidence of unusual lightball phenomena
or "earth lights".

Hal
Puthoff

President

Earthtech
International

Boundary
Institute

Remote Viewing Program

head of the program since 1985

left SAIC on 11/28/95

Edwin
May

www.earthtech.org/
EarthTech International is a
privately funded research
organization dedicated to the
exploration of new frontiers in
physics. Our activities are primarily
centered around investigations into
various aspects of the Zero-Point
Field.

Institute of
Noetic
Sciences

InstituTe of Noetic Sciences
Founded by Edgar Mitchell in 1973.
Former president: Willis Harman.
Former research director: Brendan O'Regan.
Provided much of the early funding for the SRI
studies. (source:
www.heart7.net/mcf/honbone/places.html)

www.saic.com/
SAIC was involved in the Remote Viewing/psychic spying
studies for the CIA and DIA, along with SRI International.
The research aspect of the Remote Viewing program
were transferred from SRI to SAIC in 1991. (source:
www.heart7.net/mcf/honbone/places.html)
The SRI/SAIC psi experiments were supervised at
Langley by John McMahon, second in command under
William Casey, succeeding Bobby Ray Inman, the SAIC
director. (Source: Alex Constantine, "Psychic" Spying at
the Stanford Research Institute Or CIA Mind Control?)

Science Application
International
Corporation (SAIC)

Board of Advisors

Jacques
Vallee

Michael
Persinger

research on "neuro-impacts" of various EMFs and
ELFs. Something about wave-propagation and
influences on submariners if somebody 'beeped'
them with mind-influencing EMF signals, etc. By
controlling the nature of the magnetic fields,
causing them to simulate brain patterns, Persinger
is able to stimulate strong emotions and
hallucinations, including the illusion of touch and
movement.

Consultant in International Relations

Society of
Scientific
Exploration
(SSE)

Human
Software
Inc.

Psyos
technologies
Corp.

PSI
(Problems-Solutions-
Innovations)

Freiburg
Anomalous
Mind/Machine
Interaction
(FAMMI)

Giessen
Anomalies
Research
Program (Ge)

International
Institute
of Biophysics
(Berlin, GE)

http://www.arviewer.com

Communi-
cations
Research
Institute

founded in the 1958 to study dolphins, partially
funded by the Air Force, NASA, NIMH, the
National Science Foundation, and the Navy.

PEAR
(Princeton
Engineering
Anomalies
Research)

Laurance
Rockefeller

He funds the Starlight http://www.icrl.org/
Coalition, which claims the International Consciousness
membership of several Research Laboratories, Inc., a
former government and nonprofit interdisciplinary
military personnel who research consortium of
want to end government investigators dedicated to
secrecy on UFOs. exploring the role of
Consciousness in the
establishment of physical reality.

International
Consciousness
Research
Laboratories
(ICRL)

The Global Consciousness Project (GCP)

http://noosphere.princeton.edu/
The Global Consciousness Project (GCP) was launched in 1998 by Roger Nelson
(Princeton) in order to look at how human consciousness can influence the physical world.
Nelson started his presentation by reviewing two decades of experiments from the
Princeton Engineering Anomalies Research Lab (PEAR) which show repeatedly that
random event generators (REG's) can be intentionally influenced to bring about a less
random sequence of data - in other words, human Intentionality can reduce natural
entropy and create greater coherence within a random series of events.

mind/machine interaction

Protocol, Control, and Networks

ALEXANDER GALLOWAY AND EUGENE THACKER

For the last decade or more network discourse has proliferated with a kind of epidemic intensity: peer-to-peer file-sharing networks, wireless community networks, terrorist networks, contagion networks of biowarfare agents, political swarming and mass demonstration, economic and finance networks, massively multiplayer online role-playing games, Personal Area Networks, grid computing, "generation txt," and on and on. Often the discourse surrounding networks tends to be posed both morally and architecturally against what its participants see as retrograde structures like hierarchy and verticality, which have their concomitant techniques for keeping things under control: bureaucracy, the chain of command, and so on. "We're tired of trees," wrote Deleuze and Guattari. But even beyond the fields of technology and philosophy, the concept of the network has infected broad swaths of contemporary life. Even the U.S. military, a bastion of vertical, pyramidal hierarchy, is redefining its internal structure around network architectures, as RAND researchers John Arquilla and David Ronfeldt have indicated. Their concept of "netwar" is defined in topological terms: "Hierarchies have a difficult time fighting networks. [...] It takes networks to fight networks. [...] Whoever masters the network form first and best will gain major advantages."[1] In short, the current global crisis is an asymmetrical crisis between centralized, hierarchical powers and distributed, horizontal networks.[2] Today's conventional wisdom cajoles us into thinking that everything can be subsumed under the warm security blanket of interconnectivity. But it hasn't yet told us quite what that means, or how one might be able to draft a critique of networks. This "network fever"[3] has a delirious tendency, for we identify in the current literature a general willingness to ignore politics by masking it inside the so-called black box of technology. What is needed, then, is an analysis of networks not at the broad level of political theory but at the microtechnical level of nonhuman, machinic practices. To this end, the principle of political control we suggest is most helpful for thinking about technological networks is *protocol,* a word derived from computer science but which resonates in the life sciences as well. Action within a network can be deliberately guided by human actors or accidentally affected by

nonhuman actors (a computer virus or emerging infectious disease, for example). Often a misuse or an exploit of a protocol, be it intended or unintended, can identify the political fissures in a network. We suggest that such moments, while often politically ambiguous when taken out of context, can also serve as instances for a more critical, more politically engaged "counter-protocol" practice. As we shall see, protocological control brings into existence a certain contradiction, at once distributing agencies in a complex manner, while at the same time concentrating rigid forms of management and control.

The Politics of Algorithmic Culture

The question we aim to explore here is *What is the principle of political organization or control that stitches a network together?* Writers like Michael Hardt and Antonio Negri have helped answer this question in the sociopolitical sphere. They describe the global principle of political organization as one of "Empire." Like a network, Empire is not reducible to any single state power, nor does it follow an architecture of pyramidal hierarchy. Empire is fluid, flexible, dynamic, and far-reaching. In that sense the concept of Empire helps us greatly to begin thinking about political organization in networks. But while inspired by Hardt and Negri's contribution to political philosophy, we are concerned that no one has yet adequately answered this question for the technological sphere of bits and atoms.

What, then, is "protocol"? Protocol abounds in technoculture. It is a totalizing control apparatus that guides both the technical and political formation of computer networks, biological systems, and other media. Put simply, protocols are all the conventional rules and standards that govern relationships within networks. Quite often these relationships come in the form of communication between two or more computers, but "relationships within networks" can also refer to purely biological processes, as in the systemic phenomenon of gene expression. Thus, by "networks" we want to refer to any system of interrelationality, whether biological or informatic, organic or inorganic, technical or natural—with the ultimate goal of undoing the polar restrictiveness of these pairings.

In computer networks science professionals have, over the years, drafted hundreds of protocols to govern e-mail, Web pages, and so on, plus many other standards for technologies rarely seen by human eyes. The first protocol for computer networks was written in 1969 by Steve Crocker and is titled "Host Software."[4] If networks are the structures that connect people, then protocols are the rules that make sure the connections actually work. Internet users commonly use protocols such as HTTP, FTP, and TCP/IP, even if they know little about how such technical

standards function. Likewise, molecular biotechnology research frequently makes use of protocol to configure biological life as a network phenomenon, be it in gene expression networks, metabolic networks, or the circuitry of cell signaling pathways. In such instances the biological and the informatic become increasingly enmeshed in hybrid systems that are more than biological: proprietary genome databases, DNA chips for medical diagnostics, and real-time detection systems for biowarfare agents. Protocol is twofold; it is both an apparatus that facilitates networks and a logic that governs how things are done within that apparatus. While its primary model is the informatic network (e.g., the Internet), we will show here how protocol also helps organize biological networks (e.g., biopathways).

A recent computer science manual describes the implementation of protocol in the Internet:

> The network is made up of intelligent end-point systems that are self-deterministic, allowing each end-point system to communicate with any host it chooses. Rather than being a network where communications are controlled by a central authority (as found in many private networks), the Internet is specifically meant to be a collection of autonomous hosts that can communicate with each other freely. . . . IP [Internet Protocol] uses an anarchic and highly distributed model, with every device being an equal peer to every other device on the global Internet.[5]

That this passage sounds more like philosophy and less like science is particularly telling. Today network science often conjures up the themes of anarchy, rhizomatics, distribution, and anti-authority to explain interconnected systems of all kinds. From these sometimes radical prognostications and the larger technological discourse of thousands of white papers, memos, and manuals surrounding them, we can derive some of the basic qualities of the apparatus of organization which we here call protocol:

- protocol facilitates relationships between interconnected, but autonomous, entities;
- protocol's virtues include robustness, contingency, interoperability, flexibility, and heterogeneity;
- a goal of protocol is to accommodate everything, no matter what source or destination, no matter what originary definition or identity;
- while protocol is universal, it is always achieved through negotiation (meaning that in the future protocol can and will be different);
- protocol is a system for maintaining organization and control in networks.

Each of these characteristics alone is enough to distinguish protocol from many previous modes of social and technical organization (such as hierarchy or bureaucracy). Together they compose a new, sophisticated system of distributed control. As a technology, protocol is implemented broadly and is thus not reducible simply to the domain of institutional, governmental, or corporate power. In the broadest sense protocol is a technology that regulates flow, directs netspace, codes relationships, and connects life forms.

Networks always have several protocols operating in the same place at the same time. In this sense networks are always slightly schizophrenic, doing one thing in one place and the opposite in another. The concept of protocol does not, therefore, describe one all-encompassing network of power—there is not one Internet but many internets, all of which bear a specific relation to the infrastructural history of the military, telecommunication, and science industries. Thus protocol has less to do with individually empowered human subjects (the pop-cultural myth of the hacker) who might be the engines of a teleological vision for protocol, than with manifold modes of individuation that arrange and remix both human and nonhuman elements. But the inclusion of opposition within the very fabric of protocol is not simply for the sake of pluralism. Protocological control challenges us to rethink critical and political action around a newer framework, that of multi-agent, individuated nodes in a metastable network. This means that protocol is less about power (confinement, discipline, normativity) and more about control (modulation, distribution, flexibility).

Graph Theory in the Control Society

The emphasis on "control" is a significant part of Deleuze's later writings. In the "Postscript on Control Societies," a delectably short essay from 1990, Deleuze defines two historically distinct social formations: first, the "disciplinary societies" of modernity, growing out of the rule of the sovereign into the "vast spaces of enclosure," the social castings and bodily molds that Michel Foucault has described so well; and second, what Deleuze terms the "societies of control" that inhabit the late twentieth century—these are based around protocols, logics of "modulation," and the "ultrarapid forms of free-floating control."[6] While the disciplinary societies are characterized by more physical semiotic constructs, such as the signature and the document, the societies of control are characterized by more immaterial ones such as the password and the computer. These control societies are characterized by the networks of genetic science and computers, but also by much more conventional network forms:

A control is not a discipline. In making freeways, for example, you don't enclose people but instead multiply the means of control. I am not saying that this is the freeway's exclusive purpose, but that people can drive infinitely and "freely" without being at all confined yet while still being perfectly controlled. This is our future.[7]

Whether it be a political roadmap, a disease pathway, an information superhighway, or a plain old freeway, what Deleuze defines as control is key to understanding how networks of all types function.

But there also exists an entire science behind networks, commonly known as graph theory, which we would like to briefly outline here.[8] Mathematically speaking, a "graph" is a finite set of points connected by a finite set of lines. The points are called "nodes" or vertices, and the lines are called "edges." For the sake of convenience we will use "G" to refer to a graph, "N" to refer to the nodes in the graph, and "E" to refer to its edges. Thus a simple graph with four nodes (say, a square) can be represented as

$$N = \{n_1, n_2, n_3, n_4\}$$

and its edges as

$$E = \{(n_1, n_2), (n_2, n_3), (n_3, n_4), (n_4, n_1)\}.$$

In a graph, the number of nodes is called the "order" (in the square example, $|N| = 4$), and the number of edges is called the "size" ($|E| = 4$). This is a standard connect-the-dots situation. Given this basic setup of nodes and edges, a number of relationships can be quantitatively analyzed. For instance, the "degree" of a node is the number of edges that are connected to it. A "centralized" or "decentralized" graph exists when one or several nodes in the graph have many edges connected to them (giving it a lower order and a higher size). Likewise, a "distributed" graph exists when all nodes in the graph have roughly the same degree (giving it a roughly equivalent order-size relationship [order = size]).

What can we tell by both the order and size of a graph? One of the basic theorems of graph theory states that for any graph G, *the sum of the degrees of the nodes equals twice the number of edges* of G. That is, if the degree of any node is the number of edges connected to it (for node n_1 with two edges connected to it, its degree = 2), the sum of all the degrees of the graph will be double the size of the graph (the number of edges). In other words, a network is not simply made up of a certain number of elements connected to one another, but is constituted by, qualified by, the connectivity of the nodes. How connected are you? What type of connection do you have? For a square, the sum of the degrees is 8 (the nodes [the

square's corners] each have two edges [the square's lines] connected to them), while the sum of the edges is 4. In the IT industries connectivity is purely a quantitative measure (bandwidth, number of simultaneous connections, download capacity). Yet, in a different vein, Deleuze and Guattari describe network forms such as the rhizome as, in effect, edges that contain nodes (rather than vice versa), or even, paradoxically, as *edges without nodes.* In graph theory we see that the *connectivity* of a graph or network is a value different from a mere count of the number of edges. A graph not only has edges between nodes but edges connecting nodes.

Thus, from a graph theory perspective, networks display three basic characteristics: their organization into nodes and edges (dots and lines), their connectivity, and their topology. The same set of principles can result in a centralized, rigidly organized network or a distributed, highly flexible network. The institutional, economic, and technical development of the Internet is an instructive case in point. While the implementation of packet-switching technology in the U.S. Department of Defense's ARPANET (Advanced Research Projects Agency Network) ostensibly served the aims of military research and security, the network also developed as a substantial commercial network. Paul Baran, coinventor of packet switching, uses basic graph theory principles to show how, given the same set of nodes/dots and a different set of edges/lines, one gets three very different network topologies. Same dots, different lines, different networks. The familiar distinction between centralized, decentralized, and distributed networks can be found everywhere today, not only within computer and information technologies but in social, political, economic, and, especially, biological networks as well.

From the perspective of graph theory we can provisionally describe networks as *metastable sets of variable relationships in multi-node, multi-edge configurations.* As we've suggested, networks come in all shapes and flavors, but common types of networks include centralized ones (pyramidal, hierarchical schemes), decentralized ones (a main hub
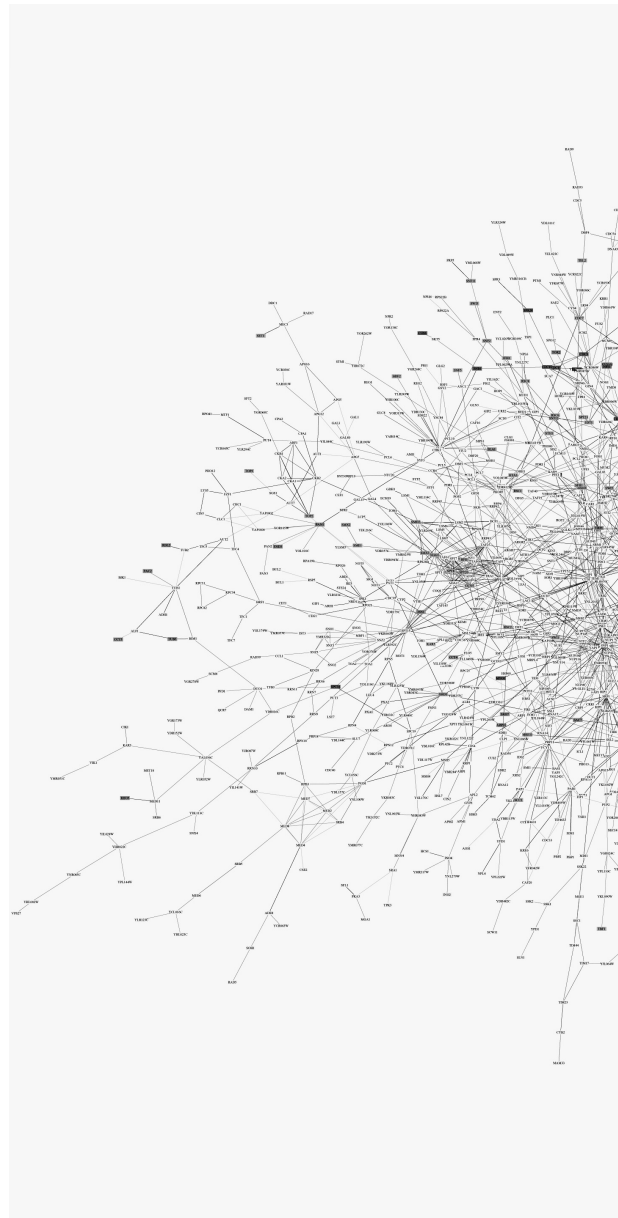
or "backbone" with radiating peripheries), and distributed ones (a collection of node-to-node relations with no backbone or center). In the abstract, networks can be composed of almost anything: computers (Internet), cars (highways), people (communities), animals (food chains), stocks (capital), statements (institutions), cultures (diasporas), and so on. Indeed, much of the research in complex dynamic systems and network science stresses this convergence of heterogeneous phenomena under universal, mathematical principles.[9]

However, we stress this point: graph theory in isolation is not enough for an understanding of networks; or rather it is only a beginning. Although graph theory provides the mathematical and technical underpinning of many technological networks (and the tools for analyzing networks), the assumptions of graph theory are equally instructive for what they omit. For instance, the division between nodes and edges implies that while nodes refer to objects, locations, or space, the definition of edges refers to actions effected by nodes. While agency is attributed to the active nodes, the carrying out of actions is attributed to the passive edges (the effect of the causality implied in the nodes). Graphs or networks are then diagrams of force relationships (edges) effected by discrete agencies (nodes). In this, graphs imply a privileging of spatial orientations, quantitative abstraction, and a clear division between actor and action. The paradox of graphs or networks is that their geometrical basis (or bias) actually works against an understanding of networks as sets of relations existing in time.

In our use of the phrase *protocological control* we suggest something further. Not only are networks distinguished by their overall topologies, but networks always contain several coexistent, and sometimes incompatible, topologies. A "technical" topology of the Internet might describe it as distributed (for example, in the case of peer-to-peer file-sharing networks based on the Gnutella model). But this technical topology is indissociable from its motive, use, and regulation, which also makes it a social topology (file sharing communities), an economic topology (distribution of
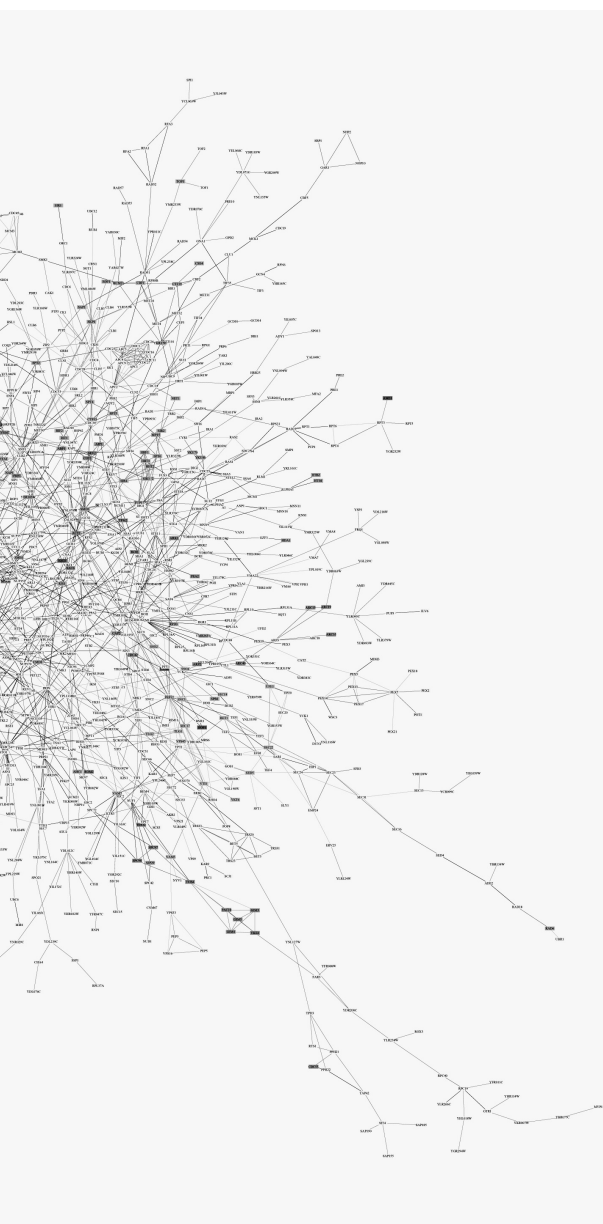
Network topologies in cellular metabolism. Originally published in Benno Schwikowski, et al., "A Network of Protein-Protein Interactions in Yeast," *Nature Biotechnology* **(Dec. 2000).**

commodities), and even a legal topology (digital copyright). All of these networks coexist and sometimes conflict with one another, as the controversy surrounding file-sharing has shown. Thus, not only do the foundations of our understanding of networks exclude the element that makes a network a network (their dynamic quality), but they also require that networks exist in relation to fixed topological configurations (either centralized or decentralized, either technical or political). This can be made clearer through a consideration of two paradigmatic examples: computer networks and biological networks.

Protocol in Computer Networks

In a technical sense, computer networks consist of nothing but schematic patterns describing various protocols and the organizations of data that constitute those protocols. These protocols are organized into layers. The white paper called "Requirements for Internet Hosts" defines four basic layers for the Internet suite of protocols:

1. the application layer (e.g., Telnet, the Web);
2. the transport layer (e.g., TCP);
3. the Internet layer (e.g., IP); and
4. the link (or media-access) layer (e.g., Ethernet).

These layers are nested, meaning that the application layer is nested within the transport layer, which is nested within the Internet layer, and so on. At each level the protocol higher in precedence parses and encapsulates the protocol lower in precedence. Parsing and encapsulating are both pattern-based: parsing (computing checksums, measuring size, and so on) forces data through various patterns, while encapsulation adds a specific pattern of information (a header) to the beginning of the data object.

After the header comes the rest of the datagram. But what does that mean in practical terms? Consider an average telephone conversation as an analogy. There are several protocols at play during a telephone call. Some are technical, some social. For example, the act of listening for a dial tone and dialing the desired phone number can be considered to be in a different "layer" than the conversation itself. Furthermore, the perfunctory statements that open and close a telephone conversation—"Hello," "Hi, this is . . . ," "Well, I'll talk to you later," "Okay, good-bye," "Bye!"—are themselves not part of the normal conversation "layer" but are merely necessary to establish the beginning and end of the conversion.

The Internet works the same way. The application layer is like the conversation layer of the telephone call. It is responsible for the content of the specific

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version|  IHL  |Type of Service|          Total Length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Identification        |Flags|      Fragment Offset    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Time to Live |    Protocol   |         Header Checksum        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Source Address                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Destination Address                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Options                    |    Padding     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
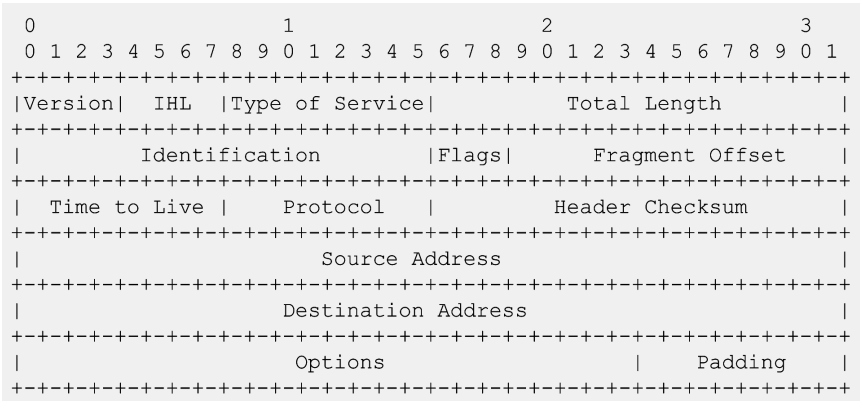
technology in question, be it checking one's e-mail, or accessing a Web page. The application layer is a *semantic* layer, meaning that it is responsible for preserving the content of data within the network transaction. The application layer has no concern for larger problems such as establishing network connections or actually sending data between those connections. It simply wants its "conversation" to work correctly.

The transport layer is one step higher in the hierarchy than the application layer. It has no concern for the content of information (one's e-mail, one's Web page). Instead, the transport layer is responsible for making sure that the data traveling across the network arrives at its destination correctly. It is a social layer, meaning that it sits halfway between the content or meaning of the data being transferred and the raw act of transferring that data. If data are lost in transit, it is the transport layer's responsibility to resend the lost data.

Thus, in our hypothetical telephone conversation, if one hears static on the line, one might interject the comment "Hello . . . are you still there?" This comment is *not* part of the conversation layer (unless your conversation happens to be about "still being there"); it is an interstitial comment meant to confirm that the conversation is traveling correctly across the telephone line. The opener and closer comments are also part of the transport layer. They confirm that the call has been established and that it is ready for the conversation layer—and conversely that the conversation is finished and the call will be completed.

The third layer is the Internet layer. This layer is larger still than both the application and transport layers. The Internet layer is concerned with one thing: the actual movement of data from one place to another. It has no interest in the content of that data (the application layer's responsibility) or whether parts of the data are lost in transit (the transport layer's responsibility).

The fourth layer, the link layer, is the hardware-specific layer that must ultimately encapsulate any data transfer. Link layers are highly variable due to the many differences in hardware and other physical media. For example, a telephone conversation can travel just as easily over normal telephone wire as it can over fiber-optic cable. However, in each case the technology in question is radically different. These technology-specific protocols are the concern of the link (or media-access) layer.

The different responsibilities of the different protocol layers allow the Internet to work effectively. For example, the division of labor between the transport layer and the Internet layer—whereby error correction is the sole responsibility of the transport layer and routing (the process by which data are "routed" or sent toward their final destination) is the sole responsibility of the Internet layer—creates the

An Internet Protocol (IP) header.
Source: Jon Postel, ed., "Internet
Protocol DARPA Internet
Program Protocol Specification,"
RFC 791, September 1981.

conditions of existence for the distributed network.

Thus, if a router goes down in Chicago while a message is en route from New York to Seattle, the lost data can be re-sent via Louisville instead (or Toronto, or Kansas City, or Lansing, or myriad other nodes). It matters not whether the alternate node is smaller or larger, or is on a different subnetwork, or is in another country, or uses a different operating system.

The Requests for Comments (RFCs) state this quality of flexibility with great clarity:

> A basic objective of the Internet design is to tolerate a wide range of network characteristics—e.g., bandwidth, delay, packet loss, packet reordering, and maximum packet size. Another objective is robustness against failure of individual networks, gateways, and hosts using whatever bandwidth is still available. Finally, the goal is full "open system interconnection": an Internet host must be able to interoperate robustly and effectively with any other Internet host, across diverse Internet paths.[10]

As long as the hosts on the network conform to the general suite of Internet protocols—like a lingua franca for computers—then the transport and Internet layers, working in concert, will take care of everything.

The ultimate goal of the Internet protocols is totality. The virtues of the Internet protocol are robustness, contingency, interoperability, flexibility, heterogeneity, pantheism. Accept everything, no matter what source, sender, or destination.

Protocol in Biological Networks

In the example of computer networks, "protocol" is both a technical term and, as we've suggested, a way of describing the control particular to informatic networks generally. What is the "protocol" of biological networks? While molecular biology, genetics, and fields in biotechnology do not use the technical term *protocol,* they nevertheless employ protocols at several levels. Recall that the concept of protocol developed here combines an informatic worldview with a description of standardized network relationships. While biotechnology is an incredibly diversified industry, it is also predicated on a common set of knowledges, which include cellular biology, biochemistry, and molecular genetics. Perhaps no other concept is as central to biotechnologies as is the notion of genetic "information." As historians of science have pointed out, the notion of an informatic view of the genetic and molecular body has its roots in the interdisciplinary exchanges between cybernetics and biology during the postwar period.[11] In the very concept of a Human Genome Project, of genetic pharmaceuticals, of

genetic patents, and of bioterrorism, there is the notion of a genetic "code" that remains central to an understanding of "life" at the molecular level.

We can begin by suggesting that the protocols of biological networks are the modes of biological regulation and control in the genome and in the cell. These protocols are of three types: gene expression (how a network of genes are switched on and off to produce proteins), cell metabolism (how the components of enzymes and organelles transform "food" molecules into energy), and membrane signaling (the molecular cryptography of bringing molecules into and out of a cell membrane). In each instance molecular interactions (DNA complementarity, enzymatic catalysis, molecular binding) are understood to construct networked relationships, such as the transcription of DNA into RNA, the conversion of sugar molecules into usable energy, or the infection by a viral or bacterial agent. In each type of protocol we see networks of biological components interacting with one another, driven by a "genetic code" and mediated by "biochemical information."

Undoubtedly, the *instrumentality* of biological processes has been a hallmark of biotechnology throughout its history. One regularly witnesses biological networks in action, as in recent examples such as the anthrax bioterrorist acts, the severe acute respiratory syndrome (SARS) epidemic, and legislation concerning world intellectual property laws. But it is when we see biotechnology in its non-medical yet still instrumental context that the protocols of biological networks become most evident. One such example is the nascent field of DNA computing, or "biocomputing."[12] While DNA computing is so new that it has yet to find its "killer app," it has been used in a range of contexts—from security and cryptography to network routing or navigation problems to the hand-held detection of biowarfare agents. DNA computing is exemplary of the broader shift in the genetic sciences toward a network paradigm.

The techniques of DNA computing were developed in the mid-1990s by Leonard Adleman as a proof-of-concept experiment in computer science.[13] The concept is that the combinatorial possibilities inherent in DNA (not one but two sets of binary pairings in parallel: A-T, C-G) could be used to solve specific types of calculations. A famous example is the so-called traveling salesman problem (also more formally called "directed Hamiltonian path" problems): You're a salesman, and you have to go through five cities. You can visit each only once and cannot retrace your steps. What is the most efficient way to visit all five cities? In mathematical terms these types of calculations are called "NP complete" problems, or "nonlinear polynomial" problems, because they involve a large search field that gets exponentially larger as the number of variables increases (five cities, each with five possible routes). For silicon-based computers, calculating all of the

possibilities of such problems can be computationally taxing. However, for a molecule such as DNA, the well-understood principle of "base-pair complementarity" (that A always binds to T, C always binds to G) makes for something like a parallel processing computer, except that it functions not through microelectrical circuits but through enzymatic annealing of single strands of DNA. You can "mark" a segment of any single-stranded DNA for each city (using gene markers or fluorescent dye), make enough copies to cover all the possibilities (using your polymerase chain reaction thermal cycler, a type of Xerox machine for DNA), and then mix. The DNA will mix and match all the cities into many linear sequences, and, quite possibly, one of those sequences will represent your most efficient solution to the "traveling salesman" problem.

As a protocological mode of control, biocomputing encodes the network into the biomolecular body. The nodes of the network are DNA fragments (encoded as specific nodes A, B, C, D, etc.), and the edges are the processes of base-pair binding between complementary DNA fragments (encoded as overlaps A-B, B-C, C-D, etc.). The network resulting from the experiment is actually a set of networks in the plural; the DNA computer generates a large number of networks, each network providing a possible Hamiltonian path. The network is therefore a series of DNA strands; it is combinatorial and recombinatorial. This encoding implies a correlative zone of recoding and decoding as the network moves from one material substratum (pixels, paper, and ink) to another, qualitatively different substratum (DNA, GPCRs, the Krebs cycle). The prospect of cellular computing is the most interesting in this respect, for it takes a discipline already working through a diagrammatic logic (biochemistry and the study of cellular metabolism) and encodes a network into a network (Hamiltonian paths onto the Krebs cycle).

Biocomputing—and the example of DNA computing in particular—demonstrates protocological control at the microlevel of biomolecules, molecular bonds, and annealing/denaturing processes. DNA computing shows how the problem-solving process is not dependent on any one problem-solving "agent" but that the solution (mathematically and biochemically) arises from a context of distributed regulation. The solution comes not from brute number crunching *but from an open, flexible array of total possibilities.* This is how it is protocological. The exponential search field for NP-complete problems provides DNA with a context within which base-pair complementarity proceeds in a highly distributed fashion. This means that DNA computing facilitates a peer-to-peer set of relationships between its nodes of base pairs, which bind or do not bind. From this perspective DNA computing carries out its computations without direct, centralized control. All that the DNA computer requires is a context and a problem set defining a

O_{2-3} GTATATCCGA GCTATTCGAG O_{3-4} CTTAAAGCTA GGCTAGGTAC
CGATAAGCTC GAATTTCGAT
$\hat{O}_3$
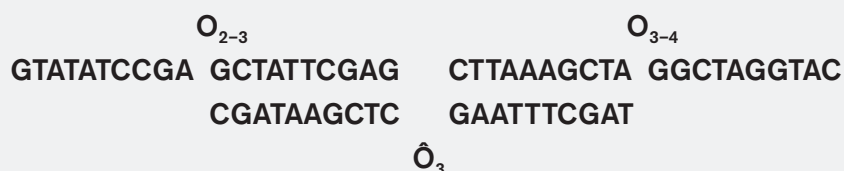
search field (such as the Hamiltonian path). Recall that one of the primary concerns of the ARPANET was to develop a network which would be robust enough to survive the failure of one or more of its nodes. Adleman's Hamiltonian-path problem could just as easily be reconceived as a contingency problem: given a directed path through a given set of nodes, what are the possible alternative routes if one of the nodes is subtracted from the set?

However, this distributed character in no way implies a freedom from control. Rather, in the context of protocol, DNA computing establishes the terms within which network activity (computation of mathematical problems with large search areas) can possibly occur. DNA computing is "biological" in a specific way, in that only certain biological processes are isolated to carry out this problem. These basic biological protocols, the basic principles of molecular biology (gene expression, metabolism, signaling), form the basis for the more familiar biological networks of infectious disease, organ and tissue donor and transplantation networks, biological patent systems, and the epidemiological tactics of biowarfare and bioterrorism.[14]

An Encoded Life

We have, then, two networks—a computer network and a biological network—both highly distributed, both robust, flexible, and dynamic. While the former is silicon-based and may make use of biological concepts (intelligent agents, artificial life, genetic algorithms), the latter is fully biological and yet recodes itself in computational terms (biology as computation, as opposed to evolution). Two "computers," two networks—two protocols? Yes and no. What we can learn from understanding DNA computing is that protocological control can be biological as well as computational. In the example of DNA computing, what is the protocol? On the one hand the aim of the experiment is mathematical and computational; yet on the other the medium through which this is realized is biological and biochemical. So while computational protocols may govern the inner workings of the informatic component of DNA computing, protocols also govern the interfacing between wet and dry, between the informatic and the biological. So two orders are happening simultaneously. In the example of TCP/IP, protocological control is almost exclusively mathematical and computational, with the wetware being left outside the machine. Protocol facilitates the integration and standardization of these two types of networks: an "inter" network relating different material orders (silicon-carbon), and an "intra" network relating different variables within protocological functioning (nodes as DNA; edges as base-pair binding). The protocol of biocomputing therefore does double the work. It is quite literally

Two "links" from a single node, showing overlapping binding by DNA base-pair complementarity. Adapted from Leonard Adleman, "Molecular Computation of Solutions to Combinatorial Problems," *Science* 266 (11 November 1994): 1021–1024.

*bio*technical, integrating the logics and components specific to computers with the logics and components specific to molecular biology.

We again emphasize a point made at the outset: protocol is a materialized emanation of distributed control. Protocol is not an exercise of power "from above," despite the blatant hierarchical organization of the Domain Name System or the vague policies concerning genetic patents in the United States Patent and Trademark Office. Protocol is also not an anarchic liberation of data "from below," despite the distributive organization of TCP/IP or the combinatorial possibilities of gene expression. The relation between protocol and power is somewhat inverted: the greater the distributed nature of the network, the greater the number of controls that enable the network to function as a network. Protocol answers the complicated question of how control pervades distributed networks. In other words, protocol tells us that heterogeneous, asymmetrical power relations are the absolute essence of the Internet-network or the genome-network, not their fetters.

In both computer and biological networks, the primary function of protocol is to direct the flows of information. In a way this is no surprise, for both fields have their common roots in World War II and postwar technical research.[15] What the genealogies of cybernetics, information theory, and systems theory do show, however, is that "information," and an informatic worldview, display an ambivalent relation to the material world. On the one hand, information is seen as being abstract, quantitative, reducible to a calculus of management and regulation—this is the disembodied, immaterial notion of "information" 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. In the cybernetic feedback loop, in the communications channel, and in the organic whole of any system, we find this dual view of information. *Both immaterial and materializing, abstract and concrete, an act and a thing.*

In short, we can say that Deleuze's societies of control provide a *medium* through which protocol is able to express itself. In such an instance it is "information"—in all the contested meanings of the term—that constitutes the ability for protocol to materialize networks of all kinds. Protocol always implies some way of acting through information. In a sense, information is the concept that enables a wide range of networks—computational, biological, economic, political—to be networks. Information is the key commodity in the organizational logic of protocological control. *Information is the substance of protocol.* Information makes protocol matter.

Toward a Political Ontology of Networks

While graph theory and network science provide us with a set of useful principles for analyzing networks, they also tend to obfuscate some of the core characteristics of networks: their dynamic temporality (Bergsonian "virtual" networks), the equal importance of edges and nodes (Deleuze and Guattari's edges-without-nodes), and the possibility of having more than one topology for each network (Negri's "collective singularities").

Ideally, our political ontology of networks would provide a set of concepts for describing, analyzing, and critiquing network phenomena. It would depend upon and even require a technical knowledge of a given network, but without being determined by it. It would view the fundamental relationships of control in a network as immanent and integral to the functioning of a network. Most importantly, such a political ontology would take into account the double-sided nature of networks in the control society, at once producing new forms of domination, while also creating new openings.

A first principle, then, is the concept of *individuation.* For Deleuze, a mode of individuation has little to do with individual human subjects and more to do with the process through which aggregates are maintained over time. As he states, the "digital language of control is made of codes indicating where access to some information should be allowed or denied." "We're no longer dealing with a duality of mass and individual" from the modern era. Instead, "individuals become *'dividuals,'* and masses become samples, data, markets, or *'banks.'* "[16] Similarly, Gilbert Simondon, writing about the relationships between individuation and social forms, suggests that we should "understand the individual from the perspective of the process of individuation rather than the process of individuation by means of the individual."[17] Therefore, a network also individuates within itself in a constructionist fashion; for, while the whole is greater than the sum of the parts, it is nevertheless the parts (or the localized action of part-clusters) that constitute the possibility of the individuation of "a" network. However, the way a primary individuation occurs may be quite different from the way a secondary one occurs; the individuation of the network as a whole is not the individuation of the network components. In addition, individuation is related to identification— identifying the network, identifying the agencies of the network. In short, the political distinction between the individual and the group is transformed into a protocological regulation between the network as a unity and the network as a heterogeneity (what computer programmers call a "struct," an array of dissimilar data types). In terms of protocological control, the question of individuation is a question of how discrete nodes (agencies) and their edges (actions) are identified

and managed as nodes and edges. What counts as a node or an edge in a given network? Does this change depending on the granularity of the analysis? What resists individuations, or "dividuations"? What supports individuations, or diversifies them?

From this follows a second principle: networks are a *multiplicity.* They are robust and flexible. While networks can be individuated and identified quite easily, networks are also always "more than one." Networks are multiplicities, not because they are constructed of numerous parts but because they are organized. This means not only that networks can grow (adding nodes or edges), but, more important, it means that networks are reconfigurable—perhaps this is what it means to be a network, to be capable of transformation, reconfiguration. As Deleuze and Guattari have noted, "the multiple must be made, not by always adding a higher dimension, but rather in the simplest of ways, by dint of sobriety, with the number of dimensions one already has available—always n–1."[18] In decentralized and especially distributed network dynamics, the network topology is created by subtracting centralizing nodes and/or edges—distribution versus agglomeration. A technical synonym for multiplicity is therefore *contingency handling,* or how a network is able to manage sudden, unplanned, or localized changes within itself (this is built into the very idea of the Internet itself). As Negri states, "the multitude is an active social agent, a multiplicity that acts. Unlike the people, the multitude is not a unity, but as opposed to the masses and plebs, we can see it as something organized. In fact, it is an agent of self-organization."[19] A network is, in a sense, something that holds a tension with itself—a grouping of differences that is unified. It is less the nature of the parts in themselves that is of concern, but more the conditions under which those parts may interact that is relevant. What are the terms, the conditions, upon which "a" network may be constituted by multiple agencies? Protocols serve to provide that condition of possibility, and protocological control the means of facilitating that condition.

A third conclusion, that of *movement,* serves to highlight the inherently dynamic qualities of networks. Although we've stated that networks are both one and multiple, this point still serves to portray only a static, snapshot view of a network. Most of the networks we are aware of—economic, epidemiological, computational—are dynamic ones. Perhaps if there is one truism to the study of networks, it is that networks are only networks when they are "live," when they are enacted, embodied, or rendered operational. This applies as much to networks in their potentiality (sleeper cells, network downtime, idle mobile phones) as it does to networks in their actuality. In an everyday sense this is obvious—

movements of exchange, distribution, accumulation, disaggregation, swarming, clustering are the very "stuff" of a range of environments, from concentrated cities, to transnational economies, to cross-cultural contagions, to mobile and wireless technologies. Yet our overwhelming need to locate, position, and literally pinpoint network nodes often obfuscates the dynamic quality of the edges. To paraphrase Henri Bergson, we often tend to understand the dynamic quality of networks in terms of stasis; we understand time (or duration) in terms of space. He writes, "there are changes, but there are underneath the changes no things which change: change has no need of a support. There are movements, but there is no inert or invariable object which moves: movement does not imply a mobile."[20]

Finally, the peculiarly informatic view of networks today has brought with it a range of concerns different from other, non-IT-based networks such as those in transportation or analog communications. The popular discourse of cyberspace as the global frontier or a digital commons, where access is a commodity, conveys the message that the political economy of networks is managed through *connectivity*. As RAND researchers John Arquilla and David Ronfeldt have commented, whereas an older model of political dissent was geared toward "bringing down the system," many current network-based political movements are more interested in "getting connected"—and staying connected.[21]

There are, certainly, many other ways of understanding networks akin to the ones we've mentioned. Our aim is not simply to replace the current science-centric view with another view that is more political and more philosophical. Rather, we want to propose that an understanding of the control mechanisms within networks needs to be as polydimensional as networks are themselves. One way of bridging the gap between the technical and the political views of networks is therefore to think of networks as continuously expressing their own modes of individuation, multiplicity, movements, and levels of connectivity—from the lowest to the highest levels of the network. It is for this reason that we view networks as political ontologies inseparable from their being put into practice, and likewise we have tried to ground this essay in an analysis of the actual material practice of networks as it exists across both the biological and information sciences.

Counter-Protocol

Contemplating this in the context of network-network conflict, we can ask a further question: How do networks transform the concept of political resistance? As we've stated, the distributed character of networks in no way implies the absence of control or the absence of political dynamics. The protocological nature

of networks is as much about the maintenance of the status quo as it is about the disturbance of the network.

We can begin to address this question by reconsidering resistance within the context of networked technology. If networks are not just technical systems but are also real-time, dynamic, experiential "living networks," then it would make sense to consider resistance as also living, as *life-resistance.* This is what Hardt and Negri call "being-against"; that is, the vast potential of human life to counter forces of exploitation.[22] There are (at least) two meanings of the phrase *life-resistance:* (1) life is what resists power; and (2) to the extent that it is co-opted by power, "life itself" must be resisted by living systems.

Deleuze states, "Life becomes resistance to power when power takes life as its object."[23] On the one hand, life is a sort of counterpower, a return flow of forces aimed backward toward the source of exploitation, selectively resisting forms of homogenization, canalization, and subjectification. (But then this is really not a resistance at all but instead an intensification, a lubrication of life.)

> When power becomes bio-power, resistance becomes power of life, a vital-power that cannot be confined within species, places, or the paths of this or that diagram. . . . Is not life this capacity to resist force? . . . [T]here is
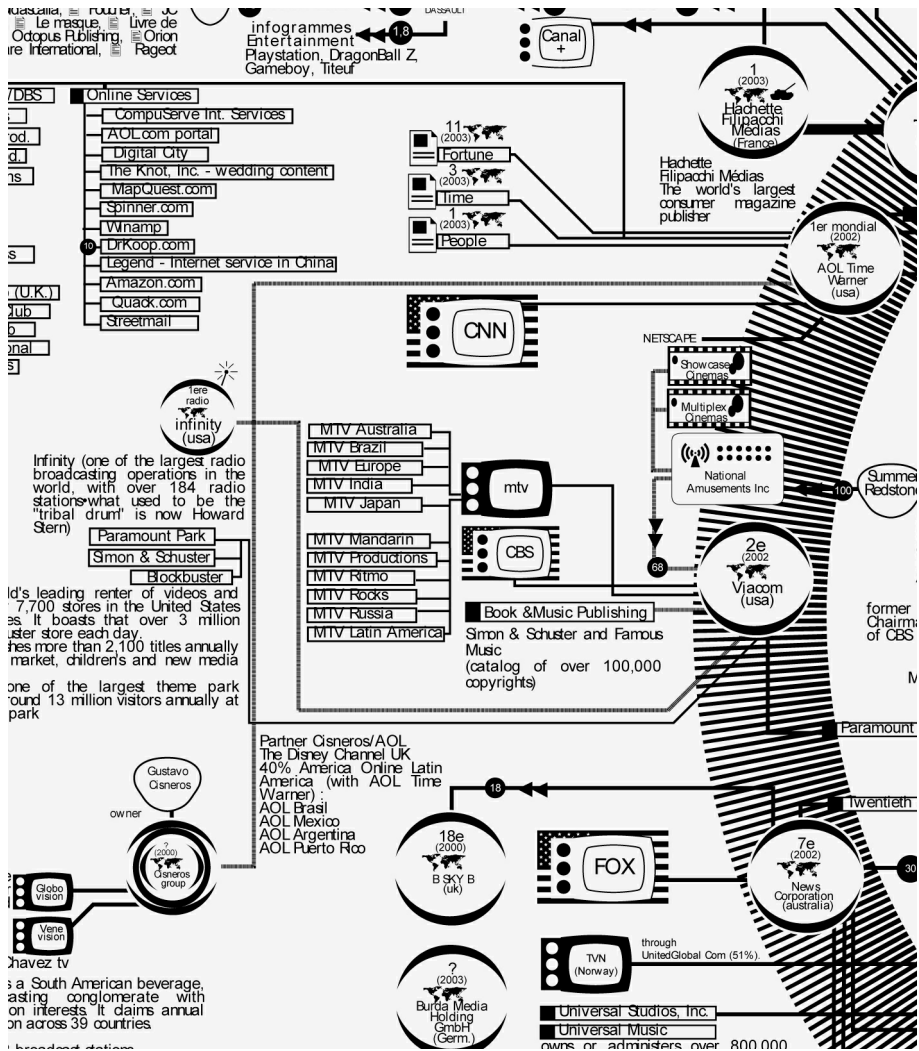
no telling what man might achieve "as a living being," as the set of "forces that resist."[24]

On the other hand, life is also that which is resisted (resistance-to-life), that against which resistance is propelled. Today "life itself" is boxed in by competing biological and computational definitions. In the biological definition the icon of DNA is thought to explain everything from Alzheimer's to ADD. In the computational definition information surveillance and the extensive databasing of the social promote a notion of social activity that can be tracked through records of transactions, registrations, and communications. Resistance-to-life is thus a challenge posed to any situation in which a normative definition of "life itself" dovetails with an instrumental use of that definition.

Might this consideration of life-resistance make possible a "counterprotocol"? If so, how might counterprotocological practices keep from falling into the familiar aporias of opposition and recuperation? We can close with a few suggestions.

First, oppositional practices will have to focus not on a static map of one-to-one relationships but on a dynamic diagram of many-to-many relationships. This means that *the counterprotocols of current networks will be pliant and vigorous* where existing protocols are flexible and robust.[25] Counterprotocological practice will not avoid downtime. It will restart often.

A second point about tactics. In reality, counterprotocological practice is not "counter" anything. Thus *the concept of resistance in politics should be superceded by the concept of hypertrophy.* The goal is not to destroy technology in some neo-Luddite delusion but to push technology into a hypertrophic state, further than it is meant to go. We must scale up, not unplug.

Third, because networks are (technically) predicated on creating possible communications between nodes, *oppositional practices will have to focus less on the characteristics of the nodes and more on the quality of edges-without-nodes.* In this sense the node-edge distinction will break down. In communications media, conveyances are key. Nodes may be composed of clustering edges, while edges may be extended nodes.

Using various protocols as their operational standards, networks tend to combine large masses of different elements under a single umbrella. *Counterprotocol practices can capitalize on the homogeneity found in networks to resonate far and wide with little effort.* Protocological control works through inherent tensions, and, as such, counterprotocol practices can be understood as particular types of implementations and intensifications of protocological control.

Protocological control fosters the creation and regulation of life itself. In other

words, the set of procedures for monitoring, regulating, and modulating networks as living networks is geared, at the most fundamental level, toward the production of life, in its biological, social, and political capacities. So the target is not simply protocol; rather, to be more precise, the target of resistance is the way in which protocol inflects and sculpts life itself.

Notes

1. John Arquilla and David Ronfeldt, *Networks and Netwars: The Future of Terror, Crime, and Militancy* (Santa Monica: RAND, 2001), 15; emphasis removed from original.

2. There are several sides to the debate. The technophilic perspectives, such as those expressed by Howard Rheingold or Kevin Kelly, are expressions of both a technological determinism and a view of technology as an enabling tool for the elevation of bourgeois humanism in a general sense. The juridical/governance perspective, seen in the work of Lawrence Lessig, Yochai Benkler, and others, posits a similar situation whereby networks will bring about a more just and freer social reality via legal safeguards. The network science perspective, expressed in popular books by Mark Buchanan and Albert-László Barabási, portrays networks as a kind of apolitical natural law, operating universally across heterogeneous systems, be they terrorism, AIDS, or the Internet. And, further, this dichotomy (between networks as political and networks as technical) is equally evident in a variety of other media, including news reportage, defense and military research, and the IT industry.

3. See Mark Wigley's recent essay of the same name in *Grey Room* 4 (Summer 2001): 80–122.

4. The largest and most important publication series for Internet protocols is called "Request for Comments" (RFC). A few thousand RFC documents have been drafted to date. They are researched, published, and maintained by the Internet Engineering Task Force and related organizations.

5. Eric Hall, *Internet Core Protocols: The Definitive Guide* (Sebastopol, CA: O'Reilly, 2000), 6, 407. See also the key text on computer protocols, W. Richard Stevens, *TCP/IP Illustrated, Volume 1: The Protocols* (New York: Addison-Wesley, 1994).

6. Gilles Deleuze, *Negotiations* (New York: Columbia University Press, 1995), 178.

7. Gilles Deleuze, "Having an Idea in Cinema," in *Deleuze and Guattari: New Mappings in Politics, Philosophy and Culture,* ed. Eleanor Kaufman and Kevin Jon Heller (Minneapolis: University of Minnesota Press, 1998), 18; translation modified.

8. Overviews of graph theory are contained in any discrete mathematics textbook. See also Gary Chartrand, *Introductory Graph Theory* (New York: Dover, 1977). For a historical overview, see Norman Biggs, et al., *Graph Theory 1736–1936* (Oxford: Clarendon, 1976). Graph theory principles are commonly used in communications and network routing problems, as well as in urban planning (road and subway systems), industrial engineering (workflow in a factory), molecular biology (proteomics), and Internet search engines.

9. "Thus a web of acquaintances—a graph—emerges, a bunch of nodes connected by links. Computers linked by phone lines, molecules in our body linked by biochemical reactions, companies and consumers linked by trade, nerve cells connected by axons, islands connected by bridges are all examples of graphs. Whatever the identity and the nature of the nodes and links, for a mathematician they form the same animal: a graph or a network." Albert-László Barabási, *Linked: The New Science of Networks* (Cambridge, MA: Perseus, 2002), 16.

10. Robert Braden, "Requirements for Internet Hosts," RFC 1123, October 1989.

11. See Lily Kay, *Who Wrote the Book of Life? A History of the Genetic Code* (Stanford: Stanford University Press, 2000); and Evelyn Fox Keller, *Refiguring Life: Metaphors of Twentieth-Century Biology* (New York: Columbia University Press, 1995).

12. See Alan Dove, "From Bits to Bases: Computing with DNA," *Nature Biotechnology* 16 (September 1998): 830–832; and Antonio Regalado, "DNA Computing," *MIT Technology Review* (May/June

2000): http://www.technologyreview.com/articles/regalado0500.asp. Biocomputing includes sub-areas such as protein computing (using enzymatic reactions), membrane computing (using membrane receptors), and even quantum computing (using quantum fluctuations).

13. See Leonard Adleman, "Molecular Computation of Solutions to Combinatorial Problems," *Science* 266 (11 November 1994): 1021–1024. Also see Adleman's follow-up article, "On Constructing a Molecular Computer," *First DIMACS Workshop on DNA Based Computers,* Vol. 27 (Princeton: DIMACS, 1997), 1–21.

14. We should also note that what differentiates biocomputing from much of biotech research is that it is largely nonmedical in its application. Thus far, biocomputing experiments have been applied to network routing problems, security, and cryptography, and in the development of hybrid molecular-silicon computer processors for the IT industry. That is, instead of using technology to further the biological domain, biocomputing uses biology to further the technological domain. In doing so, it reframes biology more along the lines of a technology, but a technology that is thoroughly biological.

15. Compare, for instance, the views of cybernetics, information theory, and systems theory. First, Norbert Wiener's view of cybernetics: "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." Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine* (Cambridge: MIT Press, 1965), 27. Second, Claude Shannon's information-theory perspective: "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." Claude Shannon and Warren Weaver, *A Mathematical Theory of Communication* (Chicago: University of Illinois Press, 1963), 8. Finally, Ludwig von Bertalanffy's biologically inspired systems theory: "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." Ludwig von Bertalanffy, *General Systems Theory: Foundations, Development, Application* (New York: George Braziller, 1976), 121. From the perspective of control, Bertalanffy's work stands in contrast to Wiener or Shannon. While Bertalanffy does have a definition of "information," it plays a much lessened role in the overall regulation of the system than other factors. Information is central to any system, but it is nothing without an overall logic for defining information and using it as a resource for systems management. In other words, the logics for the handling of information are just as important as the idea of information itself.

16. Deleuze, *Negotiations,* 180; emphasis added.

17. Gilbert Simondon, "The Genesis of the Individual," in *Zone 6: Incorporations*, ed. Jonathan Crary and Sanford Kwinter (New York: Zone, 1992), 300; emphasis removed from original.

18. Gilles Deleuze and Félix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987), 6.

19. Antonio Negri, "Approximations," Interactivist Info Exchange (posted 12 November 2002). Available online: http://slash.autonomedia.org.

20. Henri Bergson, *The Creative Mind*, trans. Mabelle Andison (New York: Citadel Press, 1997),

147. Another way of stating this is to suggest that networks have no nodes. Brian Massumi corroborates this when he states that "in motion, a body is in an immediate, unfolding relation to its own nonpresent potential to vary. . . . *A thing is when it isn't doing.*" Brian Massumi, *Parables for the Virtual* (Durham: Duke University Press, 2002), 4, 6.

21. John Arquilla and David Ronfeldt, "The Advent of Netwar," in Arquilla and Ronfeldt, *Networks and Netwars,* 5.

22. See Michael Hardt and Antonio Negri, *Empire* (Cambridge: Harvard University Press, 2000), 210.

23. Gilles Deleuze, *Foucault,* trans. Seán Hand (Minneapolis: University of Minnesota Press, 1999), 92.

24. Deleuze, *Foucault,* 92; translation modified. The quoted phrases refer to Foucault's *History of Sexuality.*

25. We're tired of being flexible. Being pliant means something else, something vital and positive. Perhaps *superpliant* would be an even better term, following Deleuze's use of the word in the appendix to his book on Foucault: "the *Superfold* [*Surpli*], as borne out by the foldings proper to the chains of the genetic code, and the potential of silicon in third-generation machines. . . . The forces within man enter into a relation with forces from the outside, those of silicon which supersedes carbon, or genetic components which supersede the organism, or agrammaticalities which supersede the signifier. In each case we must study the operations of the superfold, of which the 'double helix' is the best known example." See Deleuze, *Foucault,* 131–132.