PEDAGOGIES OF DISASTER · PEDAGOGJITË E SHKATËRRIMIT

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CYBER-CATASTROPHE
TOWARDS A PEDAGOGY OF ENTROPY

Justin Joque

One of the earliest glimpses of the possible impact of an all out cyberwar occurred in June of 1997. That month a small team of hackers using publicly available tools and programs was supposedly able to gain access to the power grid in nine United States cities, their emergency response systems and a number of critical Pentagon networks including those that managed military supply chains and the command-and-control structure. According to James Adams who has written at length about these attacks:

> The hackers also managed to infect the human command-and-control system with a paralyzing level of mistrust. Orders that appeared to come from a commanding general were fake, as were bogus news reports on the crisis and instructions from the civilian command authorities. As a result, nobody in the chain of command, from the president on down, could believe anything. This group of hackers using publicly available resources was able to prevent the United States from waging war effectively.[1]

Luckily, the series of attacks, which have been code-named Eligible Receiver, were carried out by the US's National Security Agency as an unannounced test of military and civilian digital infrastructure. The attackers, who were working as part of a No-Notice Interoperability Exercise Program, were asked only to prove what was possible and not to actually destroy anything.

While the military provided no substantial evidence about Eligible Receiver, aside from interviews with the media and congressional testimony, for a while Eligible Receiver was repeatedly referenced as a brief glimpse of future war and the dark nature of our digital technologies. Of course, there were those who were convinced it was merely the media-security complex displaying their newest bogeyman. In *The Crypt Newsletter,* a hacking publication whose provenance and history have gone the way of dial-up modems but still lingers in various parts of the Internet, Joseph K refers to Eligible

Receiver as, "A Pentagon ghost story repeated *ad nauseum* to journalists and the easily frightened in which ludicrous or totally unsubstantiated claims about menaces from cyberspace are passed off as astonishing deeds of techno-legerdemain performed by cybersoldiers working within a highly classified wargame."[2]

Although Joseph K meant to dismiss Eligible Receiver, the discourse surrounding it seems to still tell an interesting ghost story especially if it is treated as such and read not as baseless, but as a myth that functions even without proof. John Arquilla, a military theorist who teaches at the US Naval Postgraduate School, sums up the state of the public relation to the event aptly when in an interview he says, "Eligible Receiver is a classified event about which I can't speak. What I can say is that when people say there is no existence proof of the seriousness of the cyber threat, to my mind, Eligible Receiver provides a convincing existence proof of the nature of the threat that we face."[3] This Kafkaesque claim is telling: he cannot say what transpired, but its existence, despite being under classified erasure, proves the point he would like to make. This event appears in this light not then as an attack against military information systems, but instead as an attack against our belief in the digital systems that increasingly provide the fabric of everyday life. Perhaps in Adams's claims that no one could believe anything from the President on down, we should read a warning that we too, outside the wargame, can no longer believe anything from the President on down. It takes little extra imagination to suggest the implied result is some cascading catastrophic social collapse. Ultimately, the collapse of the entire system may already be upon us. It is not merely our military communication technologies that are at stake in Eligible Receiver but the entirety of society.

Computer systems, especially when seen as data storage devices, function to guarantee that the writing of the past persists into the future. While computers are often theorized solely as computing devices or communication machines, it is clear that in contemporary society they serve to store information about the past into the future. Anything that calls computer security into question in the future undermines it in the present as well. Thus, the futurity of a "real" attack like Eligible Receiver infects our belief in these systems in the present. To conceptualize the situation in Virilio's terms: the database is the invention of the data accident. Furthermore, Eligible Receiver moves this possibility even further into the realm of a militarized data catastrophe. Not only is it possible that our computer systems will fail us in the future, but it is possible they are already compromised in the present. As much as this unannounced test-exercise may have been a test of military security, it is also a test of our belief in our digital world. And it is not only our digital systems, as we could add to this digital catastrophe a catastrophe for every system our lives are embedded in: ecological collapse, speculative bubbles, new drug-resistant diseases, market crashes, global warming, the end of the university, etc.

Joseph K's mocking dismissal then appears, like a pithy sermon by an unknown sage of our digital belief, to reassure us that these events are merely phantasms thought up to terrify the gullible and will never come to pass. At the same time these claims seem to serve another purpose. The complete dismissal of this ghost story doubles the future: on the one hand the possibility of utter collapse and on the other complete faith and resilience. Likewise, it doubles the structure of belief and skepticism. Are the believers

those who put faith in our technological world or those who blindly take the military's word that the catastrophe is around any corner? If we cannot believe "anyone from the President on down," how can we believe those who call that belief into question?

The future catastrophe becomes immanent to these technologies, not because of any inevitability but precisely because of its undecidability. The future becomes binary but also probabilistic, in so much as we can never know if we are condemned to catastrophe or not. It is not merely unknown but contains both the possible catastrophe and the non-event of the digital everyday. As such the future appears closed. It is either a future of the total collapse of systems or the non-event of the continuation of neoliberal capitalism. This binary structure overwhelms the future closing off the possibility of new meanings and new modes of thought. To teach and learn in the space of this closure requires a pedagogy that must be a pedagogy of disaster, but at the same time also a pedagogy of the non-event. Brian Massumi, in a 2012 article, puts this closure well when he describes the effect of the Bush doctrine and preemption on global politics: "The only certainty is that you have to act now to do everything possible to preempt the potential. In the vocabulary of Bush's Secretary of Defense, Donald Rumsfeld, the only thing certain is that you have to "go kinetic," even though "you don't really know and can't know and know you don't know."[4] The catastrophe does not efface the present order; it rather calls into question the symbolic present and as such leaves the present order, with our digital belief, as the only alternative. Moreover, it calls the present order to act preemptively, against the catastrophe, to always be ready to go kinetic against the unknown future. It becomes a dedication not to the possibility of the future, but merely the survival of the present. The only future that matters now is the future that is already here, the future of constant capitalist innovation that we are always already late for. Any other future is already lost.

Despite the appearance of this closure, it may be possible that another reading of the current situation is already encoded into our increasingly communicative and controlled world. In 1948, in his text *Cybernetics or Control and Communication in the Animal and Machine,* Norbert Wiener laid out the basics of a new science of systems entitled cybernetics, intended to explore the science and study of systems, their structures, regulation, emergent properties and possibilities across a large array of disciplines from technology to biology to society. The term cybernetics refers to the Greek *kybernētēs* meaning steersman or governor. Its earlier advocates, including Wiener, believed it would develop into the science of science. While there are still waves of cybernetics being developed, its more grandiose plans largely collapsed and the mathematical and scientific breakthroughs made under the name cybernetics have been parceled out to other fields including communication theory, engineering, cryptography, complex systems, network analysis, etc. One of the main focuses of cybernetics was on mathematically describing information and communication within systems. Wiener along with Claude Shannon developed the key mathematics that underlie our present understanding of communication systems, including the Internet, cellular phones, encryption technologies and information compression systems. In many ways our current situation, with the rise of communicative capitalism and societies of control, owes much to the history of cybernetics as the enabling science behind many technologies of both war and peace. Furthermore, even so-called "French Theory" is deeply indebted to cy-

bernetics as it influenced countless thinkers including Roman Jakobson, Levi-Strauss, Lacan, etc., not to mention Heidegger and Derrida's more critical positions on the science.[5] It could thus be argued that cybernetics underwrites much of the closure of the future we find ourselves in, but my hope is to suggest that there in the heart of this closure lies another possibility.

While Wiener and Shannon both developed what is now called communication theory, Claude Shannon's abstract mathematical description of communication channels and their information capacity has become the standard in the field. In 1948, Shannon, who worked on cryptographic systems during the war, published a now legendary article in the *Bell Systems Technical Journal,* entitled "A Mathematical Theory of Communication." The following year a book length version of the article, with a more easily readable (and also slightly more philosophical) introduction written by Warren Weaver, was published as *The Mathematical Theory of Communication.*[6] Prior to Shannon's mathematical description, the communication possibilities of a given channel, which could be a radio signal, a telegraph line, or now a fiber optic cable, were largely determined experimentally by engineers. Shannon was able to define the upper limit for any channel to carry information. Hence his work has become the basis of our contemporary thinking about communication, at least as an engineering problem.

One of the major breakthroughs that Shannon made was to consider a communication system being between a source and a destination (with transmitters and receivers added). It should be noted that for Shannon this was solely a question of the material support of communication, and not of meaning. For the current purposes, I will follow him in that distinction, but much could be said about the relationship between information and meaning. Regardless, Shannon theorized the selection of the message as a random process. If the creation of the message is treated as random, it then follows that the amount of information contained in a given message is a result of the randomness of its selection. The larger the potential message-space, or number of possible messages, the more random the selection is and thus the more information that can be communicated. Furthermore, the probability of any given message affects the total information that can be communicated over a given channel. A simple example can demonstrate this well. In written English it is incredibly rare to have a *q* followed by any letter other than a *u*. Hence, the *u* by being highly determined provides very little additional information. Other linguistic markers, letters, etc. display similar properties. It should be noted that the claim is never that they are useless. In fact adding redundancy, as Shannon calls it, is critical to be able to send a message over a noisy channel since the message then does not depend on every sound or bit arriving intact. At the same time the more redundancy the less information can be transmitted. Similarly to the lack of information provided by the *u* following a *q,* a message source that only transmitted a single series of ones would provide no information at all.

The formula that Shannon developed to describe the amount of information in a message or across a channel depends then on the probability of a given message, or part of a message, being selected. Shannon chose to call the amount of information, or we could say the randomness of a message, entropy. This was mainly due to the similarity between his formula and the statistical formula for thermodynamic entropy, but also represented the modeling of communication systems as random processes. While the

term Shannon-entropy has become standard in the field to describe the amount of information in a message or transmittable across a channel, I believe such terminology makes an interesting and important philosophical and ideological claim. To suggest that information, and although this is not meaning per se, at least the possibility of communicating meaning, comes to rest on entropic random processes is rather radical. With this definition it follows then that even noise adds information to a message as it increases the randomness. Granted encoding schemas can minimize the effect of noise on a message, but still this is a somewhat shocking conclusion that even noise increases the amount of information in a message. What this means, and is so radical, is that the very possibility of information becomes in Shannon's work premised on our not knowing, or our never completely knowing. In Shannon's world knowledge of the message can never exist ahead of time, only in the moment of receiving the message. Not only that, but were we to know too early, we would gain nothing and by definition there would be no message. It is a process not of control but a communication that while always working with a limited message space must be open to its unpredictability. While of course Shannon never considered it as such, it is possible to read his work as a mathematical manifesto of unknowing; of living in a world we cannot know. We arrive in a sense at Massumi's point from above, but now by necessity, the world, especially as communicative technologies take hold, writes randomness and unknowability into its very rules.

Norbert Wiener's description of this work in his text *Cybernetics,* suggests just how radical Shannon's claims were. Wiener, who was working on related mathematical descriptions and directly referencing Shannon's work, says in the introduction to *Cybernetics,*

> The notion of the amount of information attaches itself very naturally to a classical notion in statistical mechanics: that of entropy. 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.[7]

In describing information and its relation to entropy, Wiener is unable to describe communication as premised on entropy. He instead reverses the description claiming that information and entropy are opposed rather than the description of each other. While this divergence of terminology was mentioned very little at the time or afterwards, and some texts even refer to "Shannon–Wiener Entropy," it suggests how radical Shannon's discovery was and how much it challenged Wiener's desire to see cybernetics as uniting communication and control.

In this light, Shannon's work provides an important lesson, and even a philosophical position, on technology, thought and their respective futures. In tracing this lesson, we arrive by way of Shannon at an especially Deleuzean moment. For Deleuze the subject, the interior and thought itself is always a fold of the outside. In his text on Foucault he develops the idea that thought itself is random chance, even comparing it to a dice throw. As such, thought is always a thought of the outside. Deleuze says, "Artaud contrasted the innate and the acquired with the 'genital', the genitality of thought as such, a

thought which comes from the outside that is farther away than any external world, and hence closer than any internal world. Must this outside be called Chance?"[8] Shannon's treatment of communication as an entropic process is based then on a similar structure, communication itself becomes a thought of the outside. All communication and communication technology folds the entropic outside inwards, creating a possibility that exists not in one place, but in the space between two. Even a closed or limited message-space, such as a dice with only six sides, still folds chaotic random processes inside.

Not only is this the lesson of Shannon's discovery, but also of his praxis. Shannon never set out to create an entropic world, rather he found it there waiting for him, one possibility or one message out of a limited message space. The confluence between thermodynamic and information entropy appears as the replication of a mathematical structure. It strikes one as a random possibility in the very construction of the universe. It becomes in a sense undecidable whether Shannon's mathematical theory of communication is his thought or the universe's. Perhaps it appears itself as a line of communication between the two. A random entropic process that reveals itself only after it is sent and received. A thought of the universe folded inside Claude Shannon.

As communication technologies proliferate and turn also into technologies of control, surveillance, war and catastrophe, the lesson of Shannon is that even as the future closes tightly around us an entropic outside is always there. In the midst of closure there are always possibilities. This is not to say that some, if not most of these possibilities, may be as or more horrific and terrifying than the current global system, but still it calls us to think, to theorize, and to learn their possibilities in the face of the future and present catastrophe; whether this is the catastrophe of a global cyberwar or of the university. Deleuze in the appendix to his text on Foucault, published first in 1986, says something similar:

> Dispersed work had to regroup in third-generation machines, cybernetics and information technology. What would be the forces in play, with which the forces within man would then enter into a relation? It would no longer involve raising to infinity or finitude but an unlimited finity, thereby evoking every situation of force in which a finite number of components yields a practically unlimited diversity of combinations […]. 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 […] it is the advent of a new form that is neither God nor man and which, it is hoped, will not prove worse than its two previous forms.[9]

Deleuze outlines here, some forty years afterwards, the lesson of Shannon: even as everything including the future seems closed, we always have access to an unlimited finity, the entropic space of communication that carries with it an uncontrollable fold of the outside.

While claiming that "it is hoped" an unlimited finity will prove better than earlier forms is a rather modest sentiment, it is striking how positive it is given Deleuze's tendency to stress how easily systems can fall back upon themselves unleashing even worse outcomes. This hopeful note with which Deleuze ends the Foucault text is dras-

tically different from his discussion of similar themes in "Postscript on the Societies of Control" published four years later in 1990.[10] In the short text Deleuze outlines the new type of society that he believes will replace the disciplinary societies Foucault explicated in his work. Deleuze says of these new societies:

> Everyone knows that these institutions [prisons, hospitals, schools, etc.] are finished, whatever the length of their expiration periods. It's only a matter of administering their last rites and of keeping people employed until the installation of the new forces knocking at the door. These are the societies of control, which are in the process of replacing disciplinary societies […] There is no need to invoke the extraordinary pharmaceutical productions, the molecular engineering, the genetic manipulations, although these are slated to enter into the new process. There is no need to ask which is the toughest or most tolerable regime […] There is no need to fear or hope, but only to look for new weapons.[11]

It is a minor change, but the hope of unlimited finity is replaced in the latter text with only the need for new weapons. It is not merely a rhetorical shift away from hope. Deleuze's development of this notion of control marks a closure of the possibilities of the third form he outlines in the Foucault text. The fold of the outside now constitutes only a new mechanism of power to individualize (or dividualize as Deleuze calls it) its methods of domination. Instead of treating workers as a mass they are now made to compete with each other for salaries. Deleuze sees the machines and technologies associated with such a movement arising from the same "third generation machines" and information technology that marked the moment of hope in the text on Foucault. Deleuze goes on in the "Postscript" to invoke both the closure of the future in the non-event of neoliberal capitalism and the unlimited finity of this situation stating, "Control is short-term and of rapid rates of turnover, but also continuous and without limit, while discipline was of long duration, infinite and discontinuous. Man is no longer man enclosed, but man in debt."[12] It is now completely negative; the unlimited finity no longer marks new possibilities but rather the unlimited debt and resilience of the current global system.

This reconsideration of both the closure of the future and hope for an unlimited finity is striking. While it may be that this shift is merely a result of historical pessimism, it seems also to reflect Deleuze's reading of Shannon. At the very least, it is possible to read Shannon against this shift in Deleuze. Deleuze and Guattari in *A Thousand Plateaus* refer to Shannon's work, though not by name, saying:

> The most general schema of information science posits in principle an ideal state of maximum information and makes redundancy merely a limitative condition serving to decrease this theoretical maximum in order to prevent it from being drowned out by noise. We are saying that the redundancy of the order-word is instead primary and that information is only the minimal condition for the transmission of order-words (which is why the opposition to be made is not between noise and information but between all the indisciplines at work in language, and the order-word as discipline or "grammaticality").[13]

Immediately, two problems with their reading of information theory should be noted. First, for Shannon noise and information are not opposed. Noise, in adding uncertainty to the message, increases the raw information (even if for a particular engineering problem this added information is undesirable). Second, there is no reason to assume that redundancy is secondary in Shannon's formulation. While it is true that redundancy does decrease the amount of information transmitted across a channel, Shannon sees it as important as any element in communicating information. Deleuze and Guattari's reading assumes that Shannon envisions some ideal system with zero redundancy, but that would only be a possible solution to a system with no noise. What Shannon's discovery realizes and makes it so powerful is that the condition of zero noise is highly unlikely; thus any effective communication system requires redundancy. The breakthrough that Shannon makes is by recognizing the noisy condition and hence the condition requiring redundancy for communication as the mathematically interesting case.

In missing this, and reading Shannon as placing redundancy second, Deleuze and Guattari end up downplaying the radical nature of Shannon's discovery especially in terms of the relationship between the inside and outside. Speaking again of information theory in *A Thousand Plateaus,* they say, "In fact, there must not be any exterior […]. One can make subjective choices between two chains or at each point in a chain only if no outside tempest sweeps away the chains and subjects."[14] It is here that the implication of this reading of Shannon becomes apparent. For Shannon the message is selected as part of a random process, not unlike Deleuze's dice-throw, and not by a subject. By making noise a primary part of the system, Shannon admits the necessity of the outside rather than a subject who chooses. In its most radical, Shannon's work is not the closure of the outside but instead the exact opposite. It is the mathematical theory of that "outside tempest that sweeps away both chains and subjects."

We can return then to the discrepancy between the text on Foucault and the "Postscript." In *Foucault* the future appears open as a result of the hoped-for unlimited finity, but in the "Postscript" Deleuze sees in our situation precisely the discipline and closure he and Guattari see in information theory. Ultimately, Deleuze in the "Postscript" seems to fall into the closure of the future catastrophe outlined above. While it is not the total cyber-catastrophe of all information systems, it is a similarly structured micro-catastrophe of technology enabled complete control. Deleuze ends the "Postscript" with a grim future with very few options. While he does make some suggestions for future research and resistances, they pale in comparison to the hope of an unlimited finity. Thus, I think it is ultimately necessary to read Shannon against this closure that operates even here in Deleuze's work. Shannon in writing randomness, chaos and entropy into the heart of these technologies should serve as a reminder that even in the heart of catastrophe and control there are always entropic possibilities. In the entropic realizations of Shannon's work there exists a reading of technology and communication that ultimately point back to the hope of Deleuze's earlier text.

Not only does this lesson of Shannon suggest a relation to the forces of technology and capitalism, but it also speaks to the future of academia and its exteriors (which Deleuze differentiates from the completely outside). First, I think it calls for a program of thought and inquiry that would attune itself to the notion of unlimited finity, especially as it produces possibilities out of the entropy of a closed set of options. I believe

it calls for a program of thinking, of learning from the world and its outside, that does not attempt to pre-empt the unknown; to try to know the world too early but rather opens itself up to the communicative thought of the outside. Instead of "going kinetic" against the unknown as the Bush Doctrine suggests, we must prepare instead to think the unknown in all its radicality only at the moment the message arrives. Moreover, precisely at this moment where technology along with the University and its exteriors themselves appear closed, ossified, stagnant and over coded by cheap technological and managerial tricks that attempt to sell off education and gut it of all its prospects, we must hold open the possibility that at the very heart of this closure, and indeed within all communicative and technological systems still lie new combinations, new thoughts, new outsides, new unlimited finities, and new pedagogies.

Notes

1 James Adams, "Virtual Defense," *Foreign Affairs* (May/June 2001).

2 Joseph K, "The Joseph K Guide to Tech Terminology: Eligible Receiver," *The Crypt Newsletter* (December/January 1998–9): http://www.thehackademy.net/madchat/vxdevl/vxmags/crptlt52/CRYPT52.TXT

3 John Arquilla, "Interview John Arquilla," Frontline (March 4, 2003): http://www.pbs.org/wgbh/pages/frontline/shows/cyberwar/interviews/arquilla.html

4 Brian Massumi, "The Remains of the Day," in *Histories of Violence* (2012): http://historiesofviolence.com/reflections/brian-massumi-the-remains-of-the-day/

5 For more on the connections between cybernetics and French Theory see Céline Lafontaine, "The Cybernetic Matrix of 'French Theory,'" *Theory, Culture & Society* 24.4 (2007): 27–46.

6 Claude Shannon and Warren Weaver, *The Mathematical Theory of Communication* (Urbana: University of Illinois Press, 1971 [1949]). It is worth noting that in the short space of a year the title was changed from "a theory" to "the theory," suggesting the importance of Shannon's discovery.

7 Norbert Wiener, *Cybernetics: or the Control and Communication in the Animal and the Machine,* 2nd ed (Cambridge MA: MIT Press, 1961 [1948]), 11.

8 Gilles Deleuze, *Foucault,* trans. Sean Hand (Minneapolis: University of Minnesota Press, 1988 [1986]), 117.

9 Ibid., 132.

10 Originally in French: *L'Autre Journal* 1 (May 1990).

11 Gilles Deleuze, "Postscript on the Societies of Control," *October* 59 (Winter 1992): 4.

12 Ibid., 6.

13 Gilles Deleuze and Félix Guattari, *A Thousand Plateaus,* trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987 [1980]), 79.

14 Ibid., 179.